Waste Isolation Pilot Plant Documented Safety Analysis

Prepared by
Nuclear Waste Partnership LLC Carlsbad, NM
U.S. Department of Energy Contract DE-EM0001971

Prepared for:
U.S. Department of Energy Carlsbad Field Office Carlsbad, NM

APRIL 2016

E.1 EXECUTIVE SUMMARY

This Documented Safety Analysis (DSA) is written for the U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP). The purpose of this document is to demonstrate an acceptable level of safety in compliance with the *Code of Federal Regulations*, Title 10, part 830 (10 CFR 830), “Nuclear Safety Management.” Subpart B, Section 830.202, “Safety Basis Requirements,” Subsection (a) requires that the contractor responsible for a Hazard Category 1, 2, or 3 DOE nuclear facility must establish and maintain the safety basis of the facility. The WIPP facility is categorized as a Hazard Category 2 DOE Nonreactor Nuclear Facility for all surface and Underground (UG) operations. This revision of the DSA replaces the previous Safety Basis documentation (i.e., Revision 4 of the DSA and all existing Evaluations of the Safety of the Situation). Upon implementation of this Revision 5b of the DSA, Revision 4 and all Evaluations of the Safety of the Situation are superseded.

In accordance with 10 CFR 830, Subpart A, independent quality assurance (QA) assessments are used on an ongoing basis in support of nuclear operations at the WIPP facility to ensure the adequate and effective implementation of requirements set forth in the DSA. Independent QA oversight is integrated with the application of Safety Management Systems to support nuclear safety in WIPP operations.

The “safe harbor” methodology followed for preparation of this DSA to demonstrate compliance with 10 CFR 830 was *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis* (DOE-STD-3009-2014) and the supplemental guidance specific to Transuranic (TRU) Waste processing facilities given in *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities* (DOE-STD-5506-2007). This DSA addresses the hazards and the controls necessary to provide adequate protection to the public, workers, and the environment with regard to those hazards.

Changes between Revision 4 and Revision 5b include:

- Revisions associated with the Conclusions and Judgments of Need from the Accident Investigation Board (AIB) Reports and required by the conversion to the DOE-STD-3009-2014 DSA format. The Phase I and Phase II AIB reports (*U.S. Department of Energy Accident Investigation Report, Phase 1 Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014* and *U.S. Department of Energy Accident Investigation Report, Phase 2 Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014*) have been reviewed to ensure that the Conclusions and Judgments of Need associated with the content of the safety envelope have been addressed. In particular, Judgments of Need 3, 4, 5, 6, and 7 from the April 2014 WIPP Phase I AIB report are reflected in the content of the DSA.
- The remote-handled (RH) TRU process is not being authorized under Revision 5b of the DSA as this activity will not be implemented as part of contact-handled (CH) waste emplacement restart. While the RH process has been included in the hazard analysis (HA) and consequence calculations, together with partial descriptions in various sections of the DSA, the RH process did not drive any of the required safety significant controls. Future authorization of the RH TRU process will require revalidation of the RH analysis and must include a resolution for the vulnerabilities of the RH crane in a seismic event and other comments on the RH hazard evaluations.
- The statistical approach to material at risk (MAR) recommended by DOE-STD-5506-2007 has been adopted for establishing unmitigated dose consequences for events involving multiple Waste Containers.
- Fire scenarios have been revised based on the forensic analyses of the February 5 and 14, 2014, events, and address propagating fires.

- Per Option 3 of Section 3.2.4.2, “Radiological Dose Consequence,” of DOE-STD-3009-2014, the WIPP-specific radiological dose consequence methods and parameters were defined in a modeling protocol and approved by DOE Carlsbad Field Office (CBFO) in September, 2015.
- Dose analysis for co-located workers at 100 meters uses the same methodology as approved for use with the Maximally Exposed Offsite Individual (MOI) for releases from the UG and for releases from the Waste Handling Building (WHB) in which the WHB is assumed to collapse. Co-located Worker doses are calculated using the recommended atmospheric dilution factor χ/Q for releases from the WHB in which the WHB remains largely intact such that the building wake effect inherent in this dilution factor is applicable.
- Updating of the following Initial Conditions (ICs), design features (DFs), and controls:
  - A variety of modifications to vehicle-related controls in the UG, WHB, and Outside Area have been implemented and Vehicle Barriers and Alternative Barrier Provisions have been credited.
  - The Underground Ventilation System (UVS) is now credited as a Safety Significant (SS) control.
  - The Battery Exhaust System is now included within the CH Waste Handling (WH) Confinement Ventilation System (CVS).
  - WHB FSS now requires both the diesel and electric pump to be operable.
  - The Waste Hoist Support Structure is now credited as a DF.
  - The WIPP Waste Acceptance Criteria (WAC) are now credited as an IC, replacing a number of former initial assumptions.
  - The Panel 6 and Panel 7, Room 7 Closure Bulkheads are now credited as DFs due to known noncompliant containers in those areas and Real-Time Monitoring at Panel 6 and Panel 7 Isolation Bulkheads Specific Administrative Control (SAC) has been created.
  - An explicit requirement that TRU Waste Containers be in closed Type B shipping packages when aboveground outside the WHB has been added.
  - The RH and CH shipping packages (Type B Packages) are now credited.
  - The location of the UG Fuel Storage and Oil Storage Areas away from the Disposal Rooms and Waste Transport Paths is now credited as an IC.
  - The initial assumption that operation of the facility will be in accordance with 30 CFR 57 has been replaced with specific Technical Safety Requirement (TSR), Safety Management Program (SMP), and IC controls.
  - Initial assumptions with regard to RH Borehole protection of waste in fires, the location of UG electrical substations, and experimental area hazards have been added.
  - The WHB Facility Cask Loading Room (FCLR), Transfer Cell, and Cask Unloading Room (CUR) shielding is now a credited DF.
  - The RH Bay floor slope is no longer credited as an IC and the Hot Cell Ventilation System, Transuranic Package Transporter Model II (TRUPACT-II) Unloading Dock (TRUDOCK) Cranes, and UG Vehicle capability to protect fluids from spilling in a collision are no longer credited as SSC controls.
  - A SAC has been developed for Waste Conveyance Operations.

   – The initial assumptions regarding maximum waste in the CH and RH Bays are no longer required as the number of containers required to challenge limits is far larger than the number possible to store.

- In Chapter 2.0, provided clarifications, editorial changes, and minor corrections throughout. The more significant revisions are as follows:
  – Added Section 2.1.1, “The Two Incidents at WIPP in February 2014.”
  – Stated that mining and waste emplacement can take place simultaneously only based on adequate available airflow.
  – Added description of Criticality Control Overpacks.
  – Added description of “Upcasting” in 2.4.4.1.
  – Added extensive text in several sections regarding changes to the UG Ventilation System, including modifications to existing equipment and the addition of the Interim Ventilation System (IVS) and Supplemental Ventilation System (SVS).
  – Added Section 2.4.4.6.1, “Panel 6 and Panel 7, Room 7 Closure.”
  – Deleted notations that the 10-160B process is not in use.
  – Added description of Battery Exhaust System in 2.7.3.1.
  – In Section 2.7.3.2, “Waste Handling Building Contact-Handled and Remote-Handled Waste Handling Area Ventilation Systems,” information with regard to the response of tornado dampers to an earthquake is now provided.
  – Section 2.8.2 and subsections have been updated to reflect changes in Fire Protection.
  – Section 2.10.4, “Central Monitoring Room,” has been added.
  – Revised several figures and added Figures 2.4-7, 2.7-10, 2.7-11.
- A comprehensive revision of the hazards evaluation was performed and is documented in Chapter 3.0. The revised HA now addresses potential chemical exothermic reactions in noncompliant drums present at WIPP and propagating fires.
- Chapter 4.0 has been totally rewritten to conform to the requirements of DOE-STD-3009-2014 and reflect the results of the revised hazards analysis. Chapter 4.0 also notes that instrumentation has been augmented to provide local readouts and analog feeds to Central Monitoring Room (CMR) displays, as appropriate.
- Chapter 5.0 has been totally rewritten to conform to the requirements of DOE-STD-3009-2014 and reflect the results of the revised HA.
- In Chapter 6.0, added coverage of Criticality Control Overpacks, increased the number of contingencies explicitly addressed in Section 6.4.3 by five (liquid events previously “included” are now individually addressed, other contingencies are added), and, in conjunction with Chapter 18.0, clarified the use of non-destructive assay.
- A discussion of “Ground Control” has been added to Chapter 11.0.
- SMP Chapters 6.0 through 17.0 have been reviewed and updated. As permitted by DOE-STD-3009-2014, the chapters have been left in the DOE-STD-3009-94 format, including the Key Attributes (KAs) identified in Revision 4. KAs are not called for by the DOE-STD-3009-2014 format and will be deleted in Revision 6.

- Key elements (KEs) have been added in SMP Chapters 7.0, 8.0, 10.0, 11.0, 12.0, 14.0, 15.0, and 17.0 to conform to the requirements of DOE-STD-3009-2014.
- Chapters 13.0, "Human Factors," and 16.0, "Provisions for Decontamination and Decommissioning," have been deleted as DOE-STD-3009-2014 does not require this content and WIPP has no special considerations requiring presentation of the information in those chapters.
- Chapter 18.0, which includes KEs, has been added to describe the WIPP WAC compliance program. This reflects the importance placed on the WIPP WAC as an IC by the HA.

E.2 FACILITY BACKGROUND AND MISSION

The WIPP facility mission is to provide a safe and permanent disposal location for government-owned TRU and TRU Mixed Wastes. The current WIPP mission includes the disposal of both CH Waste (i.e., waste with a radiation level of less than 200 millirem per hour at the surface of the Waste Container) and RH Waste (i.e., waste with a radiation level of equal to or greater than 200 millirem per hour but less than 1,000 rem per hour) in the UG repository.

The DOE was authorized by Public Law in 1979 to provide a research and development facility for demonstrating the safe permanent disposal of TRU Wastes from national defense activities and programs of the United States, exempted from regulation by the U.S. Nuclear Regulatory Commission (NRC). Construction of the WIPP site started in the early 1980s after completion of a site selection study in which several sites in southeast New Mexico were evaluated and the present site was selected based on extensive geotechnical research, supplemented by testing. In 1992, the WIPP facility property was transferred from the U.S. Department of the Interior to the DOE. Consistent with the WIPP mission, lands within and around the WIPP site boundary are administered according to a multiple land-use policy. During operations, the area within the WIPP site boundary will remain under federal control. After completion of facility construction, the facility entered into its current life-cycle phase, disposal. WIPP began receipt and disposal of CH Waste in March 1999 and RH Waste in January 2007. The disposal phase is planned to last 35 years.

On February 5, 2014, a fire occurred in the UG involving a salt haul truck. This event was investigated by both DOE and Nuclear Waste Partnership LLC (NWP). The DOE Accident Investigation Report (*U.S. Department of Energy Accident Investigation Report, Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant, February 5, 2014*) was issued on March 13, 2014, including 22 Conclusions of Need and 35 Judgments of Need. The Fire Origins and Cause Investigation Findings and Recommendations prepared for NWP was issued on July 28, 2015.

On February 14, 2014, a radioactive release event occurred in the UG due to a chemical exothermic reaction in a drum noncompliant with the WIPP WAC, involving a small release to the environment. The Phase 1 DOE Accident Investigation Report was issued on April 22, 2014 with 31 Conclusions of Need and 47 Judgments of Need. Following the completion of a virtual survey of the affected panel room, the Phase 2 Accident Investigation Report was issued on April 16, 2015 with 24 Conclusions of Need and 40 Judgments of Need. The *Fire Forensic Analysis of the Radiological Release Event at the Waste Isolation Pilot Project on February 14, 2014* was issued by DOE on April 6, 2015.

E.3 FACILITY OVERVIEW

The 10,240-acre WIPP site is located in Eddy County in southeastern New Mexico, 26 miles east of Carlsbad. The WIPP site is located in an area of low population density. The area surrounding the facility is used primarily for grazing and the development of potash, oil, and gas resources. No mineral resource development is allowed within the WIPP site boundary, with the exception of existing leases in Section 31 (the far southwest corner of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992* Land Withdrawal Area), which will be acquired if needed. All other sections are reserved to the center of the earth.

The WIPP site is divided into surface structures, shafts, and subsurface structures and is designed to receive and handle 500,000 cubic feet per year of CH Waste and 10,000 cubic feet per year of RH Waste. The WIPP surface structures support the receipt of TRU Waste from generator sites. The WHB is the surface location for the unloading of generator-prepared Waste Containers from DOE-owned and NRC-certified U.S. Department of Transportation (DOT) Type B shipping packages. The CH and RH Waste Containers are transferred from the surface to the UG through the Waste Shaft using the Waste Shaft Conveyance. The surface entry/egress from the Waste Shaft Conveyance and the Waste Hoist system and support structure are within the WHB. The CH and RH Waste Containers are removed from the Waste Shaft Conveyance at the Waste Shaft Station in the UG at 2,150 feet below the surface. The Waste Containers are moved along a predetermined Transport Path to their final disposal location. The WIPP facility is designed to have a TRU Waste disposal capacity of 6.2 million cubic feet. In rare circumstances the disposal process may be reversed if WIPP is notified by a generator site that a disposed Waste Container has been received in error and must be retrieved.

The nearest site boundary from either the WHB or the UG Exhaust Shaft is at a distance of approximately 2.9 kilometers. The enclosed area is the Land Withdrawal Area (WIPP site boundary) as described in Figure 1.3-3 of Chapter 1.0, "Site Characteristics."

Electrical power required for WIPP operations is provided by an offsite utility. This utility plays a role in the safety aspects of the normal WIPP operations by supporting the operations of the WHB and UG ventilation, the WHB Fire Suppression System (FSS), and the Waste Hoist. Loss of power was analyzed within the DSA, however, the systems selected to reduce the consequences do not require electrical power to initiate the mitigation of the consequences of the event. Additionally, WIPP has auxiliary power systems that will supply power for critical life safety functions that require electricity.

The WIPP fire and potable water are obtained via a 10-inch water pipeline managed by the City of Carlsbad.

Onsite medical support is provided on the surface and in the UG.

WIPP maintains a number of Mutual Aid Agreements with surrounding entities. These agreements relate to medical, fire response, and mine emergency support, as required. A summary of the Mutual Aid Agreements is included in *WIPP Emergency Management Plan* (WP 12-9).

E.4 FACILITY HAZARD CATEGORIZATION

The WIPP facility is classified as a Hazard Category 2 DOE Nonreactor Nuclear Facility. Facility categorization was performed consistent with *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports* (DOE-STD-1027-92). Based on a single Waste Container inventory limit of 80 plutonium-239 equivalent curies (PE-Ci), the WIPP radiological inventory exceeds the DOE-STD-1027-92 plutonium-239 threshold quantity for Hazard Category 2.

For non-radiological hazards, based on the criteria of DOE-STD-3009-2014, Section A.2, the chemicals in the WIPP Chemical Inventory that do not screen out would still not result in a release that would exceed the Protective Action Criteria (PAC)-1 for MOI or PAC-2 for the co-located worker consequence thresholds. Of the chemical constituents associated with U.S. Environmental Protection Agency (EPA) Hazardous Waste Numbers that may be present in the TRU Mixed Waste per the *Waste Isolation Pilot Plant Hazardous Waste Facility Permit* (HWFP) and polychlorinated biphenyls (PCBs) per the EPA PCB Conditions of Approval (EPA 2011), only beryllium powder did not screen out, as there are multiple TRU Waste Containers that contain significant beryllium in a solid form. However, the bulk of the beryllium material in TRU Waste is in solid form (i.e., not powder) and would not be dispersible due to insult to a TRU Waste Container. Since the predominant and most probable hazard in TRU Waste is radioactive material, any release of beryllium would be coincident with a release of radioactive material. The chemical hazard consequences due to the release of any material intermixed with TRU Waste and released simultaneously due to an insult of a TRU Waste Container are less than the radiological consequences of the same event; therefore, the controls derived for the radiological event are considered to prevent/mitigate any chemical release.

E.5 SAFETY ANALYSIS OVERVIEW

The principal operations at WIPP involve the receipt and disposal of TRU Waste. WIPP CH and RH Waste operations considered in this DSA include the following:

- Receipt, movement, and emplacement of CH Waste Containers with battery-powered and diesel-fueled forklifts, electric-powered Automated Guided Vehicles, cranes, the Waste Hoist, and UG transporter.
- Receipt, movement, and emplacement of RH Waste Containers with cranes, transfer cars, the Waste Hoist, UG 41-ton diesel-fueled forklift, and the Horizontal Emplacement and Retrieval Equipment (HERE) or Horizontal Emplacement Machine (HEM).
- Retrieval, movement, and shipment of CH and RH Waste Containers, if required.
- Maintenance and operation of surface and UG Waste Handling equipment and engineered features.
- Maintenance of surface buildings and outside areas.
- Maintenance and preparation (i.e., mining) of the UG disposal facility.

Movement of CH and RH Waste Containers in the UG involves large Waste Handling equipment containing significant amounts of diesel fuel and hydraulic fluid.

The principal hazard analyzed for the WIPP is the potential for the release of radiological material associated with the TRU Mixed Waste resulting from fires, deflagrations/overpressurizations, and loss of confinement events due to in-process activities, external initiation, or Natural Phenomena Hazard (NPH) initiated events. The hazard and accident analyses were performed using the methodology outlined in DOE-STD-5506-2007 for compliance with DOE-STD-3009-2014, and approved by CBFO for application at WIPP. There are two hazard scenarios that challenge the Evaluation Guideline for MOI: the Large Pool Fire in Waste Shaft and Loss of Confinement at the Waste Shaft Station Due to Drop of Vehicle/Equipment from the Waste Collar. Therefore, they were the only events that were candidates for accident analysis. The MOI doses determined by the analyses, 7.3 and 5.2 rem, barely exceed the Moderate consequence threshold of 5.0 rem. The SACs “Waste Conveyance Operations” and “Liquid-fueled Vehicle/Equipment Prohibition” were selected to control these hazards. Table 3.3-9, “Hazard Evaluation Events Requiring Further Evaluation,” summarizes other events which were evaluated with regard to appropriate mitigation.

The HA and accident analyses were performed using the methodology outlined in DOE-STD-5506-2007 for compliance with DOE-STD-3009-2014. The HA identified over 600 events. A review of these events resulted in grouping them into a set of 167 unique and representative radiological events, which are listed in Table 3.3-6. A subset of the events further identified as being an unmitigated Risk Class I or II hazard to one or more receptors, requiring further evaluation to reduce risk to the facility worker or co-located worker. The major hazardous events in WIPP are fires, explosion, loss of confinement, external events, and NPH events. The following SS SSCs are selected to protect co-located worker or facility worker:

- **UG Automatic Fire Suppression System**. Vehicles and equipment with a significant combustible liquid capacity that are selected for use near CH Waste are equipped with an automatic FSS. UG vehicles/equipment that are selected for use shall have an automatic FSS as determined by NFPA 122 required analysis when operating in the Waste Shaft Station when CH Waste is present, when transporting CH Waste in the Vehicle Exclusion Zone (VEZ), when transporting CH Waste between the VEZ and the CH Waste Face, and any other vehicles/equipment to be operated within 200 feet of the CH Waste Face.
- **UG Ventilation Filtration System/Interim Ventilation System**. The Underground Ventilation Filtration System (UVFS)/IVS provides for high-efficiency particulate air (HEPA) filtration of UG exhaust air. This system also draws potential airborne contamination away from normally occupied locations in the UG. These features reduce the consequences to the co-located worker and MOI (HEPA filtration) and reduce the consequences for the facility worker by drawing contamination away from normally occupied areas of the UG.
- **WHB Fire Suppression System**. The WHB FSS provides for suppression of fires in the WHB before they become large enough to affect waste not in a closed Shipping Package.
- **CH WH CVS**. The CH WH CVS provides a confinement barrier with HEPA filters providing the capability to limit releases of airborne radioactive contaminants from the CH Bay, Room 108, or Conveyance Loading Room (CLR). These features reduce the consequences to the co-located worker and MOI.

The following DFs are selected to reduce the risk to co-located worker or facility worker:

- **Type B Shipping Package**. The Type B Shipping Package design is certified by the NRC for transport of radiological wastes on the public highways. Extensive testing has been performed to ensure the waste is protected from release in the case of an upset condition. The passive DF of the Type B Shipping Package prevents radiological releases from its contained loads and provides shielding to reduce consequences to the facility worker.
- **UG Fuel Storage and Oil Storage Areas located away from Waste Handling and Storage Areas**. The UG Fuel Storage and Oil Storage Room locations are defined in the configuration of the UG and are located north of the storage and transport of radiological waste areas. This passive DF prevents fires and/or explosions at the refueling station or oil storage room from affecting the handling and storage of waste.
- **Facility Cask (RH Facility Cask/Light Weight Facility Cask)**. The robust construction of the RH Facility Cask ensures that RH Waste is protected from anticipated insults (e.g., fire, deflagration, loss of confinement) and its lead lining reduces the consequences to the facility worker when handling RH Waste.
- **Waste Hoist Support Structure**. The Waste Hoist Support Structure is the physical structure that supports the Waste Hoist, and is designed to withstand the DBE. The Waste Hoist systems in the shaft and all shaft furnishings are designed to resist the dynamic forces of the hoisting

operations (the dynamic forces are greater than the seismic forces on the UG facilities). The design reduces the likelihood for failure of the Waste Conveyance.

- **WHB Design for High Wind**. The WHB is built as a Type II construction per the Standard on Types of Building Construction (NFPA 220), and serves as a confinement barrier to control the potential for release of hazardous and/or radioactive material. The WHB is designed and constructed to withstand the Design Basis Tornado (DBT) with 183 miles per hour (mph) winds and a translational velocity of 41 mph, a tangential velocity of 124 mph, a tangential velocity of 124 mph, a maximum rotational velocity radius of 325 feet, a pressure drop of 0.5 pounds per square inch (psi) and a pressure drop rate of 0.09 psi per second. This passive DF reduces the likelihood for impacts to Waste Containers located in the WHB which could result in a loss of confinement of radiological material.
- **WHB Design for Noncombustible Construction and Curbing**. The WHB is constructed primarily of metal and concrete with its exterior surfaces and roofing consisting of noncombustible materials and curbing extending above the floor of the WHB. This passive construction DF reduces the likelihood of small fires propagating into a large fire and also reduces the likelihood of a fire originating external to the WHB to penetrate the outer wall.
- **WHB Design for Roof Loading**. The roof of the WHB is designed to withstand 27 pounds per square foot (lb/ft^2) of snow load. The 100-year recurrence maximum snowpack for the WIPP region is 10 lb/ft^2. This passive DF reduces the likelihood for collapse of the WHB roof that could result in the loss of confinement of radiological material.
- **WHB Design for Seismic**. The WHB is designed and constructed to withstand the Design Basis Earthquake (DBE) with 0.1 g peak ground acceleration (PGA) and a 1,000-year return interval.
- **WHB Design for Waste Shaft Access**. The Waste Shaft Collar Area prevents direct and unrestricted access to the Waste Shaft. Vehicles/equipment entering the access area must make a 90 degree turn toward the Waste Shaft.
- **FCLR, Transfer Cell, and CUR Shielding**. The Hot Cell is constructed of thick concrete for shielding. This DF reduces the consequences to the facility worker when processing RH Waste Containers in the Hot Cell Complex.
- **Panel 6 and Panel 7, Room 7 Bulkheads**. The installation of isolation bulkheads mitigates the consequences of a TRU Waste Container exothermic event in a closed Disposal Panel.
- **Facility Pallet**. The facility pallet provides shielding for the bottom tier CH Waste Containers from direct flame impingement. This reduces the consequences to all receptors by ensuring that CH Waste Containers remain intact (e.g., no lid loss with waste ejection) and, therefore, the airborne release fraction / respirable fraction (ARF/RF) factors are lower as compared to unconfined burning ARF/RFs.
- **Vehicle Barriers**. Vehicle Barriers consist of a double row of concrete (e.g., Jersey type barriers, installed a nominal distance of 5 feet west of the CH Bay/TRUPACT Maintenance Facility (TMF) common wall extending south from the TMF south exterior wall a minimum distance of 25 feet and, one set of interconnected concrete barriers positioned a minimum 25 feet south of the CH Bay exterior wall extending between Airlock 100 to a point nominally 5 feet west of the CH Bay/TMF common wall (approximately 85 feet in total length) to intersect with the other section. A nominal 3-foot gap at the intersection of the east-west barrier and the double row of barriers is permitted for fire department access.

- **Waste Hoist Brakes**. The Waste Hoist Brakes work in conjunction with the Waste Hoist Support Structure to control movement of the conveyance up and down the Waste Shaft. This prevents an uncontrolled drop of the conveyance loaded with waste down the shaft.

The following Administrative Controls (ACs) are selected to reduce the risk to the co-located worker or facility worker:

- **WIPP WAC Compliance**. Compliance with the WIPP WAC reduces both the likelihood and consequences of adverse events. The WIPP WAC provides assurance that waste meets specific criteria for the containers and their contents. The container provides some resistance to adverse events (e.g., drops). WIPP WAC requirements limit radionuclide composition, quantities of liquids, constituencies of contents, combinations of materials which are relied upon when determining consequences from upsets to the containers.
- **Vehicle Exclusion Zone**. A VEZ, defined as distance between the leading edge of the lead escort vehicle and the trailing edge of the lag escort vehicle, and the nominal width of the drift, shall be established about the TRU Waste being transported in the UG, and be maintained for the duration of the transport. Only one liquid-fueled vehicle is allowed in the VEZ, except in cases involving repair/replacement of vehicles and/or transfers. This prevents vehicle-to-vehicle collisions which could result in a fire event.
- **Limit of Two Liquid-fueled Vehicles/Equipment ≤ 25 ft. of CH Waste Face**. UG vehicle and equipment interactions are controlled when operating within 25 feet of the CH Waste Face by restricting vehicle/equipment access (e.g., emplacement, waste extraction). Limiting the number of liquid-fueled vehicles/equipment operating within 25 feet of the CH Waste Face to a maximum of two reduces the likelihood for collisions.
- **UG Lube Truck Operations**. Lube trucks are prohibited within 200 feet of the Waste Face and excluded from the Waste Shaft Station and the E-140 Drift between Bulkheads 310 and 415 when CH Waste is present in the Waste Shaft Station. Prohibiting the Lube Truck from being within 200 feet of the Waste Face and/or the Waste Shaft Station reduces the likelihood for large liquid combustible fires involving CH Waste and thereby limits that amount of MAR (i.e., consequences) that would be involved in a pool fire should it occur.
- **Pre-operational Checks of UG Vehicles/Equipment**. Waste Handling Vehicles and UG vehicles/equipment in an active Disposal Room when CH Waste is present, when transferring CH Waste between the VEZ and the CH Waste Face, within the VEZ, or within the Waste Shaft Station when CH Waste is present, shall have a pre-operational check prior to their use. Inspection provides assurance that the vehicle and/or equipment is operating properly and has no obvious signs of degradation that could lead to its misoperation, thereby reducing the likelihood of collisions and/or combustible liquid leaks that could lead to a fire or pool fire event. Liquid-combustible capacity equipment in an active Disposal Room when CH Waste is present, when transferring CH Waste between the VEZ and the CH Waste Face, within the VEZ, or within the Waste Shaft Station when CH Waste is present, creates the potential for leaks and ignition and/or vehicles colliding with the equipment resulting in a pool fire.
- **Area Attendance: Spotter**. Liquid-fueled vehicles in the VEZ, when transferring CH Waste between the VEZ and the Waste Face, the Waste Shaft Station when CH Waste is present, and within 200 feet of the CH Waste Face are Attended. Attendance provides assurance that unnecessary vehicles will be removed from the area, spotting of vehicles/ equipment when operating in close proximity, observation for indications of vehicle/equipment misoperation and conditions that could lead to a fire. Vehicles/equipment with liquid combustible capacity greater

than 25 gallons shall be attended in the RH Bay when CH Waste is present in the CH Bay. An Attendant is independent of vehicle/equipment operation.

- **Area Attendance: Notification**. Liquid-fueled vehicles in the VEZ, the Waste Shaft Station when CH Waste is present, and within 25 feet of the CH Waste Face are Attended. Attendance ensures that UG Facility Workers are notified of conditions requiring response to mitigate worker consequences. Vehicles/equipment with liquid combustible capacity greater than 25 gallons shall be attended in the RH Bay when CH Waste is present in the CH Bay. An Attendant is independent of vehicle/equipment operation.
- **Waste Conveyance Control**. The Waste Conveyance is required to be present at the Waste Shaft Collar prior to the loading or unloading of TRU Waste at the Waste Shaft Collar. The control ensures the Waste Conveyance is present at the Waste Shaft Station prior to the unloading or loading of TRU Waste at the Waste Shaft Station. When TRU Waste is in transit between the Waste Shaft Collar and the Waste Shaft Station, Doors 155 and 156 are required to be closed. The Waste Shaft Conveyance shall remain at the Waste Shaft Station until the Waste is loaded onto the Waste transporter and the transporter is moving away from the Waste Shaft. This reduces the likelihood for vehicles, equipment, and/or loads to drop down an open Waste Shaft into the shaft sump.
- **Aboveground Liquid-Fueled Vehicles/ Equipment Prohibition: Vehicle Operations**. Liquid-fueled vehicles and equipment are prevented from entering the CH Bay, Room 108, and Waste Shaft Access Area when CH Waste is present. This control reduces the likelihood of pool fire occurring in the presence of CH Waste by removing a likely source of liquid fuel.
- **Fuel Tanker Prohibition**. Fuel Tanker trucks are prohibited from entering the Parking Area Unit south of the WHB. Prohibition of Fuel Tankers from the WHB parking area unit reduces the likelihood for a large source of liquid-fuel to contribute to a large pool fire affecting CH Waste located in the CH Bay.
- **TRU Waste Outside the WHB**. The TRU Waste Outside the WHB control is established to ensure that TRU Waste Containers are protected from adverse events (e.g., fires, explosions, impacts) when located aboveground and outside the WHB. This control excludes site-derived TRU Waste. This is accomplished by ensuring that TRU Waste (excluding site-derived TRU Waste), aboveground and outside of the WHB, is contained in a closed Type B Shipping Package.
- **Real-time Monitoring at Panel 6 and Panel 7, Room 7 Isolation Bulkheads**. The Real-time Monitoring at Panel 6 and Panel 7, Room 7 Isolation Bulkheads is established to ensure that active radiological monitoring is in place to protect workers in these areas. The real-time monitoring will ensure an immediate detection of and response to a potential radiological release originating inside the closed Panel 6 and Panel 7, Room 7 areas should a repeat chemical exothermic reaction occur in known WAC noncompliant containers. Detection of leaks around the isolation bulkhead into potentially occupied areas of the UG would prompt action to minimize UG facility worker consequences of the event.
- **CH Bay Alternative Vehicle Barrier**. The CH Bay Alternative Barrier Provision control is established to ensure that the southwest section of the WHB wall is protected when a portion of the Vehicle Barriers is required to be removed to permit liquid-fueled vehicle/equipment access to the excluded area.

The above controls reduce the risk to public, co-located worker and facility worker to an acceptable level from normal, abnormal and accident conditions that could occur during WIPP operations.

E.6 ORGANIZATIONS

NWP is the current WIPP Management and Operating Contractor. NWP performs the unloading of the NRC-certified DOT Type B shipping containers, the transfer of CH and RH Waste Containers to the UG, and the emplacement into a disposal location, as well as maintenance of the surface and UG facilities, but may use subcontractor support as required. The WIPP facility is owned by DOE, which provides oversight of WIPP operations through the CBFO.

Other DOE prime contractors supporting operations of the WIPP facility include Sandia National Laboratories – Carlsbad Program Group (which is responsible for research and development and acts as a scientific and technical advisor); Los Alamos National Laboratory – Carlsbad Operations (which provides expertise in support of TRU Waste characterization and transportation and National TRU Program (NTP) Central Waste Analysis); and CBFO Technical Assistance Contractor (which provides regulatory and technical support to CBFO).

DSA preparation was developed under the direction of NWP, using a variety of professional resources within the NWP organization and affiliated organizations.

E.7 SAFETY ANALYSIS CONCLUSIONS

The DSA process describes and analyzes the WIPP site and the Waste Handling and disposal operations. It has identified associated hazards and the conditions and hazard controls necessary to protect the worker, the public, and the environment. The safety basis demonstrates that WIPP employs the necessary controls to provide an acceptable level of safety compliant with 10 CFR 830, Subpart B.

The SVS is a project currently in process, which will not be completed at the time of implementation of this DSA, to increase airflow to the UG. It is described in Chapter 2.0, “Facility Description,” but its operation is explicitly prohibited under this DSA. Upon completion and prior to its operation, any associated controls will be added to the safety basis and its operation will be permitted under a revised DSA.

Additionally, there are ongoing DOE programmatic activities which may ultimately impact the facility safety basis. Issues have arisen concerning the MAR methodology and conservatisms in DOE-STD-5506-2007 as well as the manner in which chemical exothermic reactions should be modeled. As the safety basis analyses conform to requirements of DOE-STD-5506-2007, changes in the standard could propagate to this DSA.

E.8 DSA ORGANIZATION

This DSA was organized in accordance with the guidelines of DOE-STD-3009-2014. The body of the DSA parallels the format delineated in the standard. Chapters 7.0–17.0 maintain the format of DOE-STD-3009-94, CN 3, as permitted by DOE-STD-3009-2014. Chapter 18.0, “WIPP Waste Acceptance Criteria Compliance Program,” new in this DSA revision, is in the DOE-STD-3009-2014 format.

Chapter	Content
Executive Summary	Facility Background and Mission; Facility Overview; Facility Hazard Categorization; Safety Analysis Overview; Organizations; Safety Analysis Conclusions; DSA Organization
Chapter 1.0, Site Characteristics	Introduction; Requirements; Site Description; Environmental Description; Natural Event Accident Initiators; Man-made External Accident Initiators; Nearby Facilities; Validity of Existing Environmental Analysis
Chapter 2.0, Facility Description	Introduction; Requirements; Facility Overview; Facility Structure; Remote-Handled Waste Handling Equipment and Process Description; Contact-Handled Waste Handling Equipment and Process Description; Confinement Systems; Safety Support Systems; Utility Distribution Systems; Auxiliary Systems and Support Facilities
Chapter 3.0, Hazard and Accident Analysis, and Control Selection	Introduction; Requirements; Hazard Analysis; Accident Analysis; Beyond Design/Evaluation Basis Accidents; Planned Design and Operational Safety Improvements
Chapter 4.0, Safety Structures, Systems, and Components	Introduction; Requirements; Safety Class Structures, Systems, and Components; Safety Significant Structures, Systems, and Components; Specific Administrative Controls
Chapter 5.0, Derivations of Technical Safety Requirements	Introduction; Requirements; Technical Safety Requirement Coverage; Derivation of Process Areas and Facility Modes; Technical Safety Requirements Derivation; Administrative Controls; Design Features; Interface with Technical Safety Requirements from Other Facilities
Chapter 6.0, Prevention of Inadvertent Criticality	Introduction; Requirements; Criticality Concerns; Criticality Controls; Criticality Safety Program; Criticality Instrumentation
Chapter 7.0, Radiation Protection	Introduction; Requirements; Radiation Protection Program and Organization; As Low as Reasonably Achievable (ALARA) Policy and Program; Radiological Protection Training; Radiation Exposure Control; Radiological Monitoring; Radiological Protection Instrumentation; Radiological Protection Recordkeeping; Occupational Radiation Exposures
Chapter 8.0, Hazardous Material Protection	Introduction; Requirements; Hazardous Material Protection and Organization; Hazardous Materials Exposure Control Program; Hazardous Material Training; Hazardous Material Exposure Control; Hazardous Material Monitoring; Hazardous Material Protection Instrumentation; Hazardous Material Protection Recordkeeping; Hazard Communication Program; Occupational Chemical Exposures
Chapter 9.0, Radioactive and Hazardous Waste Management	Introduction; Requirements; Radioactive and Hazardous Waste Management Program and Organization; Radioactive and Hazardous Waste Streams and Sources
Chapter 10.0, Initial Testing, In Service Surveillance, and Maintenance	Introduction; Requirements; Initial Testing Program; In Service Surveillance Program; Maintenance Program
Chapter 11.0, Operational Safety	Introduction; Requirements; Conduct of Operations; Fire Protection; Ground Control
Chapter 12.0, Procedures and Training	Introduction; Requirements; Procedure Program; Training Program
Chapter 13.0, Human Factors	Not required – Deleted from Revision 5b
Chapter 14.0, Quality Assurance	Introduction; Requirements; Quality Assurance Program and Organization; Quality Improvement; Documents and Records; Quality Assurance Performance
Chapter 15.0, Emergency Preparedness Program	Introduction; Requirements; Scope of Emergency Preparedness; Emergency Preparedness Planning
Chapter 16.0, Provisions for Decontamination and Decommissioning	Not Required – Deleted from Revision 5b

Chapter	Content
Chapter 17.0, Management, Organization, and Institutional Safety Provisions	Introduction; Requirements; Organizational Structure, Responsibilities, and Interfaces; Safety Management Policies and Programs
Chapter 18.0, WIPP Waste Acceptance Criteria Compliance Program	Organizational Roles and Responsibilities; Transuranic WAC for the Waste Isolation Pilot Plant; WIPP Facility WAC Compliance Program Description; WIPP Certified Programs; Prior to Authorizing Shipment; Upon Receipt at WIPP; At DOE Sites: Generator Site Technical Review; Previously Certified Waste Preclusion of Shipments; Key Elements

E.9 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

DOE/CBFO-15-3554, September 2015, *Basis for Approval WIPP Dispersion Modeling Protocol*, Letter from Carlsbad Field Office to Nuclear Waste Partnership LLC.

DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, November 2014, U.S. Department of Energy, Washington, DC.

DOE-STD-5506-2007, *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*, April 2007, U.S. Department of Energy, Washington, DC.

DOE-STD-1027-92, Change 1, 1997, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, *Nuclear Safety Analysis Reports*, September 1997, U.S. Department of Energy, Washington, DC.

EPA (U.S. Environmental Protection Agency), Letter and enclosed Conditions of Approval from Carl E. Edlund (Director, Multimedia Planning and Permitting Division, EPA) to Edward Ziemianski, Acting Manager, Carlsbad Field Office, DOE, dated January 5, 2011, granting approval for WIPP to dispose of TRU and TRU-mixed wastes containing PCBs.

HWFP, *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*, NM4890139088-TSDF (current revision), New Mexico Environment Department, Santa Fe, NM.

NFPA 220, *Standard on Types of Building Construction*, 2006 Edition, National Fire Protection Association, Quincy, MA.

NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*, 2015 Edition, National Fire Protection Association, Quincy, MA.

Public Law 94-580, 90 Stat. 2795. *Resource Conservation and Recovery Act of 1976*.

Public Law 102-579, 106 Stat. 4777, 1992 (as amended by Public Law 104-201, 1996), *Waste Isolation Pilot Plant Land Withdrawal Act*.

U.S. Department of Energy Accident Fire Forensic Analysis of the Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014, U.S. Department of Energy, Washington, DC.

U.S. Department of Energy Accident Investigation Report, Phase 1 Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014, U.S. Department of Energy, Washington, DC.

U.S. Department of Energy Accident Investigation Report, Phase 2 Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014, U.S. Department of Energy, Washington, DC.

U.S. Department of Energy Accident Investigation Report, Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant, February 5, 2014, U.S. Department of Energy, Washington, DC.

WP 12 9, *WIPP Emergency Management Plan* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

List of Acronyms and Abbreviations

A	Anticipated (frequency level)
AA	accident analysis
AC	Administrative Control
acfm	actual cubic feet per minute
ACGLF	adjustable center-of-gravity lifting fixture
AEGL	Acute Exposure Guideline Level
AFA	Alignment Fixture Assembly
AGV	Automated Guided Vehicle
AIB	Accident Investigation Board
AK	Acceptable Knowledge
ALARA	As Low As Reasonably Achievable
AMWTP	Advanced Mixed Waste Treatment Project
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARF	airborne release fraction
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BDBA	Beyond Design Basis Accident
BEBA	Beyond Evaluation Basis Accident
BEU	Beyond Extremely Unlikely (frequency level)
BLM	Bureau of Land Management
CAM	Continuous Air Monitor
CBFO	DOE Carlsbad Field Office
CCEM	chemical compatibility evaluation memo
CCO	Criticality Control Overpack
CCP	Central Characterization Program
CCTV	closed-circuit television
CFR	*Code of Federal Regulations*
cfm	cubic feet per minute
CH	contact-handled
CIS	characterization information summary
CLR	Conveyance Loading Room
CMR	Central Monitoring Room
CMRO	Central Monitoring Room Operator
CMS	Central Monitoring System
CUR	Cask Unloading Room
CVS	Confinement Ventilation System
DAC	derived air concentration
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DBT	Design Basis Tornado
DDC	Direct Digital Control
DF	design feature
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy

DOE-EM	U.S. Department of Energy - Environmental Management
DOELAP	U.S. Department of Energy Laboratory Accreditation Program
DOT	U.S. Department of Transportation
DP	differential pressure
DR	damage ratio
DSA	Documented Safety Analysis
EAL	Emergency Action Level
EFB	Exhaust Filter Building
EPA	U.S. Environmental Protection Agency
EPHA	Emergency Planning Hazard Assessment
ERO	Emergency Response Organization
ERT	Emergency Response Team
ESS	Evaluation of the Safety Situation
EST	Emergency Services Technician
EU	Extremely Unlikely (frequency level)
EUA	Exclusive Use Area
EXT	External
f	frequency
FAS	Fixed Air Sampler
FCLR	Facility Cask Loading Room
FCRD	Facility Cask Rotating Device
FCTC	Facility Cask Transfer Car
FGE	fissile gram equivalent
FHA	Fire Hazard Analysis
FMEA	Failure Modes and Effects Analysis
fpm	feet per minute
FPP	Fire Protection Program
FSM	Facility Shift Manager
FSS	Fire Suppression System
ft^3	cubic feet
FTV	Facility Transfer Vehicle
g	gravitational acceleration or gram(s)
GET	General Employee Training
gpm	gallons per minute
HA	hazard analysis
HalfPACT	Half-package Transporter
HAZMAT	hazardous material
HAZOP	Hazard and Operability Analysis
HDBK	Handbook
HEM	Horizontal Emplacement Machine
HEPA	high-efficiency particulate air
HERE	Horizontal Emplacement and Retrieval Equipment
HVAC	heating, ventilation, and air conditioning
HWFP	Waste Isolation Pilot Plant Hazardous Waste Facility Permit

IBC	International Building Code
IC	Initial Condition
ICE	integrated cooling material
ICV	Inner Containment Vessel
IO	independent observation
IS&H	Industrial Safety and Hygiene
ISMS	Integrated Safety Management System
ISO	International Standards Organization
ITR	Independent Technical Review
IVS	Interim Ventilation System
IWMDL	Interface Waste Management Documents List
JIC	Joint Information Center
KA	key attribute
KE	key element
KeV	kilo-electron volt
kW/m^2	kilowatt per square meter
lb/ft^2	pounds per square foot
LCO	Limiting Conditions for Operation
LCS	Limiting Control Setting
LED	light emitting diodes
LOC	loss of confinement
LPF	Leak Path Factor
LWA	Waste Isolation Pilot Plant Land Withdrawal Act of 1992
LWFC	Light Weight Facility Cask
M&O	management and operating
MAR	material at risk
MeV	mega-electron volt
MgO	magnesium oxide
MOI	Maximally Exposed Offsite Individual
mph	miles per hour
mrem	millirem
MSHA	Mine Safety and Health Administration
NA	not applicable
NARAC	National Atmospheric Release Advisory Center
NCR	nonconformance report
NCS	Nuclear Criticality Safety
NFPA	National Fire Protection Association
NMED	New Mexico Environment Department
NMIMT	New Mexico Institute of Mining and Technology
NPH	Natural Phenomena Hazard
NRC	U.S. Nuclear Regulatory Commission
NTP	National TRU Program
NVP	natural ventilation pressure
NWP	Nuclear Waste Partnership LLC

OA	Outside Area
OCA	Outer Confinement Assembly
OCV	Outer Confinement Vessel
OJT	on-the-job training
OP	overpack
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PAC	Protective Action Criteria
PCB	polychlorinated biphenyl
PCR	Permittees Conformation Representative
PDIT	Pressure Differential Indicating Transmitter
PDP	Performance Demonstration Program
PE-Ci	plutonium-239 equivalent curies
PGA	peak ground acceleration
PISA	Potentially Inadequate Safety Analysis
PIV	Post Indicator Valve
PLC	Programmable Logic Controller
POC	Pipe Overpack Container
PPA	Property Protection Area
PPE	personal protective equipment
psi	pounds per square inch
psig	pounds per square inch gauge
psf	pounds per square foot
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QAPP	Quality Assurance Project Plan
RAP	Radiological Assistance Program
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	Radiological Control Technician
RCTC	Road Cask Transfer Car
REMS	Radiological Effluent Monitoring (Sampling) System
RF	respirable fraction
RH	remote-handled
RIDS	Records Inventory and Disposition Schedule
RPP	Radiation Protection Program
RTR	real-time radiography
SAC	Specific Administrative Control
SC	Safety Class
SCAPA	Subcommittee on Consequence Assessment and Protective Actions
SDC	seismic design category
SDD	System Design Description
SDS	safety data sheet
SL	Safety Limit
SLB2	Standard Large Box 2
SMP	Safety Management Program
SNF	Spent Nuclear Fuel

SR	Surveillance Requirement
SS	Safety Significant
SSC	Structures, Systems, and Components
ST	Source Term
STD	Standard
SVS	Supplemental Ventilation System
SWB	Standard Waste Box
TDOP	10-Drum Overpack
TED	Total Effective Dose
TIM	Training Implementation Matrix
TLD	thermoluminescent dosimeter
TMF	TRUPACT Maintenance Facility
TRAMPAC	TRUPACT-II Authorized Methods for Payload Control
TRU	Transuranic
TRUDOCK	TRUPACT-II Unloading Dock
TRUPACT-II	Transuranic Package Transporter Model II
TRUPACT-III	Transuranic Package Transporter Model III
TSDF	Treatment, Storage, or Disposal Facility
TSR	Technical Safety Requirement
U	Unlikely (frequency level)
UG	Underground
UL	Underwriters Laboratory
UNS	unified numbering system
UPS	uninterruptible power supply
USQ	Unreviewed Safety Question
UVFS	Underground Ventilation Filtration System
UVS	Underground Ventilation System
VEZ	Vehicle Exclusion Zone
VOC	volatile organic compound
w.g.	water gauge
WAC	Waste Acceptance Criteria
WAP	Waste Analysis Plan
WDS	WIPP Waste Data System (WWIS is a part of the WDS system)
WH	Waste Handling
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant
WIPP WAC	*Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*
WSHPD	Worker Safety and Health Program Description
WSPF	waste stream profile form
WTM	waste transfer mechanism
WTMA	waste transfer machine assembly
YTV	Yard Transfer Vehicle

This page intentionally left blank

Table of Contents

List of Tables

List of Figures

1.0 SITE CHARACTERISTICS

1.1 INTRODUCTION

This chapter provides information on the location of the Waste Isolation Pilot Plant (WIPP) site and the site characteristics to support assumptions used in the hazards and accident analyses for potential external and natural event accident initiators and accident consequences.

This chapter is organized as follows:

- Requirements (Section 1.2).
- Site Description (Section 1.3).
- Environmental Description (Section 1.4).
- Natural Event Accident Initiators (Section 1.5).
- Man-made External Accident Initiators (Section 1.6).
- Nearby Facilities (Section 1.7).
- Validity of Existing Environmental Analysis (Section 1.8).
- References (Section 1.9).

1.2 REQUIREMENTS

The U.S. Department of Energy (DOE) was authorized by the *U.S. Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980* (Public Law 96-164) to provide a research and development facility for demonstrating the safe, permanent, disposal of transuranic (TRU) Wastes from national defense activities and programs of the United States exempted from regulations by the U.S. Nuclear Regulatory Commission (NRC). In accordance with the 1981 and 1990 Records of Decision (46 FR 9162 and 55 FR 25689), the development of the WIPP site was to proceed with a phased approach. Development of the WIPP site began with a siting phase, during which several sites in southeast New Mexico were evaluated and the present site was selected based on extensive geotechnical research supplemented by testing. Information relating to ecology, extractable resources, water and air quality, environmental radioactivity, surface- and groundwater hydrology, and geology necessary to support the 40 CFR 191 long-term performance assessment of the repository is found in *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant* (DOE/CAO 1996-2184).

During initial construction, all the federal lands within the WIPP site boundary were managed in accordance with the terms of "Public Land Order 6403" (48 FR 31038) and a DOE/Bureau of Land Management (BLM) "Memorandum of Understanding between the U.S. Department of Energy and the U.S. Department of the Interior, Bureau of Land Management" (DOE and BLM 1994).

WIPP was designed and constructed according to the *General Design Criteria Manual for Department of Energy Facilities* (DOE Order 6430), dated June 10, 1981, and codes and standards applicable at the time of construction. Facility modifications designed prior to DOE Order 6430 being superseded were designed according to the revision of the order and codes and standards applicable at the time of modification. Facility modifications designed and constructed after DOE Order 6430 was superseded were performed in accordance with the applicable revision of *Facility Safety* (DOE Order 420.1), *Life*

Cycle Asset Management (DOE Order 430.1), and the codes and standards in *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide* (DOE Guide 420.1-1).

On October 30, 1992, the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992* (LWA) (Public Law 102-579) transferred the land from the U.S. Department of the Interior to the DOE. Consistent with the WIPP mission, lands within and around the WIPP site boundary are administered according to a multiple land-use policy. During operations, the area within the WIPP site boundary will remain under federal control.

1.3 SITE DESCRIPTION

1.3.1 Geography

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 1.3-1). The center of the WIPP site is 103°47'27" west longitude and 32°22'11" north latitude.

Prominent natural features within 5 miles of the center of the WIPP site include Livingston Ridge and Nash Draw, which are located about 5 miles west (Figure 1.3-2). Livingston Ridge, the most prominent physiographic feature near the WIPP site, is a northwest-facing bluff about 75 feet high that marks the east edge of Nash Draw, a shallow drainage course about 5 miles wide.

The Pecos River is about 12 miles southwest of the WIPP site at its nearest point. The Guadalupe Mountains are about 42 miles from the WIPP site, which include the Carlsbad Caverns National Park and Guadalupe Mountains National Park, 40 and 70 miles, respectively. The nearest prominent man-made features are oil and gas production wells and associated tank batteries, as well as oil and gas exploration wells. The nearest cities are Loving (with a 2010 population of 1,413), which is 18 miles southwest, and Carlsbad (with a 2010 population of 26,138), which is 26 miles west. The population numbers are taken from the 2010 *Census of Population and Housing* (USDOC 2010).

1.3.1.1 Waste Isolation Pilot Plant Area

The land area within the WIPP Land Withdrawal Area (WIPP site boundary) is 16 square miles. It contains 10,240 acres including Sections 15-22 and 27-34 in Township 22 South, Range 31 East. The area containing the WIPP surface structures is surrounded with a chain link fence and covers about 35 acres in Sections 20 and 21 of Township 22 South, Range 31 East. This fenced area is the WIPP Property Protection Area (PPA). The location and orientation of the WIPP surface structures are shown in Figure 2.4-1. These structures include the following:

- The Waste Handling Building (WHB), where radioactive TRU Waste is received and prepared for Underground (UG) disposal.
- Four shafts to the UG area.
- A Support Building containing office facilities, showers, and change rooms for UG workers.
- An Exhaust Filter Building (EFB).
- Water storage tanks and pump house.
- Modular trailers for office staff and auxiliary buildings for personnel offices.
- Two warehouses.

Support structures outside the PPA include the following:

- Sewage stabilization ponds.
- A 170-foot meteorological tower.
- A communication tower.
- Two mined rock (salt) piles.
- Evaporation ponds for managing site runoff.

The underground facility is centrally located within the 16-section WIPP site boundary and covers a footprint of 550 acres. The UG facility is 2,150 feet below the surface in bedded salt of the Permian Salado Formation and is connected to the surface by four shafts: the Air Intake Shaft, the Salt Handling Shaft, the Exhaust Shaft, and the Waste Shaft. All four shaft openings are within the WIPP PPA. Contact-Handled (CH) and Remote-Handled (RH) TRU Waste will be disposed of in 10 panels: 8 panels, consisting of 7 rooms each, at the south end of the UG facility plus two additional panels, designated as Panels 9 and 10, which may be located in access drifts.

There are no industrial, commercial, institutional, recreational, or residential structures within the WIPP site boundary. However, the DOE has an agreement with Magnum Minerals LLC of Hereford, Texas, to remove 300,000 tons of salt from the surface salt piles by truck between 2010 and 2015. This activity is currently suspended due to the events of 2014.

Access to the WIPP site is provided by two roads that connect with U.S. Highway 62/180, 13 miles to the north, and New Mexico Highway 128, four miles to the south. The north access road is used to transport TRU Mixed Waste from U.S. Highway 62/180 to the site. The north access road is used as the primary transportation route by personnel, agents, and contractors of the DOE on official business related to the WIPP and by personnel, permittees, licensees, or lessees of the BLM. The south access road is a multiple-use access. Both roads are maintained by the DOE.

There are several oil and gas wells around the periphery of the WIPP site boundary. One gas pipeline is within the WIPP site boundary, oriented northeast–southwest, and is about 1.2 miles north of the center of the WIPP PPA at its closest point.

The areas that have been designated as subdivisions within the WIPP site boundary are defined below and depicted in Figure 1.3-3.

The WIPP Land Withdrawal Area (WIPP site boundary) is 16 square miles and contains 10,240 acres. The evaluation guideline is applied at the WIPP site boundary, which is 2.9 kilometers from the UG and the WHB ventilation exhausts.

The Off-limits Area is an area of 1,454 acres that contains the Exclusive Use Area (EUA) and the PPA. This area is posted “No Trespassing,” but it is leased for grazing, and hunting is allowed.

The EUA is an area of 290 acres that contains the PPA. It is surrounded by a barbed wire fence, posted no trespassing, and restricted to DOE use only.

The WIPP PPA is an area of 35 acres surrounded by a chain link fence topped with barbed wire. The PPA boundary is the public exclusion and access control point controlled by the WIPP site 24-hour security force. Within the PPA, access is restricted to employees and approved visitors. A zone provided between the mined area underground and the WIPP site boundary is a minimum of 1 mile wide. This horizontal distance was specified based on recommendations made by the Oak Ridge National Laboratory (ORNL). The ORNL recommendation of 1 to 5 miles for the size of the zone of intact salt was to preclude unacceptable penetration of the salt formation. The ORNL stated that the actual size of the zone must be based on site-dependent factors including drilling operations, mining operations, and salt dissolution rates. This was addressed in *Geological Characterization Report, Waste Isolation Pilot Plant Site, Southeastern New Mexico* (SAND 78-1596), where the authors state that the 1-mile thickness should provide more than 250,000 years of isolation using very conservative dissolution assumptions.

1.3.1.2 Exclusion Area Land Use and Control

On October 30, 1992, the LWA transferred the land from the U.S. Department of the Interior to the DOE. Consistent with the WIPP mission, lands within and around the WIPP site boundary are administered according to a multiple land-use policy. During operations, the area within the WIPP site boundary will remain under federal control.

The *Waste Isolation Pilot Plant Land Management Plan* (DOE/WIPP 93-004) allows public access to the WIPP 16-section area up to the DOE EUA for grazing purposes and up to the DOE Off-limits Area for recreational purposes. Public access is controlled at the PPA by the WIPP site 24-hour security force.

The DOE will not permit subsurface mining, drilling, or resource exploration unrelated to the WIPP operation within the site boundary during facility operations, during the period of active institutional controls, or after decommissioning. Mining and drilling are prohibited within the site boundary by the LWA, except for purposes that support the WIPP. This prohibition precludes slant drilling under the WIPP site from within or outside the site, with the exception of existing rights under federal oil and gas leases (No. NM 02953 and NM 02953C). These leases should not be affected unless a determination is made to require the acquisition of such leases to comply with final disposal regulations or with the *Solid Waste Disposal Act of 1976* (Public Law 94-580).

Within the PPA, access is restricted to employees and approved visitors. Within the EUA, access is restricted to authorized personnel and vehicles. In addition, small areas have been fenced to control access to material storage areas, borrow pits, the sewage stabilization ponds, and biological study plots.

1.3.1.2.1 Agricultural Uses

The 5-mile radius encompasses grazing allotments of ranching operations. All the land within the WIPP site boundary (except for the EUA) has been leased for grazing, which is the only significant agricultural activity in the vicinity of the WIPP site. Grazing operates within the authorization of the *Taylor Grazing Act of 1934* (43 USC 315), the *Federal Land Policy and Management Act of 1976* (43 USC 1701–1782), the *Public Rangelands Improvement Act of 1978* (43 USC 1904), and the *Bankhead-Jones Farm Tenant Act of 1937* (7 USC 1010–1012). Portions of two grazing allotments administered by the BLM fall within the Land Withdrawal Area: Livingston Ridge (No. 77027) and Antelope Ridge (No. 77032) (DOE/WIPP 93-004). The Smith Ranch, owned by Kenneth Smith Inc. of Carlsbad, New Mexico, has lease rights to 2,880 acres within the northern portion of the WIPP site boundary. S.C. Mills of Loving, New Mexico, owner of the Mills Ranch, has lease rights to 7,360 acres within the southern portion of the WIPP site boundary. The Mills ranch house is located 1 mile outside the WIPP site boundary.

1.3.1.2.2 Water Use

Uses of surface or groundwater in the vicinity of the WIPP site include several windmills throughout the area to pump groundwater for livestock and several ponds to capture runoff for livestock. The WIPP fire and potable water are obtained via a 10-inch water pipeline managed by the City of Carlsbad.

1.3.2 Demography

The WIPP site is located 26 miles east of Carlsbad in Eddy County, near Lea County. The population of Eddy County is 53,829 with the most populated town being Carlsbad, with a population of 26,138. The population of Lea County is 64,727 with the most populated town being Hobbs, with a population of 34,122. The permanent residence nearest to the WIPP site boundary is the S.C. Mills Ranch, which is 1 mile to the south. The population numbers are taken from the 2010 census (USDOC 2010).

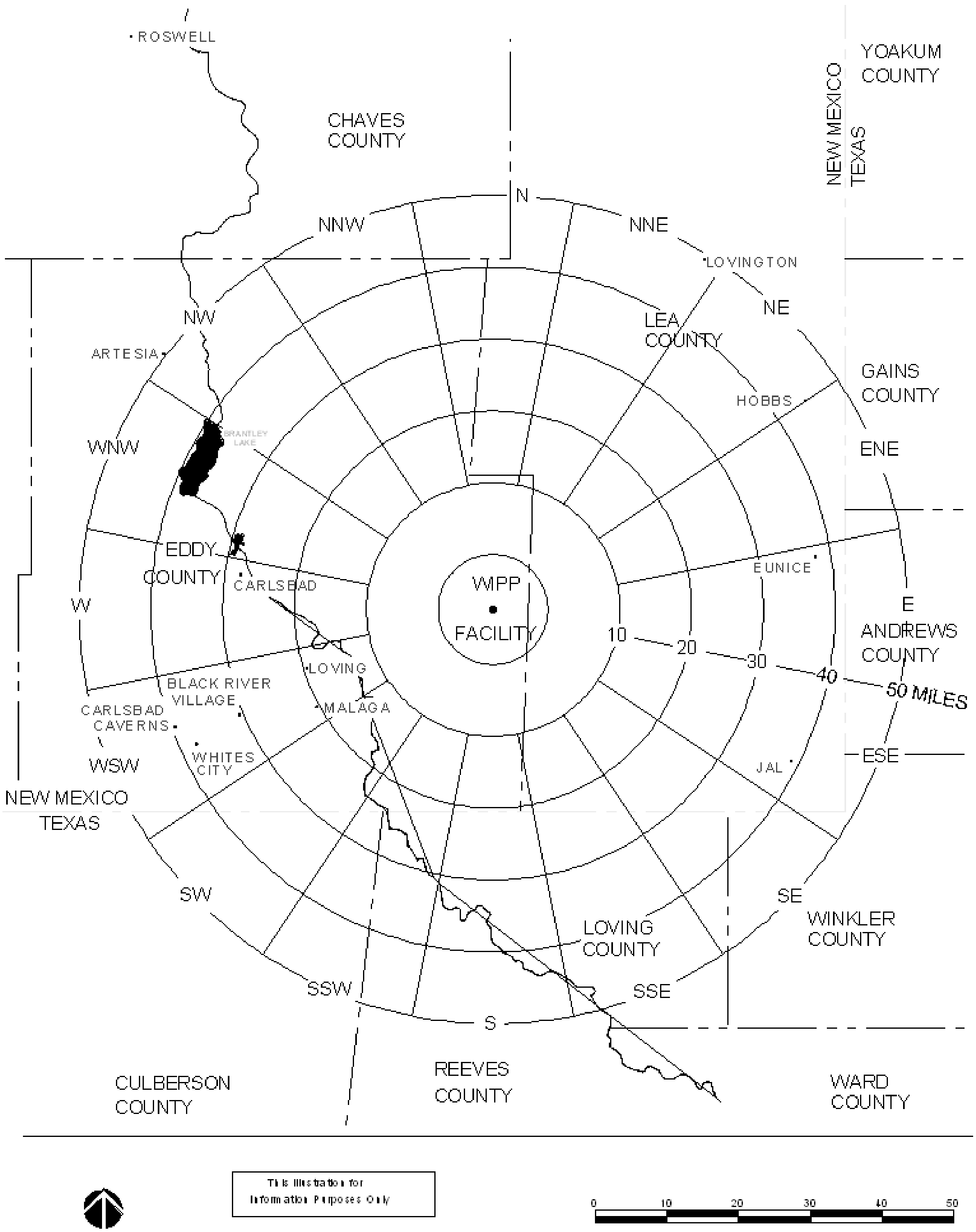
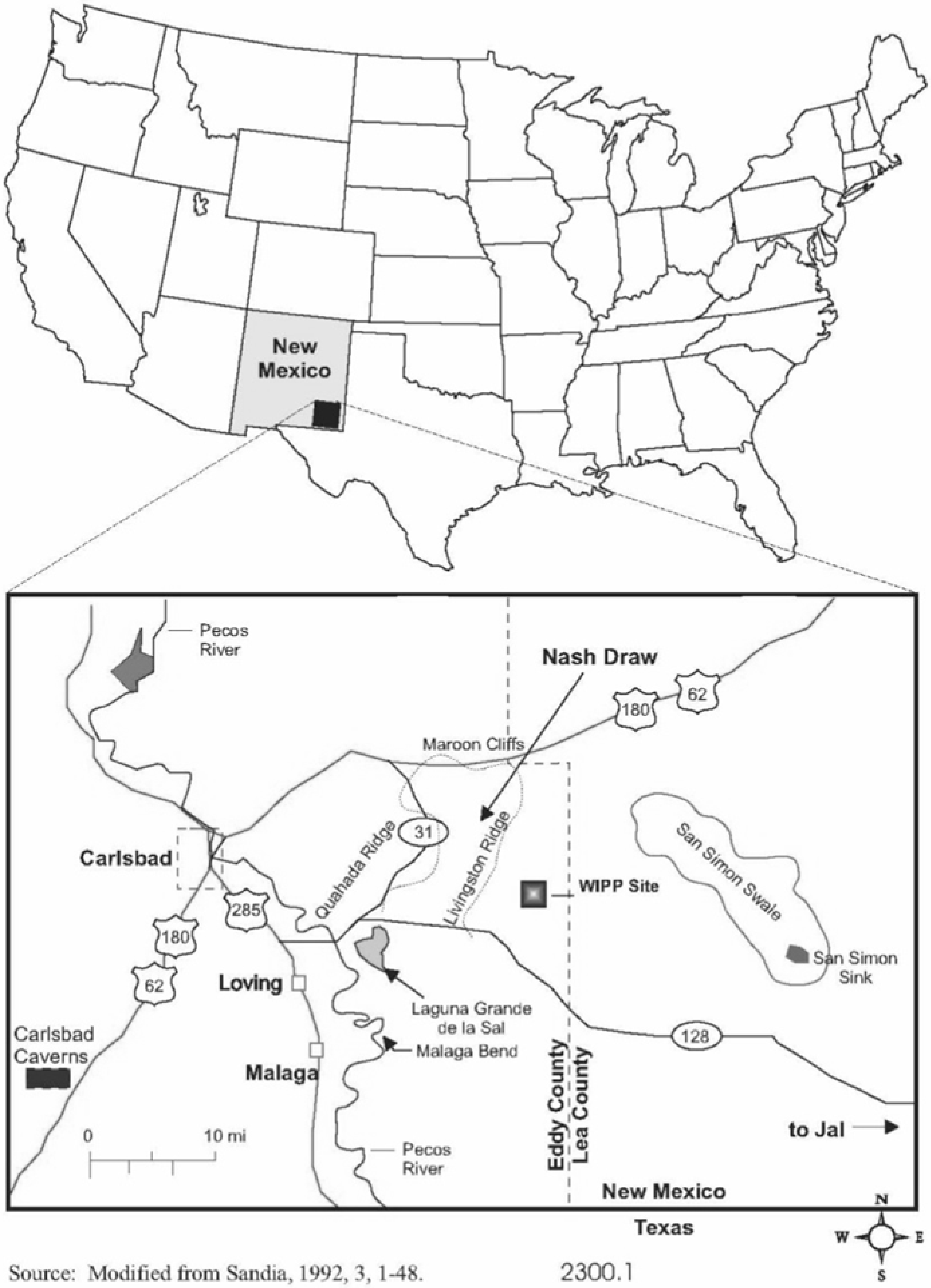


Figure 1.3-1. Region Surrounding the WIPP Site



Source: Modified from Sandia, 1992, 3, 1-48.

Figure 1.3-2. WIPP Location in Southeastern New Mexico

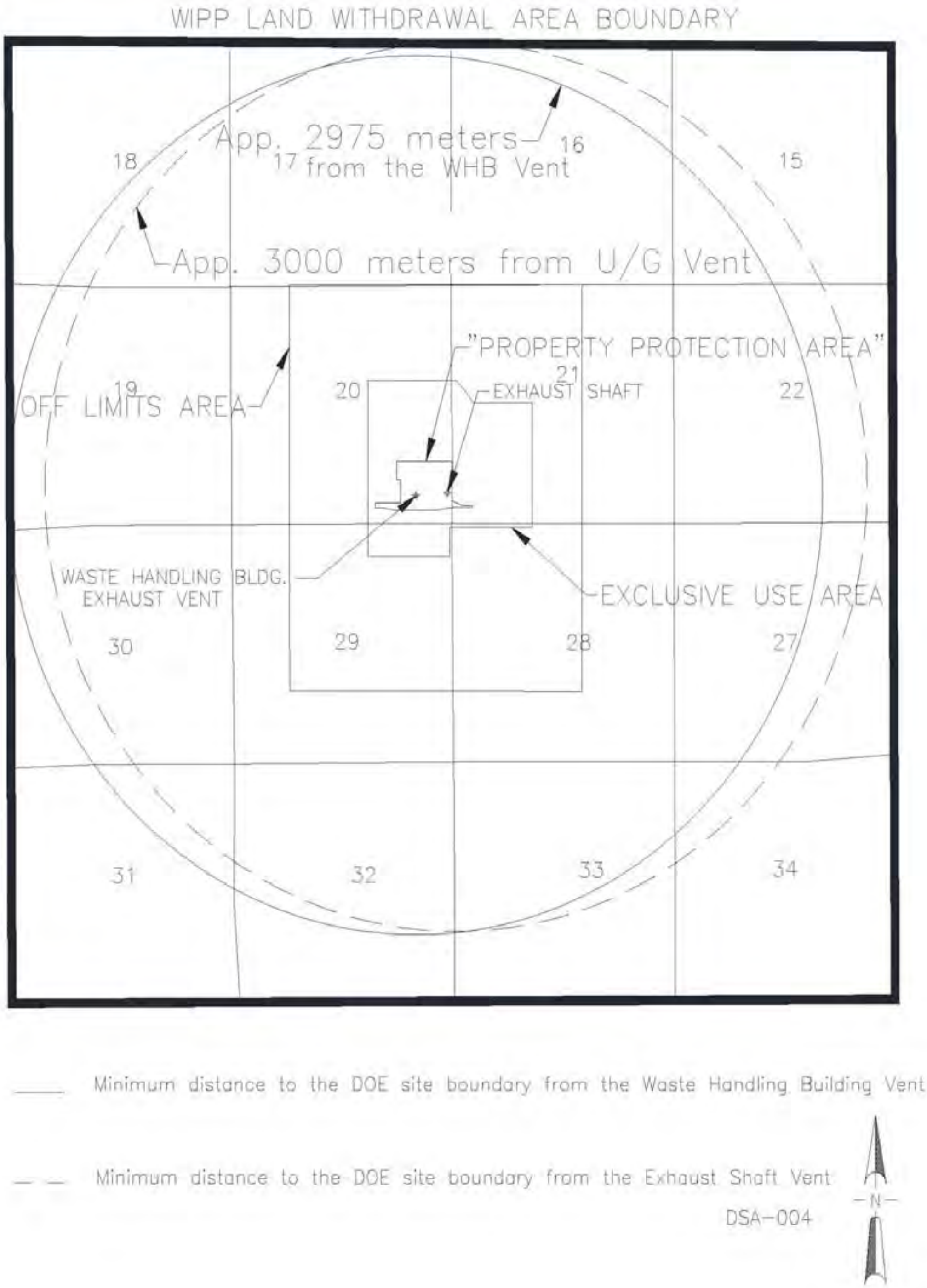


Figure 1.3-3. WIPP Site Boundary Area

1.4 ENVIRONMENTAL DESCRIPTION

1.4.1 Meteorological Conditions for Design and Operating Bases

The climate of the region is semiarid, with generally mild temperatures, low precipitation and humidity, and a high evaporation rate. Winds are mostly moderate and from the southeast. In late winter and spring, there are strong west winds and dust storms. During the winter, the weather is often dominated by a high-pressure system situated in the central portion of the western United States and a low-pressure system located in north-central Mexico. During the summer, the region is affected by a low-pressure system normally situated over Arizona (DOE/EIS-0026, *Final Environmental Impact Statement, Waste Isolation Pilot Plant*).

1.4.1.1 Precipitation Summary

Precipitation at the WIPP is light and unevenly distributed throughout the year, averaging 13 inches annually (NOAA 1976, *Climatological Data National Summary*). Winter is the season of least precipitation, averaging less than 0.6 inch of rainfall per month. Snow averages about 5 inches per year at the site and seldom remains on the ground for more than a day at a time due to the typically above-freezing temperatures in the afternoon. Approximately half the annual precipitation comes from frequent thunderstorms in June through September. Rains are usually brief, but occasionally intense, when moisture from the Gulf of Mexico spreads over the region (DOE/EIS-0026). The WIPP region has about one day of freezing rain or drizzle a year (Hull 1958, *Hail Size and Distribution*), during which an ice accumulation of 0.25 inch is typical.

At the time the WIPP site location was selected, the maximum recorded 24-hour rainfall near the WIPP site was 5.65 inches in Roswell during November 1901 (USDOC 1963, *Maximum Recorded United States Point Rainfall for 5 Minutes to 24 Hours at 207 First Order Stations*). The maximum recorded 24-hour snowfall was 15.3 inches in Roswell during December 1960. The heaviest recorded snowfall during a one-month period was 23.3 inches in Roswell during February 1905 (NOAA 1974, *Climates of the States*).

Based on the *Waste Isolation Pilot Plant Annual Site Environmental Report for 2013* (DOE/WIPP 14-3532), the total precipitation at the WIPP site for 2013 was 8.87 inches.

The 100-year recurrence maximum snowpack for the WIPP region is 10 pounds per square foot (lb/ft^2) (ANSI A58.1-1972, *Building Code Requirements for Minimum Design Loads in Buildings and Other Structures*). The probable maximum winter precipitation in the WIPP region is taken to be the probable maximum 48-hour precipitation during the winter months of December through February. The probable maximum winter precipitation for the WIPP region is estimated to be 12.8 inches of rain (i.e., 66 lb/ft^2) (USDOC 1956, *Seasonal Variations of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24 and 48 Hours*; HHFA 1956, *Snow Load Studies*). The snow load for the WIPP region is calculated (ground-level equivalent) to be 27 lb/ft^2. Specific roof loads are estimated based on American National Standards Institute (ANSI) methodology (ANSI A58.1-1972).The region has about 40 thunderstorm days annually. About 87.5 percent of these occur from May to September (USDOC 1963). A thunderstorm day is recorded if thunder is heard, but the thunderstorm record is not related to observations of rain or lightning and does not indicate the severity of storms in the region. Hail usually occurs in April through June and is not likely to develop more than three times a year. During a 39-year period at Roswell, hail was observed 97 times (about twice per year), occurring nearly two-thirds of the time between April and June (Hull 1958). For the 1 square degree (32 to 33 °N by 103 to 104 °W) surrounding the WIPP site, hailstones 0.75 inch and larger were reported eight times from 1955 to 1967 (slightly less than once per year). There were no significant hailstorms noted in DOE/WIPP 14-3532.

1.4.1.2 Tornadoes

For the period 1916 through 1958, 75 tornadoes were reported in New Mexico on 58 tornado days (USDOC 1960, *Tornado Occurrences in the United States*). Data for 1953 through 1976 indicate a statewide total of 205 tornadoes on 152 tornado days (NOAA 1976), or an average of 9 tornadoes per year on 6 tornado days. The greatest number of tornadoes in one year was 18 in 1972; the least was none in 1953. The average tornado density in New Mexico during this period was 0.7 per 1,000 square miles. Most tornadoes occur in May and June (Pautz 1969, *Severe Local Storm Occurrence, 1955–1967*). From 1955 through 1967, 15 tornadoes were reported within the 1 square degree containing the WIPP surface facility (Markee et al. 1974, *Technical Basis for Interim Regional Tornado Criteria*).

H.C.S. Thom has developed a procedure for estimating the probability of a tornado striking a given point (Thom 1963, "Tornado Probabilities"). The method uses a mean tornado path length and width and a site-specific frequency. Applying Thom's method to the WIPP yields a point probability of 0.00081 on an annual basis, or a recurrence interval of 1,235 years. An analysis by Fujita yields a point tornado recurrence interval of 2,832 years in the Pecos River Valley (Fujita 1978, *A Site-Specific Study of Wind and Tornado Probabilities at the WIPP Site in Southeast New Mexico*).

According to Fujita, the WIPP Design Basis Tornado (DBT) with a 1-million-year return period has a maximum wind speed of 183 miles per hour (mph), translational velocity of 41 mph, a maximum rotational velocity radius of 325 feet, a pressure drop of 0.5 pound per square inch (psi), and a pressure drop rate of 0.09 psi per second. There has never been a recorded tornado touchdown at WIPP.

1.4.1.3 Winds

The maximum one-minute wind speeds recorded at Roswell are shown in Table 1.4-1. The fastest one-minute wind ever recorded at Roswell was 75 mph from the west in April 1953 (USDOC 1968, *Weather Atlas of the United States* (originally titled *Climatic Atlas of the United States*)). Windstorms with speeds of 58 mph or more occurred 10 times during the period between 1955 and 1967 (USDOC 1968). The mean recurrence interval for annual high winds at 30 feet above the ground in southeastern New Mexico is shown in Table 1.4-2 (ANSI A58.1-1972; Thom 1963). The 100-year-recurrence 30-foot-level wind speed in southeastern New Mexico is 82 mph. Based on a gust factor of 1.3 (DGAF 140, *Relations between Gusts and Average Wind Speeds for Housing Load Determination*), the highest instantaneous gust expected once in 100 years at 30 feet is 107 mph. The vertical wind profile for a 100-year recurrence interval has been estimated from the 30-foot values and is presented in Table 1.4-2.

Table 1.4-1. Maximum Wind Speeds for Roswell, New Mexico

Month	Maximum Wind Speed (mph)	Month	Maximum Wind Speed (mph)
January	67	July	66
February	70	August	72
March	66	September	54
April	75	October	66
May	72	November	65*
June	73	December	72

Source: NOAA 1974.
* Occurred more than once.

Table 1.4-2. Recurrence Intervals for High Winds in Southeastern New Mexico

Recurrence Years	Speed (mph) at Elevations			
	30 feet	50 feet	100 feet	150 feet
2	58	62	65	73
10	68	73	81	86
25	72	77	86	91
50	80	86	95	101
100	82	88	97	103

Source: Sutton 1953, *Micrometeorology*.

The predominant wind direction at the WIPP site is from the southeast. The current revision of the *Documented Safety Analysis Unit Consequence Analysis* (WIPP-002) describes the wind speed data used for accident consequence calculations. The straight-line wind design is for 110 mph at 30 feet aboveground.

1.4.1.4 Dust Storms

Blowing dust or sand may occur in the region due to the combination of strong winds, sparse vegetation, and the semiarid climate. High winds associated with thunderstorms are frequently a source of localized blowing dust. Dust storms covering an extensive area occur occasionally and may reduce visibility to less than 1 mile. Winds of 50 to 60 mph and higher may persist for several days if the strongest pressure gradients, which are most likely to occur during winter and early spring, become stationary (NOAA 1974).

1.4.1.5 Temperature Summary

Temperatures are moderate throughout the year, although seasonal changes are distinct. The mean annual temperature in southeastern New Mexico is 63°F (17.2°C). In the winter (December through February), nighttime lows average near 23°F (−5°C), and daytime highs average about 55°F (12.7°C). The lowest recorded temperature at the nearest Class A weather station in Roswell was −29 °F (−33.8°C) in February 1905. In the summer, the daytime temperature exceeds 90°F (32.2°C) approximately 75 percent of the time (DOE/EIS-0026). On June 27, 1994, the National Weather Service documented a temperature of 122°F (50°C) at the WIPP site as the record high temperature for New Mexico. Based on *Waste Isolation Pilot Plant Annual Site Environmental Report for 2010* (DOE/WIPP 11-2225), the mean monthly temperatures for the WIPP in 2010 ranged from 82.04°F (23°C) during June and 42.04°F (5.58°C) in January. The lowest recorded temperature was 17.65°F (-7.97°C) in January and the maximum high temperature was 106.25°F (41.25°C) in June.

1.4.1.6 Site Meteorological Tower

The WIPP site meteorological tower and station is located 1,970 feet northeast of the WHB. The meteorological station measures and records wind speed, wind direction, and temperature at elevations of 6.5, 33, and 165 feet (2, 10, and 50 meters). The data are measured and recorded continually and then downloaded into a database in 15-minute averages. The data are validated and certified by a Certified Meteorologist, which is required for use for atmospheric dispersion calculations.

1.4.2 Hydrology

Surface and ground hydrology information is described in DOE/CAO 1996-2184. No major surface water bodies are located within 10 miles of the WIPP site. Several bodies of water, including Brantley Lake and Lake Carlsbad, are over 30 miles to the north of the WIPP site. Brantley Lake and Lake Carlsbad are at approximate elevations of 3,245 feet and 3,097 feet, respectively. The elevation of the WIPP surface is 3,410 feet above mean sea level; however, surface runoff from the WIPP site does not flow north. The Pecos River is about 12 miles west of the WIPP site at its closest point. In the vicinity of the WIPP site, there are limited occurrences of potable water and several water-bearing zones produce poor quality water. In the immediate vicinity of the WIPP site, groundwater above the Salado Formation is commonly of such poor quality that it is not usable for most purposes. There is shallow groundwater at the WIPP site. Hydrological characteristics of the WIPP site do not pose any operational safety hazards.

1.4.3 Geology

The land surface in the vicinity of the WIPP site is a semiarid, windblown plain sloping gently to the west and southwest. Its surface is characterized by an abundance of sand ridges and dunes. The average slope within a 3-mile radius is about 50 feet per mile from the east to west.

Some of the tectonic structures of the region are shown in Figure 1.4-1, with the hatched lines indicating boundaries between the Central Basin Platform, the Midland Basin, and the Delaware Basin and the solid lines indicating pre-Permian Age faults. Most of the large-scale structures, including the Central Basin Platform, the Midland Basin, and the Delaware Basin, developed from the late Pennsylvanian to early Permian time, about 270 million years ago.

The WIPP site is located in the Delaware Basin, a sub-basin of the Permian Basin about 60 miles east of the western margin of the Permian Basin. The geologic structure and tectonic pattern of the Permian Basin are chiefly the result of large-scale subsidence and uplift during the Paleozoic era (about 305 to 225 million years ago). The Permian Basin is divided into sub-basins that passed through their last stage of significant subsidence during the late Permian Age, about 230 million years ago.

All major tectonic elements of the Delaware Basin were essentially formed prior to deposition of the Permian evaporites, and the region has been relatively stable since then. Deep-seated faults are rare, except along the western and eastern basin margins, and there is no evidence of young, deep-seated faults inside the basin. A detailed description of the west Texas and southeast New Mexico geologic structures and tectonics is contained in a Sandia National Laboratories report (SAND 78-1596).

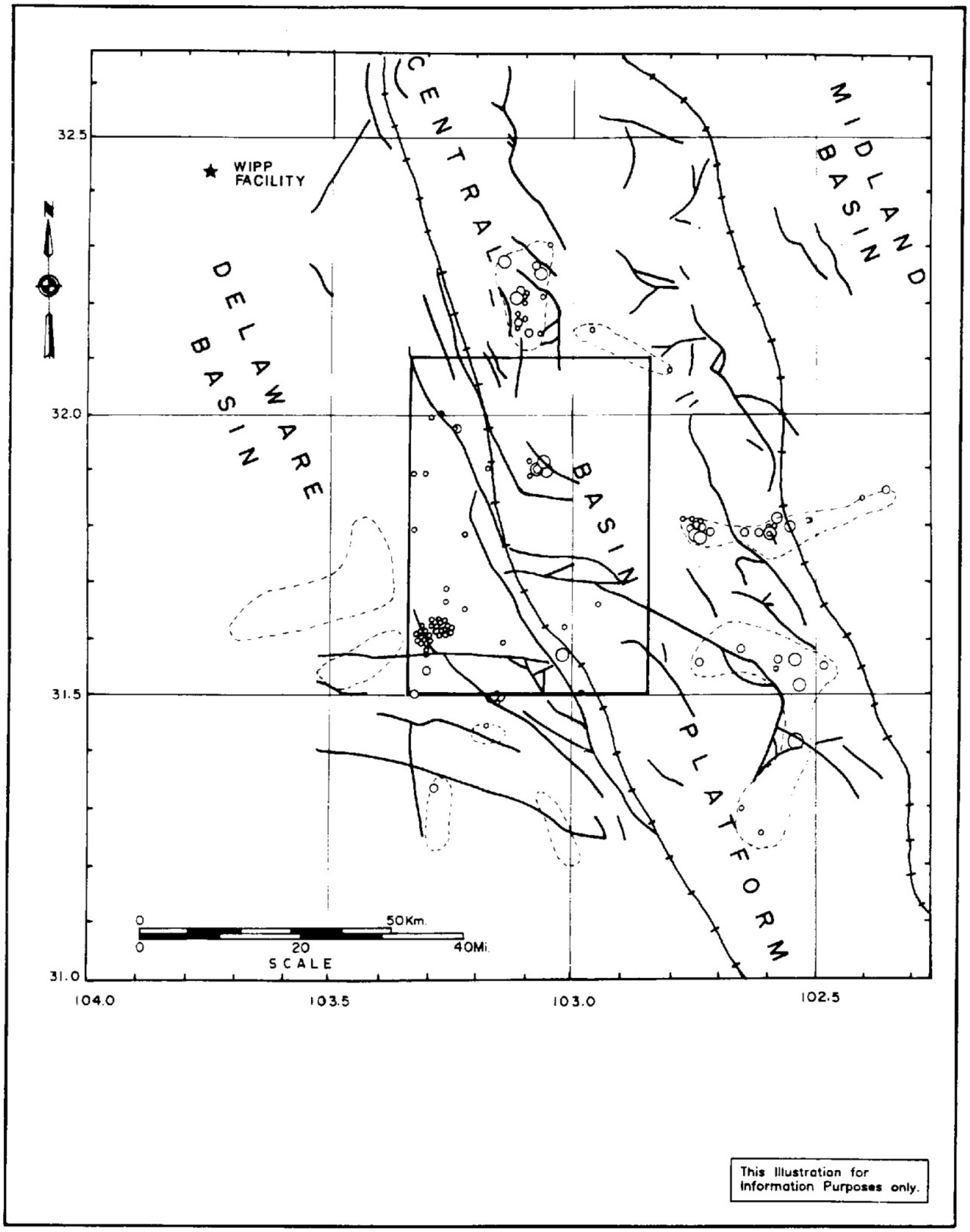


Figure 1.4-1. Tectonic Structures of Southeastern New Mexico

1.5 NATURAL EVENT ACCIDENT INITIATORS

1.5.1 Earthquakes

Tectonic activity was used as a siting criterion for the WIPP to ensure that faulting and igneous activity do not jeopardize waste isolation over the long term and to avoid areas where earthquakes could impact facility design and operations. The location of the WIPP site met both aspects of the siting tectonic activity criterion. Several seismic studies (Sanford and Toppozada 1974, *Seismicity of Proposed Radioactive Waste Disposal Site in Southeastern New Mexico*; Sanford et al. 1978, *Seismic Studies of the Los Medanos Area in Southeastern New Mexico*; and Sanford et al. 1980, *Seismicity in the Area of the Waste Isolation Pilot Project (WIPP)*) were conducted to predict ground motions that the site may be subjected to during its operational and long-term disposal phases.

This section discusses earthquake magnitude and intensity and the peak acceleration and recurrence interval that define the Design Basis Earthquake (DBE) for WIPP. In this section, earthquake magnitudes are reported in terms of the Richter scale, shown in Table 1.5-1, and intensities are based on the modified Mercalli intensity scale (Wood and Neumann 1931, "Modified Mercalli Intensity Scale of 1931") shown in Table 1.5-2. The results from this section are applied to the seismic design of the WIPP structures and equipment.

Table 1.5-1. Richter Scale

Magnitude	Description
Less than 2	Very seldom ever felt
2.0 to 3.4	Barely felt
3.5 to 4.2	Felt as a rumble
4.3 to 4.9	Shakes furniture; can break dishes
5.0 to 5.9	Dislodges heavy objects; cracks walls
6.0 to 6.9	Considerable damage to buildings
7.0 to 7.3	Major damage to buildings; breaks underground pipes
7.4 to 7.9	Great damage; destroys masonry and frame buildings
Above 8.0	Complete destruction; ground moves in waves

Table 1.5-2. Modified Mercalli Intensity Scale

Intensity	Description
I.	Not felt except by a very few under especially favorable circumstances.
II.	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III.	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like the passing of a truck. Duration estimated.
IV.	During the day, felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, and doors disturbed; walls make a cracking sound. Sensation like a heavy truck striking a building. Standing motor cars rock noticeably.
V.	Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI.	Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII.	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
VIII.	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars.
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.
XI.	Few, if any, structures (masonry) remain standing. Destroyed bridges, broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII.	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

Source: Wood and Neumann 1931.

1.5.1.1 Seismic History

Seismic history data are divided into two time frames: prior to and after the time when instrumented seismographic data for the region became available.

Seismic information for New Mexico prior to 1962 was not instrumented and was derived from chronicles of the effects of earthquakes on people, structures, and surface features. Seismic activity in New Mexico reported prior to 1962 was mostly limited to the Rio Grande Rift between Albuquerque and Socorro. The pre-1962 earthquake data indicate that 20 earthquakes with maximum reported intensities between III and VIII on the modified Mercalli intensity scale (Wood and Neumann 1931) have occurred within a 186-mile radius of the WIPP region from 1923 to 1960. With the exception of several weak shocks (reported in 1926, 1936, and 1949 and felt in Carlsbad), most known earthquakes prior to 1962 occurred to the west and southwest of the WIPP site more than 99 miles away. A listing of pre-1962 earthquakes can be found in Table 5.2-1 of the Sandia National Laboratories Geological Characterization Report for WIPP (SAND 78-1596).

Since 1962, seismograph data for New Mexico and the WIPP site has become comprehensive enough to locate the epicenters of the earthquakes occurring in the WIPP site region. Accelerometers were installed at the WIPP, one on the surface and one in the UG, in 1990. Two seismic events of magnitude 5.0 or greater on the Richter scale have occurred in the WIPP site region since 1962. The magnitude 5.0 Rattlesnake Canyon Earthquake occurred on January 2, 1992, with its epicenter 37 miles east–southeast of the WIPP site. The Marathon, Texas, earthquake, with a magnitude of 5.7, occurred on April 14, 1995. The Marathon Earthquake epicenter was 149 miles southeast of the WIPP site. At a distance of 149 miles, an event of magnitude 5.7 would produce a maximum acceleration at the WIPP site of less than 0.01 g. Neither earthquake had any effect on the WIPP structures and neither was detected by the two site accelerometers.

Seismic activity within 186 miles of the WIPP site is currently monitored by seismographs installed and operated by the New Mexico Institute of Mining and Technology (NMIMT). A network of nine seismograph stations (Figure 1.5-1) continuously monitors the seismographic activity occurring in eastern New Mexico. Data from each station are electronically transmitted to the NMIMT Seismological Observatory in Socorro, New Mexico. The recorded data are then compiled into a quarterly report on the seismicity of the WIPP site by the Geophysical Research Center of NMIMT and sent to NWP.

Based on the four quarterly reports for 2013, the largest seismic event recorded was a 2.5 magnitude event located about 173 miles northwest of the WIPP site. The closest seismic event recorded had a 1.1 magnitude and was located about 20 miles northwest of the site. The events did not produce a ground motion at the WIPP site larger than 0.01 g and had no observable effect on WIPP structures. A listing of earthquake occurrences including date, time, magnitude, and epicenter location can be found in the earthquake database maintained by the *Delaware Basin Drilling Surveillance Plan* (WP 02-PC.02).

1.5.1.2 Seismic Risk

The seismic risk analysis for the WIPP siting, completed in 1978, used procedures for the determination of earthquake probabilistic design parameters (WCEE 1966, “The Major Influences on Seismic Risk”; Cornell and Merz 1975, “A Seismic Risk Analysis of Boston”). In typical seismic risk analyses, the region of study is divided into seismic source areas such as the Central Basin Platform, Rio Grande Rift, and Delaware Basin. Future seismic events are considered equally likely to occur at any location within those areas. For each seismic source area, the rate of occurrence of events above a chosen threshold is estimated using the frequency of historical events. The sizes of successive events in each source are assumed to be independent and exponentially distributed. The maximum possible size of events for each source is determined using judgment and the historical record. All assumptions underlying a measure of earthquake risk derived from this type of analysis are explicit, and a wide range of assumptions may be employed in the analysis procedure.

Regional studies of earthquakes prior to 1972 in southeastern New Mexico indicate that most of the earthquakes occurred in the Central Basin Platform region near Kermit, Texas, and the area about 124 miles or more west and southwest of the WIPP site in the Rio Grande Rift. The strongest earthquake event was near Valentine, Texas, in 1931 and the closest was a 1972 magnitude 2.8 event with its epicenter 25 miles northwest of the WIPP site. The record from regional studies of events in the Rio Grande Rift is consistent with the record of Quaternary faulting in that area. Quaternary faults are geologic faults that have occurred within the last 3 million years or since the end of the Tertiary period.

Seismic instrument studies near the WIPP site since 1974 have recorded additional evidence of the seismic activity for the site and region. The data obtained are similar to that from regional studies where half of the events occur on the Central Basin Platform while most of the rest occur to the west and southwest of the site in the Rio Grande Rift. Some events occur in the general site region not in association with either the Central Basin Platform or the Rio Grande Rift.

The Central Basin Platform data showed that location as the most active seismic area within 186 miles of the WIPP site in terms of number of events. Seismic activity is equally likely to occur anywhere along the Central Basin Platform structure without regard to structural details such as pre-Permian buried faults. The lack of known Quaternary faults from the seismically active region of the Central Basin Platform indicates that large-magnitude earthquakes have not occurred within the recent geologic past in the area.

Analysis of the regional and local seismic data indicated that the 1,000-year acceleration is less than or equal to 0.06 g and the 10,000-year acceleration is less than or equal to 0.1 g. The WIPP geological characterization report (SAND 78-1596) contains the detailed seismic risk analysis performed for the WIPP siting.

1.5.1.3 Design-basis Earthquake

The term DBE is used for the design of surface confinement structures and components and is equivalent to the design earthquake used in *Guidance on the License Application, Siting, Design, and Plant Protection for an Independent Spent Fuel Storage Installation*, Regulatory Guide 3.24 (NRC 1974). The DBE is such that it produces ground motion at the WIPP site with a recurrence interval of 1,000 years.

From SAND 78-1596, the most conservative calculated estimate of the 1,000-year acceleration at the WIPP is 0.075 g. The geologic and seismic assumptions leading to this 1,000-year peak acceleration include the consideration of a Richter magnitude 5.5 earthquake at the site, a 6.0 magnitude earthquake on the Central Basin Platform, and a 7.8 magnitude earthquake in the Basin and Range sub-region. These magnitudes correspond roughly to equivalent epicentral intensity events of VII, VIII, and XI on the modified Mercalli intensity scale (Wood and Neumann 1931). These values, especially the first two, are considered quite conservative, and the other parameters used in the 0.075 g derivation are conservatively chosen. For additional conservatism, a peak design acceleration of 0.1 g is selected for the WIPP DBE. The design response spectra for vertical and horizontal motions are taken from *Design Response Spectra for Seismic Design of Nuclear Power Plants*, Regulatory Guide 1.60 (NRC 1973), with the high-frequency asymptote scaled to this 0.1 g peak acceleration value.

Mine experience and studies on earthquake damage to UG facilities (Pratt et al. 1978, *Earthquake Damage to Underground Facilities*) show that tunnels, mines, wells, etc., are not damaged for sites having peak accelerations at the surface below 0.2 g.

The DBE is the most severe credible earthquake that could occur at the WIPP site. DBE Structures, Systems, and Components (SSCs) are designed to withstand a free-field horizontal and vertical ground acceleration of 0.1 g, based on a 1,000-year recurrence period, and will retain their safety functions.

Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities (DOE-STD-1020-2012) provides that superseded standards are "…available for reference and use at existing facilities…" The WHB has been classified as Safety Significant (SS), therefore it is required to meet PC-2 criteria of *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities* (DOE-STD-1020-2002) which refers to International Building Code (IBC) 2000 for seismic criteria which establishes a 0.06 g seismic criteria for the WIPP site as documented in *Natural Phenomena Hazard Assessment of Waste Handling Building* (CALC-15-009).

WIPP is situated in a Uniform Building Code Seismic Zone 1 region. The WHB is designed to withstand a DBE with 0.1 g peak ground acceleration (PGA) with a 1,000-year return interval. The analysis is documented in *Plant Buildings, Facilities, and Miscellaneous Equipment System Design Description (SDD)* (SDD CF00-GC00).The original facility construction, designed to survive a 0.1 g PGA with a 1,000 year return period, is more robust when compared to the current PC-2 requirements for the WIPP geological location. The 2008 or the 2014 U.S. Geological Survey national hazard map shows that at the WIPP site (UBC Seismic Zone 1), a 0.1 g PGA would have approximately a 2500-year return interval. A 1,000-year return interval would require the WHB to survive a significantly lower PGA of approximately 0.06.

In June of 2009, a re-assessment of Natural Phenomena Hazard (NPH) was performed on the WHB in accordance with the applicable revision of DOE Order 420.1. The assessment verified no changes to NPH intensities and no significant changes in WHB SSCs.

The adjacent TRUPACT Maintenance Facility (TMF) is also constructed to withstand the 0.1 g DBE. The adjacent Support Building (office building) is designed so that its main lateral force resisting structural members prevent these structures from collapsing on the WHB during a DBE.

1.5.2 Design-basis Tornado

New Mexico has an average of nine tornadoes per year, with most occurring in May and June (Pautz 1969). Although tornados have occurred within the 1 square degree containing the WIPP surface facility, none have touched down at the WIPP site. See Section 1.4.1.2 for more information.

The DBT is the most severe credible tornado that could occur at the WIPP site. DBT SSCs at the WIPP site are designed to withstand 183 mph winds with a translational velocity of 41 mph, a maximum rotational velocity radius of 325 feet, a pressure drop of 0.5 psi, and a pressure drop rate of 0.09 psi per second generated by the DBT, based on a 1-million-year recurrence period, and will retain their safety function (Fujita 1978).

DOE-STD-1020-2012 provides that superseded standards are "…available for reference and use at existing facilities…" The WHB has been classified as SS, therefore it is required meet PC-2 criteria of DOE-STD-1020-2002 which refers to IBC 2000 for tornado criteria. IBC 2000 does not establish tornado criteria for the WIPP site as documented in CALC-15-009.

The tornado wind load characteristics of the DBT are based on the recommendations in MRP No. 155, *A Site-Specific Study of Wind and Tornado Probabilities at the WIPP Site in Southeast New Mexico*. The DBT characteristics were evaluated to be a tornado of 183 mph winds with a translational velocity of 41 mph, tangential velocity of 124 mph, a maximum rotational velocity radius of 325 feet, a pressure drop of 0.5 psi and a pressure drop rate of 0.09 psi per second, with a return period of 106 years.

In June of 2009, a re-assessment of NPH was performed on the WHB in accordance with the applicable revision of DOE Order 420.1. The assessment verified no changes to NPH intensities and no significant changes in WHB SSCs.

1.5.3 Design-basis Wind

Based on the discussion in Section 1.4.1.3, the design wind velocity for the WHB is 110 mph at 30 feet aboveground. The wind velocity selected, with a 1,000-year mean recurrence interval, is adopted from the results of a site-specific wind and tornado study (Fujita 1978). The design wind velocity exceeds the basic wind velocity specified in ANSI Standard A58.1-1972 for the geographical location of the WIPP facility.

The design wind velocity for other WIPP structures is 91 mph, with a 50-year mean recurrence interval, except for the Support Building and EFB, which is 99 mph with a 100-year mean recurrence interval.

DOE-STD-1020-2012 provides that superseded standards are "…available for reference and use at existing facilities…" The WHB has been classified as SS, therefore it is required to meet PC-2 criteria of DOE-STD-1020-2002 which refers to IBC 2000 for high wind criteria which establishes a 90 mph wind for the WIPP site as documented in CALC-15-009.

In June of 2009, a re-assessment of NPH was performed on the WHB in accordance with the applicable revision of DOE Order 420.1. The assessment verified no changes to NPH intensities and no significant changes in WHB SSCs.

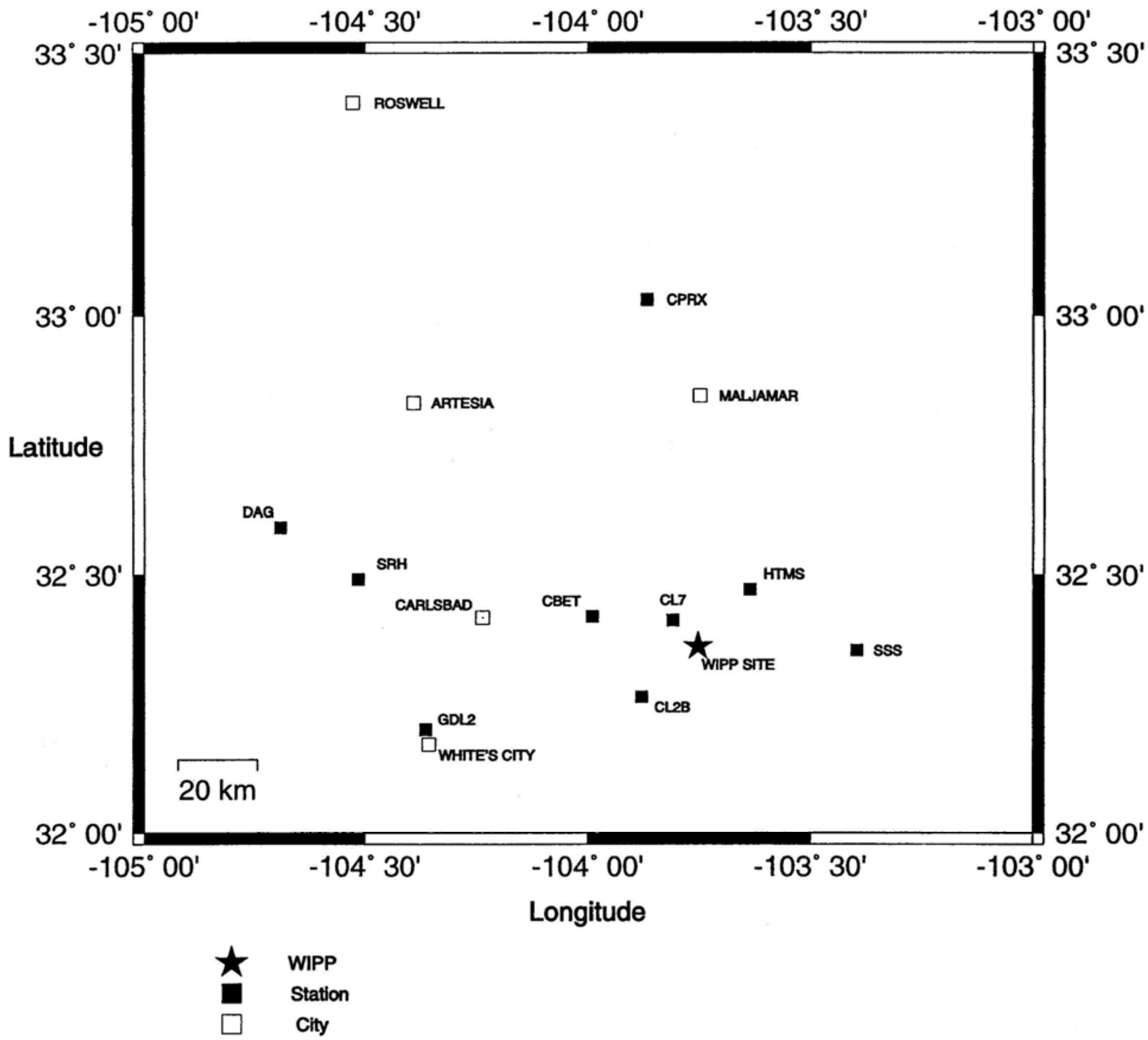
1.5.4 Design-basis Snow Loading

The WHB, including the TMF and Waste Hoist Tower, is designed for a snow load of 27 lb/ft^2.

The design snow load is based on the discussion in Section 1.4.1.1, and derived by using the 100-year-recurrence snow load of 10 lb/ft^2 specified in ANSI Standard A58.1-1972. Roof snow loads are calculated by multiplying the design snow load by the appropriate coefficients (C_s) specified in Figure 5, Figure 6, and Figure 7 of ANSI A58.1-1972.

DOE-STD-1020-2012 provides that superseded standards are "…available for reference and use at existing facilities…" The WHB has been classified as SS, therefore it is required to meet PC-2 criteria of DOE-STD-1020-2002 which refers to IBC 2000 for roof loading criteria. IBC 2000 does not establish roof loading criteria for the WIPP site as documented in CALC-15-009. The snow load characteristics were evaluated to be a maximum snowpack for the WIPP region of 10 lb/ft^2 with a 100-year recurrence interval. The WHB roof is designed to withstand 27 lb/ft^2. The ability for the WHB structure to withstand the design basis snow load is based on analyses identified in SDD CF00-GC00.

In June of 2009, a re-assessment of NPH was performed on the WHB in accordance with the applicable revision of DOE Order 420.1. The assessment verified no changes to NPH intensities and no significant changes in WHB SSCs.



Seismograph Stations:

CBET	Carlsbad East Tower	DAG	Dagger Draw
CL7	Carlsbad Station 7	GDL2	Guadalupe Mountains
CL2B	Carlsbad Station 2B	HTMS	Hat Mesa
CPRX	Caprock	SSS	San Simon Swale
SRH	Seven Rivers Hills		

Figure 1.5-1. Seismograph Stations in the WIPP Network

1.6 MAN-MADE EXTERNAL ACCIDENT INITIATORS

1.6.1 Gas Pipeline Explosion

Mining, mined material processing, and oil- and gas-related activities are the commercial operations within 5 miles of the WIPP site. There are three potash mines and three chemical processing plants (adjacent to the mines) within 5 to 10 miles of the WIPP site.

Activities associated with oil and gas exploration, production, and transportation present the most likely man-made external accident initiators to the WIPP site due to their proximity. Figure 1.6-1 shows the location and related information of each pipeline within 5 miles of the site. There are no crude oil pipelines within 5 miles of the WIPP site; however, there are four natural gas pipelines in the vicinity of the site. One pipeline is within the WIPP site boundary, oriented northeast to southwest, and is about 1.2 miles north of the center of the WIPP surface structures at its closest point.

The three potash mines and three potash chemical processing plants located between 5 and 10 miles of the WIPP site do not present a hazard to the WIPP operations.

1.6.2 Aircraft Crash

1.6.2.1 Military Facilities

There are no military facilities within a 5-mile radius of the WIPP site boundary. Holloman Air Force Base is the nearest military facility to the WIPP site and is located 138 miles to the northwest. There are two Military Operations Areas shown on Figure 1.6-2. Both Military Operations Areas are greater than 30 miles from the WIPP and have no impact on the facility.

1.6.2.2 Airports and Aviation Routes

There are no commercial airports within a 10-mile radius of the WIPP site boundary. The nearest commercial airport is Cavern City Air Terminal, 28 miles west of the WIPP site in Carlsbad. Other airports in the area include the following:

- Eunice, 32 miles east.
- Hobbs, 42 miles northeast.
- Jal, 40 miles southeast.
- Lovington, 50 miles northeast.
- Artesia, 51 miles northwest.

The relationship of these airports to the WIPP site is shown in Figure 1.6-2. The figure also shows the historic airways applicable to WIPP during the siting and design phase.

An estimate of aircraft impact frequency and consequences at the WIPP site was performed in August 2000 and documented flight information based on input from local Carlsbad airport data, military data, and Federal Aviation Administration data. Commercial and general aviation flights into the Carlsbad Airport totaled 3,924 flights per year. Military flights prior to October 2000 were about 965 flights per year and were expected to drop due to changes in U.S. Air Force training plans.

The estimate summarized Federal Aviation Administration information that included air traffic data and flight patterns for military, commercial, and private aircraft within a 5-mile radius of the WIPP site. The data indicated little air traffic over the WIPP site, with heavier air traffic to the south and west. The proximity of the WIPP site to the United States southern border serves to limit north–south air traffic. The restricted airspace associated with the White Sands Missile Range to the west of the WIPP site causes east–west traffic to preferentially fly to the north or south of the site. The highest number of flights recorded in the data provided was 35 flights in 26 hours, which was an increase over the nominal 30 flights per day during the design phase of the WIPP site. Using the guidance in *Accident Analysis for Aircraft Crash into Hazardous Facilities* (DOE-STD-3014-1996), the calculated frequency of an aircraft impacting the WIPP site (WIPP-008, *Estimate of Aircraft Crash Frequency at the Waste Isolation Pilot Plant*) was 3.6×10^{-7}/year, indicating that the WIPP site's remote location and its proximity to the nearest airport protects it from the effects of aircraft crashes.

DOE-STD-3014-1996 was reaffirmed in 2006. An updated aircraft crash frequency report (WIPP-008) documented the application of the DOE standard to assess the frequency and consequences of an aircraft crash at the WIPP site. Because local aircraft traffic associated with Carlsbad airport is outside the range of significant take-off and landing crash frequency and did not contribute to a hazardous release from the WIPP site, the frequency estimate (WIPP-008) was based on other data as allowed by the standard (DOE-STD-3014-1996). The data used in WIPP-008 were based on non-airport crash data from the following sources:

- Generic continental United States data for commercial and military aircraft categories as provided in DOE-STD-3014-1996.
- Site-specific data for the general aviation aircraft category.
- Site-specific data for the helicopter category.

Using the standard guidance for non-airport operations, the aircraft impact frequency is 9.5×10^{-7}/year, which is below the screening guideline in DOE-STD-3014-1996. Because the frequency of an aircraft crash is below the screening guideline, the potential consequences from an aircraft crash need not be further considered for this Documented Safety Analysis (DSA).

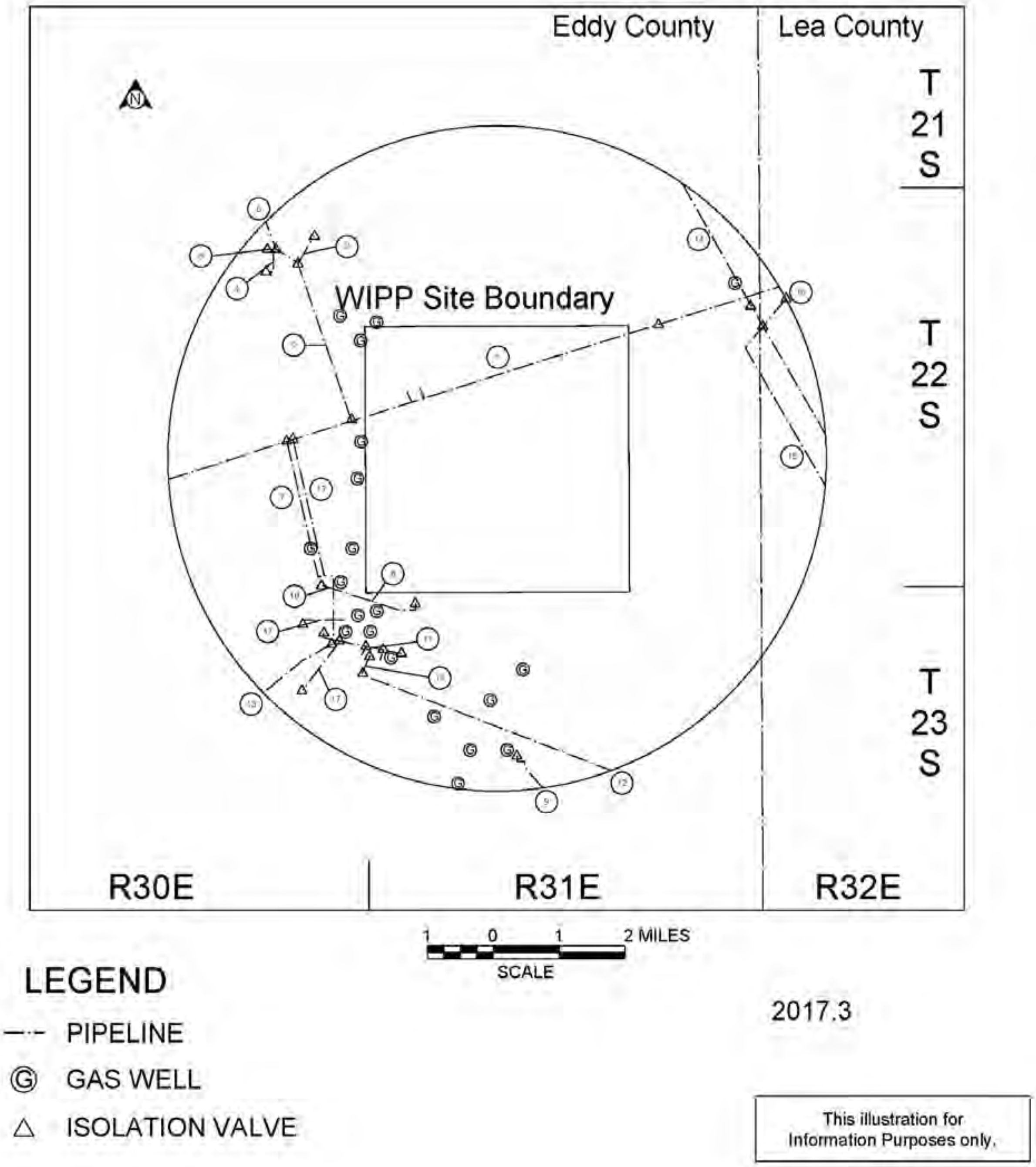


Figure 1.6-1. Natural Gas Pipelines and Wells within a 5-mile Radius of the WIPP Site

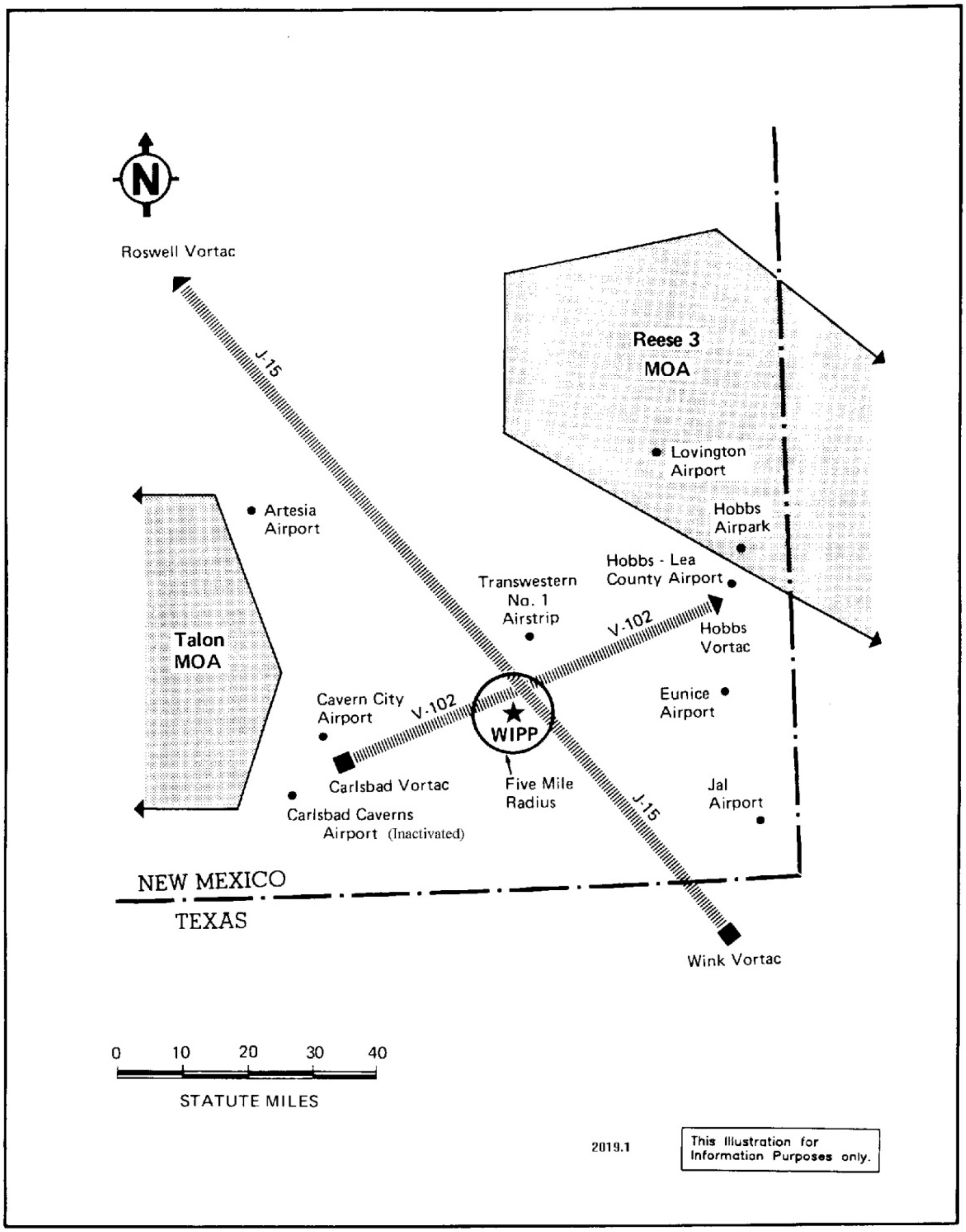


Figure 1.6-2. Airports and Aviation Routes adjacent to the WIPP Site

1.7 NEARBY FACILITIES

1.7.1 Extractive Activities

Within a 5-mile radius of the center of the LWA Area, both oil and gas are extracted below the Salado Formation. The majority of the newer wells produce oil and gas from the Brushy Canyon Formation of the Delaware Mountain Group. Gas wells typically produce from the deeper Pennsylvanian formations (Atoka, Strawn, and Morrow). There are approximately 832 oil wells (some that produced both oil and gas), 56 gas wells, and 80 plugged wells within 5 miles of the WIPP site boundary. The oil and gas well production zone is below the repository horizon (2,150 feet). There are an additional 410 oil wells, 21 gas wells, and 100 plugged wells within 10 miles of the WIPP site boundary (Figure 1.7-1). The plugged wells include wells that are considered dry holes and wells that are no longer productive. Injection wells, salt water disposal wells, and drilling wells that appear in Figure 1.7-1 are not included in the totals previously cited.

Besides the oil- and gas-producing wells, there are three active potash mines within 10 miles of the WIPP site boundary. Potash is extracted from the McNutt Potash member, which is above the WIPP repository horizon.

1.7.2 Farming and Ranching

There are approximately 300 ranches with nominally 2.6 million acres in Eddy County and 2.8 million acres in Lea County, with a nominal 100,000 to 150,000 head of livestock (USDA 2008, *New Mexico Agricultural Statistics*).

In the Carlsbad Resource Area, 160,000 acres are used for farming. The principal farm crops include cotton, alfalfa, sorghum grains, and pecans.

1.7.3 Tourism and Recreation

Recreational opportunities in the area of the WIPP site include boating, hunting, camping, horseback riding, hiking, watching wildlife, and sightseeing.

There are two national parks (Carlsbad Caverns and Guadalupe Mountains), a national forest (Lincoln), and two state parks (Living Desert Zoo and Gardens, and Brantley) located within or near Carlsbad. Carlsbad Caverns National Park, 36 miles southwest of the WIPP site, has several hundred thousand visitors per year.

1.7.4 Waterways

There are no navigable waterways within a 5-mile radius of the WIPP site. The nearest river is the Pecos River, 12 miles west of the WIPP site.

1.7.5 Land Transportation

1.7.5.1 Roads and Highways

Other than the highways that provide north or south access, only one other highway lies within a 5-mile radius of the WIPP site. New Mexico Highway 128, which is about 4.5 miles southwest of WIPP (Figure 1.3-2), connects Jal with Highway 31. Highway 128 is used by the public, ranchers, school buses, potash miners, and oil field production/exploration equipment and vehicles. Other non-hard surfaced roads in the area are used for ranching, oil field exploration, production, maintenance equipment, and other vehicles.

1.7.5.2 Railroads

Except for the inactive rail spur on the WIPP site, there are no railroads within a 5-mile radius of the site. There are railroads that service the Mosaic Corporation Main Plant and Nash Draw operation and Intrepid Mining LLC. The nearest active railroad is 10 miles from the WIPP site. The railroad lines within the general vicinity of the WIPP site are used specifically to transport potash.

1.7.6 Projected Industrial Growth

Oil and gas exploration and production and associated support industries are the only significant economic activity forecast for the future within 5 miles of the WIPP site. Active potash mining is conducted within 10 miles of the site. No extractive activity is allowed within the LWA Area, with the exception of Section 31 (the southwest corner section of the LWA Area). One gas well, referred to as James Ranch 13, is producing from that section from a zone below the 6,000-foot LWA designation. This well was slant drilled from Section 6 of Township 23 South 31 East. There are also six oil wells that have been horizontally drilled from Section 36 of Township 22 South 30 East. Other permit applications for slant drilling into Section 31 from outside sections have been denied by the BLM. The other 15 sections of the LWA Area are withdrawn to the center of the earth.

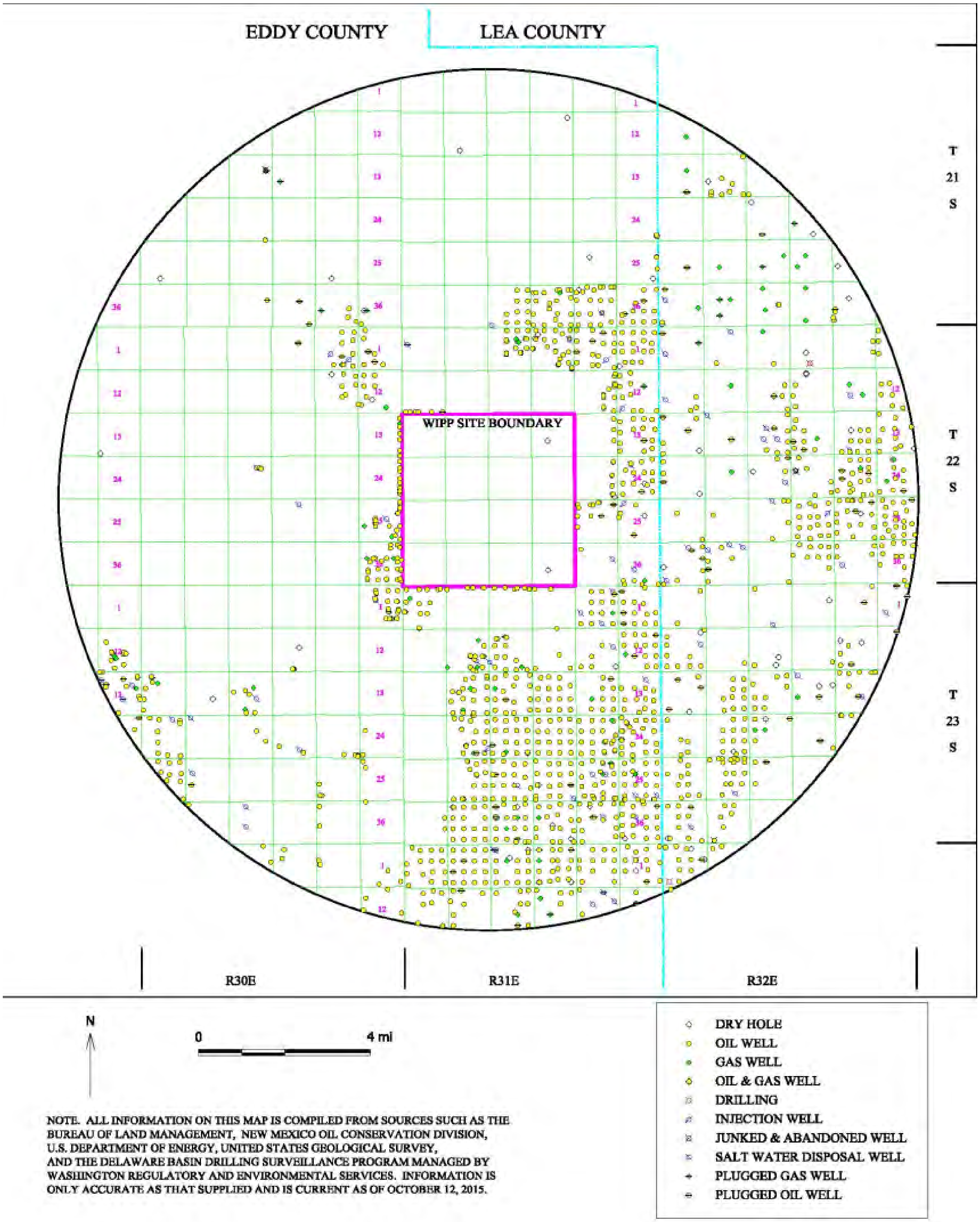


Figure 1.7-1. Natural Gas and Oil Wells within a 10-Mile Radius of the WIPP Site

1.8 VALIDITY OF EXISTING ENVIRONMENTAL ANALYSIS

Departmental Sustainability (DOE Order 436.1) describes the DOE's commitment to environmental protection and pledges to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources. The DOE conducts effluent monitoring and environmental surveillance to verify that the public and the environment are protected during the WIPP operations, and to ensure that operations comply with applicable federal and state requirements.

The WIPP Annual Site Environmental Report that is produced for each calendar year provides a description of the WIPP environmental monitoring program and the results of that monitoring. Based on environmental reports generated since the WIPP was constructed, there have been no environmental events that challenge the design basis for the WIPP site.

1.9 REFERENCES

46 FR 9162, 1981, "Record of Decision," *Federal Register*, Vol. 46, p. 9162 (January 23, 1981).

48 FR 31038, 1983, "Public Land Order 6403," *Federal Register*, Vol. 48, p. 31038 (July 6, 1983).

55 FR 25689, 1990, "Record of Decision," *Federal Register*, Vol. 55, p. 25689 (June 22, 1990).

7 USC 1010-1012, *Bankhead-Jones Farm Tenant Act of 1937*, et seq.

43 USC 315, *Taylor Grazing Act of 1934*, et seq.

43 USC 1701-1782, *Federal Land Policy and Management Act of 1976*, et seq.

43 USC 1904, *Public Rangelands Improvement Act of 1978*, et seq.

ANSI A58.1-1972, *Building Code Requirements for Minimum Design Loads in Buildings and Other Structures*, Revision of A58.1-1955, American National Standards Institute Inc., New York, NY.

CALC-15-009, *Natural Phenomena Hazard Assessment of Waste Handling Building*, September 2015, Revision 0, Nuclear Waste Partnership LLC, Carlsbad, NM.

Cornell, C.A., and H.A. Merz, 1975, "A Seismic Risk Analysis of Boston," *Journal of the Structural Division, American Society of Civil Engineering*, October 1975, Vol. 101, No. 10, pp. 2027–2043.

DGAF 140, 1946, *Relations between Gusts and Average Wind Speeds for Housing Load Determination*, Daniel Guggenheim, Airship Institute, Cleveland, OH.

DOE/CAO 1996-2184, *Title 40 CFR 191 Compliance Certification Application for the Waste Isolation Pilot Plant*, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM.

DOE/EIS-0026, *Final Environmental Impact Statement, Waste Isolation Pilot Plant*, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE Guide 420.1-1, 2000, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide*, March 28, 2000, U.S. Department of Energy, Washington, DC.

DOE Order 420.1, *Facility Safety*, applicable revision, U.S. Department of Energy, Washington, DC.

DOE Order 430.1, *Life Cycle Asset Management*, applicable revision, U.S. Department of Energy, Washington, DC.

DOE Order 436.1, 2011, *Departmental Sustainability*, May 2, 2011, U.S. Department of Energy, Washington, DC.

DOE Order 6430, 1981, *General Design Criteria Manual for Department of Energy Facilities*, Draft (superseded), June 10, 1981, U.S. Department of Energy, Washington, DC.

DOE-STD-1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*. U.S. Department of Energy, Washington, DC.

DOE-STD-1020-2012, 2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, October 3, 2012, U.S. Department of Energy, Washington, DC.

DOE-STD-3014-1996, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, Reaffirmed May 2006, U.S. Department of Energy, Washington, DC.

DOE/WIPP 93-004, *Waste Isolation Pilot Plant Land Management Plan*, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE/WIPP 11-2225, 2011, *Waste Isolation Pilot Plant Annual Site Environmental Report for 2010*, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE/WIPP 14-3532, 2014, *Waste Isolation Pilot Plant Annual Site Environmental Report for 2013*, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE and BLM, 1994, "Memorandum of Understanding between the U.S. Department of Energy and the U.S. Department of the Interior, Bureau of Land Management," July 19, 1994, U.S. Department of Energy, Washington, DC.

Fujita, T.T., 1978, *A Site-Specific Study of Wind and Tornado Probabilities at the WIPP Site in Southeast New Mexico*, SMRP Research Paper No. 155, Satellite & Mesometeorology Research Project, Department of the Geophysical Sciences, University of Chicago, Chicago, IL.

HHFA, 1956, *Snow Load Studies*, Housing and Home Finance Agency, Office of the Administrative Division of Housing Research, Washington, DC.

Hull, B.B., 1958, *Hail Size and Distribution*, Accession Number AD0157400, February 1958, U.S. Army, Quartermaster Research and Engineering Command, Natick, MA.

Markee, E.H., Jr., J.G. Beckerly, and K.E. Sanders, 1974, *Technical Basis for Interim Regional Tornado Criteria*, WASH-1300, May 1974, U.S. Atomic Energy Commission, Office of Regulation, Washington, DC.

MRP No. 155, Mesometeorology Research Project, Fujita, T.T., *A Site-Specific Study of Wind and Tornado Probabilities at the WIPP Site in Southeast New Mexico*. 43 pp. February 1978, Lubbock, TX.

NOAA, 1974, *Climates of the States*, Vol. 2, "Western States," Roswell, New Mexico, U.S. National Oceanic and Atmospheric Administration, Water Information Center, Port Washington, NY.

NOAA, 1976, *Climatological Data National Summary,* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, MD.

NRC, 1973, *Design Response Spectra for Seismic Design of Nuclear Power Plants*, Regulatory Guide 1.60, Revision 1, December 1973, U.S. Nuclear Regulatory Commission, Washington, DC.

NRC, 1974, *Guidance on the License Application, Siting, Design, and Plant Protection for an Independent Spent Fuel Storage Installation*, Regulatory Guide 3.24, December 1974, U.S. Nuclear Regulatory Commission, Washington, DC.

Pautz, M.E., 1969, *Severe Local Storm Occurrence, 1955–1967*, Environmental Sciences and Services Administration Technical Memorandum WBTM FCST12, U.S. Department of Commerce, Washington, DC.

Pratt, H.R., W.A. Hulstrulid, and D.E. Stephenson, 1978, *Earthquake Damage to Underground Facilities*, DP-1513, November 1978, Savannah River Laboratory and Terra Tek, Published by Savannah River Laboratory and U. S. Department of Energy, Aiken, SC.

Public Law 94-580, *Solid Waste Disposal Act of 1976*, 42 USC 7001, et seq.

Public Law 96-164, 1979, *U.S. Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980,* et seq., December 29, 1979.

Public Law 102-579, 1992 (1996), *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, et seq., October 30, 1992 (as amended by Public Law 104-201, September 23, 1996).

SAND 78-1596, 1978, *Geological Characterization Report, Waste Isolation Pilot Plant Site, Southeastern New Mexico*, December 1978, Sandia National Laboratories, Albuquerque, NM.

Sanford, A., S. Sanford, F. Caravella, L. Merritt, J. Sheldon, and R. Ward, 1978, *Seismic Studies of the Los Medanos Area in Southeastern New Mexico*, New Mexico Institute of Mining and Technology, Socorro, NM.

Sanford, A., S. Sanford, T. Wallace, J. Sheldon, R. Ward, S. Johansen, and L. Merritt, 1980, *Seismicity in the Area of the Waste Isolation Pilot Project (WIPP),* SAND 80-7096, January 1980, Sandia National Laboratories, Albuquerque, NM.

Sanford, A.R., and T.R. Toppozada, 1974, *Seismicity of Proposed Radioactive Waste Disposal Site in Southeastern New Mexico*, Circular 143, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

SDD CF00-GC00, *Plant Buildings, Facilities, and Miscellaneous Equipment System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

Sutton, O.G., 1953, *Micrometeorology,* McGraw-Hill Book Co., Inc., New York, NY, p. 238.

Thom, H.C.S., 1963, "Tornado Probabilities," *Monthly Weather Review,* October 1963, Vol. 91, Issue 10, pp. 730–736.

USDA, 2008, *New Mexico Agricultural Statistics*, U.S. Department of Agriculture, New Mexico Agricultural Statistics Service, Las Cruces, NM.

USDOC, 1956, *Seasonal Variations of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24 and 48 Hours*, Weather Bureau Hydrometeorological Report No. 33, April 1956, U.S. Department of Commerce, Washington, DC.

USDOC, 1960, *Tornado Occurrences in the United States*, Weather Bureau Technical Paper No. 20, July 1960, U.S. Department of Commerce, Washington, DC.

USDOC, 1963, *Maximum Recorded United States Point Rainfall for 5 Minutes to 24 Hours at 207 First Order Stations*, Weather Bureau Technical Paper No. 2, U.S. Department of Commerce, Washington, DC.

USDOC, 1968, *Weather Atlas of the United States* (originally titled *Climatic Atlas of the United States*) (1975 reprint of the 1968 Edition reprinted by the U.S. Environmental Data Service and Gale Research Co., Detroit, MI), U.S. Department of Commerce, Washington, DC.

USDOC, 2010, *Census of Population and Housing*, Census Bureau, U.S. Department of Commerce, Washington, DC.

WCEE, 1966, "The Major Influences on Seismic Risk," *Proceedings of the Third World Conference on Earthquake Engineering*, Vol. A-I, Santiago, Chile.

WIPP-002, *Documented Safety Analysis Unit Consequence Analysis*, Revision 2, November 2011, Washington TRU Solutions, LLC, Carlsbad, NM.

WIPP-008, 2008, *Estimate of Aircraft Crash Frequency at the Waste Isolation Pilot Plant*, Revision 1, September 2008, Washington TRU Solutions, LLC, Carlsbad, NM.

Wood, H.O., and F. Neumann, 1931, "Modified Mercalli Intensity Scale of 1931," *Bulletin of the Seismology Society of America*, Vol. 21, pp. 277–283.

WP 02-PC.02, 2008, *Delaware Basin Drilling Surveillance Plan*, Revision 6, Effective December 3, 2014, Nuclear Waste Partnership, LLC, Carlsbad, NM.

This page intentionally left blank

Table of Contents

List of Tables

List of Figures

2.0 FACILITY DESCRIPTION

2.1 INTRODUCTION

The purpose of this chapter is to provide descriptions of the WIPP facility and processes to support assumptions used in the hazard and accident analyses. This chapter discusses design and safety criteria for Structures, Systems, and Components (SSCs) that protect the public, workers, and the environment from hazards posed by the WIPP Transuranic (TRU) Mixed Waste disposal operations. TRU Waste with a radiation level of less than 200 millirem (mrem) per hour at the surface of the Waste Container is Contact-Handled (CH) Waste. Remote-Handled (RH) TRU Waste has a radiation level of equal to or greater than 200 mrem per hour, but less than 1,000 rem per hour. This chapter also describes the SSCs that support CH and RH Waste Handling processes.

This chapter is organized as follows:

- Requirements (Section 2.2).
- Facility Overview (Section 2.3).
- Facility Structure (Section 2.4).
- Remote-Handled Waste Handling Equipment and Process Description (Section 2.5).
- Contact-Handled Waste Handling Equipment and Process Description (Section 2.6).
- Confinement Systems (Section 2.7).
- Safety Support Systems (Section 2.8).
- Utility Distribution Systems (Section 2.9).
- Auxiliary Systems and Support Facilities (Section 2.10).
- References (Section 2.11).

2.1.1 The Two Incidents at WIPP in February 2014

Operations were suspended at WIPP on February 5, 2014, following a fire involving an Underground (UG) vehicle. Nine days later, on February 14, 2014, a radiological event occurred in the UG, contaminating a portion of the mine primarily along the exhaust ventilation path from the location of the incident, releasing a small amount of contamination into the environment.

Potentially Inadequate Safety Analyses (PISAs) were declared for both the UG vehicle fire and the radiological event. Unreviewed Safety Question (USQ) determinations associated with the PISAs were positive and, in accordance with Title 10 of the *Code of Federal Regulations* (CFR) Section 830.203, “Unreviewed Safety Question Process,” and U.S. Department of Energy (DOE) Guide 424.1-1B, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*, a number of Evaluations of the Safety of the Situation were submitted to DOE over a period of time that reflected the current understanding of the situation and its impact on the safety basis along with appropriate controls. Implementation of this revision to the Documented Safety Analysis (DSA) supersedes all previous Evaluations of the Safety of the Situation.

The WIPP management and operations contractor, Nuclear Waste Partnership LLC (NWP), has finalized corrective action plans for both the UG fire and the radiological release. Major changes include operation in Filtration Mode as normal and enhancements to fire protection, emergency management, and other facility programs. The details of the corrective action plans are outlined in the *Waste Isolation Pilot Plant Recovery Plan*. Decontamination activities, including encapsulation, have taken place to support continued UG operations.

2.2 REQUIREMENTS

The WIPP surface facilities were designed and constructed according to the *General Design Criteria Manual for Department of Energy Facilities* (DOE Order 6430), draft, dated June 10, 1981, and codes and standards applicable at the time of construction. Facility design modifications initiated between the issuance of DOE Order 6430 and DOE Guide 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide*, were designed in accordance with DOE Order 6430 and the codes and standards applicable at the time of modification.

New designs or modifications must meet the requirements of *Facility Safety* (DOE Order 420.1C) and *Real Property Asset Management* (DOE Order 430.1B) and the codes and standards in *Nonreactor Nuclear Safety Design Criteria for use with DOE O 420.1C, Facility Safety* (DOE Guide 420.1-1A). Codes and standards from DOE Guide 420.1-1A are applicable to the WIPP safety SSCs. In addition, the design and construction of the UG structures, mining equipment, ventilation, and facilities including the shafts, hoists, and conveyances are governed, where applicable, by 30 CFR 57, "Safety and Health Standards – Underground Metal and Nonmetal Mines" in accordance with the 2014 Memorandum of Understanding between the DOE and the Mine Safety and Health Administration (MSHA).

SSCs for the original WIPP design were classified as Design Class I, II, and III in the *General Plant Design Description (GPDD) System Design Description (SDD)* and individual System Design Descriptions (SDDs). Criteria for the selection of Design Class I, II, and III SSCs are identified for historical purposes in the SDD GPDD System. The WIPP has replaced Design Class classifications with functional classifications consistent with DOE Guide 420.1-1A. The WIPP safety-related SSC functional classifications are as follows:

- **Safety Class (SC)** SSCs, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material (HAZMAT) exposure to the public, as determined from safety analysis.
- **Safety Significant (SS)** SSCs that are not designated as SC SSCs, but whose preventive or mitigative function is a major contributor to defense-in-depth and/or worker safety as determined from safety analysis. Quality requirements are applied in accordance with *Nuclear Waste Partnership LLC Quality Assurance Program Description* (WP 13-1) and *Graded Approach to Application of QA Controls* (WP 09-CN3005).

2.3 FACILITY OVERVIEW

2.3.1 Facility Design

The WIPP site is located in Eddy County in southeastern New Mexico, 26 miles east of Carlsbad. The land area set aside for the WIPP site is 10,240 acres. The WIPP site is located in an area of low population density as discussed in Chapter 1.0, "Site Characteristics," Section 1.3.2. The area surrounding the facility is used primarily for grazing and the development of potash, oil, and gas resources. As the result of the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992* (LWA) (Public Law 102-579 et seq.), no mineral resource development is allowed within the WIPP site boundary, with the exception of existing leases.

The WIPP facility is designed to receive and handle 500,000 cubic feet (ft^3) per year of CH Waste and 10,000 ft^3 per year of RH Waste. CH and RH Waste is disposed of in the UG disposal area located approximately 2,150 feet beneath the surface in a deep-bedded salt formation. Waste is transferred from the surface to the UG through the Waste Shaft using a mine hoist. The disposal phase is planned to last for 35 years per the *National TRU Waste Management Plan* (DOE/NTP 96-1204) and *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE/EIS-0026-S-2).

The WIPP site is divided into surface structures, shafts, and UG structures as shown in Figure 2.4-1, Figure 2.4-2, and Figure 2.4-3. The WIPP surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of waste from the surface to the UG. The surface structures associated with Waste Handling or support of site operations are located in an area within a perimeter security fence. This area is referred to as the Property Protection Area (PPA). There are additional structures outside the PPA, but within the 10,240 acres, including the site Meteorological Monitoring Tower, sewage stabilization ponds, equipment laydown areas, a communication tower, two mined rock (salt) piles, evaporation ponds for managing site runoff, a utility switchyard, and groundwater monitoring wells.

The primary surface Waste Handling operations at WIPP are performed in the Waste Handling Building (WHB), which is divided into the CH and RH Waste processing areas and the Shaft Access Area. The CH Waste Handling areas consists of the CH Bay, Room 108, Airlock 107, and the Shielded Storage Room. Airlock 107 separates the CH Bay and Room 108. The RH Waste Handling area includes the RH Bay and the Hot Cell Complex. The Hot Cell Complex includes the Cask Unloading Room (CUR), the Transfer Cell, the Lower Hot Cell, and the Upper Hot Cell. CH and RH Waste Handling occur in the Shaft Access Area which consists of the Facility Cask Loading Room (FCLR), the Conveyance Loading Room (CLR), and the Waste Shaft Collar Room. The Waste Hoist Tower, located between the CH and RH portions of the WHB, includes the Waste Shaft Collar Room, the Waste Shaft Collar, the Waste Hoist system, and the Waste Hoist Master Control Station.

Four shafts extend from the surface to the UG horizon: the Waste Handling Shaft, the Salt Handling Shaft, the Exhaust Shaft, and the Air Intake Shaft, as shown in Figure 2.4-3.

The WIPP UG facilities include the waste disposal area, construction area, the experimental area (north of the shafts), and the shaft pillar area (the Waste Shaft Station, maintenance facilities, etc.). UG ventilation is divided into four separate flow paths supporting the waste disposal area, mining construction area, north area, and the Waste Shaft Station Area.

A Disposal Panel consists of seven Disposal Rooms with an intake and an exhaust drift. Each room within a panel is approximately 33 feet wide by 13 feet high by 300 feet long. A Disposal Room is separated from the adjacent room(s) by pillars of salt approximately 100 feet wide and 300 feet long. The panel intake drift is approximately 20 feet wide by 13 feet high, while the exhaust drift is approximately 14 feet wide by 12 feet high. Once panels are operationally filled, panel closures are installed in the first 200 feet of both panel entries.

2.3.2 Facility Operations

The principal operations at the WIPP involve the receipt and disposal of TRU Waste. CH and RH Waste Containers are transported to the WIPP site in Type B shipping packages certified by the U.S. Nuclear Regulatory Commission (NRC). The shipping packages are transported on trailers designed for each specific type of shipping package, and transported by over-the-road tractors. RH Waste is shipped in RH-TRU 72-B, while CH Waste is shipped in a TRU Package Transporter Model II (TRUPACT-II), a

Half Package Transporter (HalfPACT), or a TRU Package Transporter Model III (TRUPACT-III) shipping package. RH Waste, in shielded containers (less than or equal to 200 mrem per hour on contact), will be managed, handled, and emplaced using the same process as is used for the CH Waste, and will be shipped in HalfPACTs. Therefore, from a WIPP facility safety perspective, shielded containers are included in the CH TRU Waste process. The Waste Handling process begins when the tractor/trailer loaded with a shipping package(s) arrives at the WIPP security gate. At the gate, the shipping manifest is verified. The loaded trailer is then staged in the WHB Parking Area Unit to the south of the WHB. Radiological surveys are completed before moving the shipping packages into the WHB. The *Waste Isolation Pilot Plant Hazardous Waste Facility Permit* NM4890139088-TSDF (HWFP) administratively limits the amount of waste that can be stored in the WHB Parking Area Unit and in the WHB. The shipping packages are moved into the WHB where their contents are prepared for transport to the UG for disposal. If generator site waste is taken outside the WHB, other than to the UG, it will only be moved in closed Type-B packages. The WHB Parking Area Unit is the asphalt and concrete surface extending from north of the rail sidings to the WHB, within the waste storage areas as depicted in Figure 2.4-1.

Generator sites ensure TRU Waste is characterized in compliance with the requirements of *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WIPP WAC) (DOE/WIPP 02-3122), prior to placing the waste into shipping containers and shipping to WIPP. The Waste Container must be of a type authorized by the WIPP WAC for shipment to WIPP. Authorized CH Waste Containers are U.S. Department of Transportation (DOT) Type 7A and include 55-gallon drums, 85-gallon drums, 100-gallon drums, shielded containers, Standard Waste Boxes (SWBs), 10-Drum Overpacks (TDOPs), and Standard Large Box 2s (SLB2s). Authorized RH Waste Containers are DOT Type 7A RH Waste Canisters RH-TRU 72-B, NS15, NS30, or 55-gallon drums. RH Waste Containers are discussed in Section 2.5.2 and CH Waste Containers are discussed in Section 2.6.2.

Waste Containers from the generator sites are certified free of surface contamination above 10 CFR 835 Appendix D, "Surface Contamination Values" limits upon shipment. Waste Containers are visually inspected for physical damage (severe rusting, apparent structural defects, signs of pressurization, etc.) and leakage to ensure they are in good condition prior to storage. Waste Containers are also checked for external surface contamination. WIPP may initiate local decontamination on containers in good condition and free of leakage. External surface contamination identified above 10 CFR 835 Appendix D limits will be controlled in accordance with established operational and radiological control procedures.

2.4 FACILITY STRUCTURE

2.4.1 Waste Handling Building

TRU Waste is prepared for disposal in the WHB and then transferred to the UG via the Waste Shaft. The general layout of the WHB is shown in Figure 2.4-4 and Figure 2.4-5, with sectional views shown in Figure 2.4-6. The WHB is surrounded by pavement or gravel on three sides. The west wall of the CH Bay is the east wall of Building 412, the TRUPACT Maintenance Facility (TMF). The south wall of the WHB is separated from the PPA fence by the WHB Parking Area, railroad tracks, and gravel, a distance of approximately 200 feet. The WHB is approximately 9,500 feet from the WIPP site boundary, the point where the Evaluation Guideline is applied.

The WHB, which includes the Waste Hoist Tower, is a steel-frame structure with insulated steel siding. Portions of the WHB, such as the Hot Cell Complex and Shielded Storage Room, are constructed of thick concrete for shielding. The WHB is constructed as a Type II construction per *Standard on Types of Building Construction* (NFPA 220), and serves as a confinement barrier to control the potential for release of radioactive and/or non-radioactive hazardous material. The WHB is designed and constructed to withstand the Design Basis Earthquake (DBE) with 0.1 g peak acceleration and a 1,000-year return interval, and the Design Basis Tornado (DBT) with 183 miles per hour (mph) winds, a translational velocity of 41 mph, a maximum rotational velocity radius of 325 feet, a pressure drop of 0.5 pounds per square inch (psi) and a pressure drop rate of 0.09 psi per second. Tornado-rated doors are installed at the primary confinement wall interface. The roof of the WHB is designed to withstand 27 pounds per square foot (lb/ft^2) of snow load. The 100-year-recurrence maximum snowpack for the WIPP region is 10 lb/ft^2. The south wall of the WHB is additionally protected by concrete barriers between the airlock 100 and the TMF, as depicted in Figure 2.4-7. Sand-filled plastic barriers are placed between the airlocks.

The TMF is designed and constructed to withstand the DBE and DBT and its roof has a design snow load of 27 lb/ft^2. The main lateral-force-resisting structural members of the Support Building, located approximately 12 feet north of the CH portion of the WHB, are designed to withstand the DBE and DBT to prevent the Support Building from collapsing on the WHB.

The construction of the WHB north wall includes masonry construction. The design parameters for the WHB are described in the *Plant Buildings, Facilities, and Miscellaneous Equipment System Design Description* (SDD CF00-GC00).

Waste Handling areas in the WHB that are subject to potential contamination are provided with coatings that are easy to decontaminate.

2.4.1.1 Contact-Handled Waste Handling Facilities

2.4.1.1.1 Contact-Handled Bay Entrance Airlocks

CH shipping packages are transferred into the CH Bay from the WHB Parking Area Unit through three entrance airlocks on the south wall of the CH Bay. Each airlock can accommodate a battery-powered 13-ton forklift or Yard Transfer Vehicle (YTV) transporting a CH shipping package. The doors at each end of an entrance airlock are interlocked such that only one door can be opened at a time. Preventing both doors from being opened at the same time allows the CH portion of the WHB ventilation system to maintain the CH Bay at a lower pressure than the ambient atmospheric. Each door is opened and closed by push buttons located near the door they control.

2.4.1.1.2 Contact-Handled Bay

The CH Bay provides space for removal of CH Waste assemblies from shipping packages (TRUPACT-IIs and HalfPACTs) and storage of CH Waste assemblies on facility pallets. The CH Bay is equipped with two TRUPACT-II Unloading Docks (TRUDOCKs), with each TRUDOCK having two 6-ton overhead cranes. Figure 2.4-8 shows the TRUDOCK arrangement. A TRUDOCK has two workstations; each workstation is equipped with a 6-ton crane and can process one TRUPACT-II or HalfPACT at a time. The TRUDOCK 6-ton cranes are used for disassembling TRUPACT-IIs or HalfPACTs, removing the waste assemblies from the shipping containers, placing the waste assemblies on facility pallets, and reassembling the shipping containers. The CH Waste Handling process and equipment are described in Section 2.6.

The CH Bay has space for storing facility slip-sheets, empty pallets, and facility pallets loaded with CH Waste assemblies and transporting facility pallets with battery-powered forklifts or Facility Transfer Vehicles (FTVs) into the CLR. A battery charging area for battery-powered Waste Handling equipment is located along the north wall of the CH Bay, as is a site-derived waste storage area containing either a 55-gallon drum or an SWB.

The CH Bay and Room 108 are served by the CH Waste Handling Ventilation System which pulls air from both areas and exhausts that air through high-efficiency particulate air (HEPA) filters. The CH Waste Handling Ventilation System is designed to control the atmospheric pressure in the CH Bay and Room 108 at a lower pressure than that external of the WHB (airflows into Room 108 and the CH Bay).

The area ventilation is supplied based on constant volume and the exhaust airflow controlled by a pressure differential damper control system set to maintain the CH Bay at or below atmospheric pressure.

The CH portion of the WHB has a fire suppression system (FSS) consisting of overhead wet-pipe sprinklers. Emergency egress doors are located in the CH Bay, Room 108, and into the RH Bay.

2.4.1.1.3 Airlock 107

Airlock 107 is located in the northwest corner of the CH Bay and connects the CH Bay and Room 108. Airlock 107 can accommodate a TRUPACT-III, an SLB2, or facility pallets transported by battery-powered vehicles (forklifts, Automated Guided Vehicles, etc.). The airlock doors are interlocked such that only one door can be opened at a time. Each door is opened and closed by push buttons located near the door they control.

2.4.1.1.4 Room 108

Room 108 provides space for removal of SLB2 Waste Containers from TRUPACT-III shipping packages. Room 108 is equipped with a bolting station and a Payload Transfer Station. There is a monorail hoist at the bolting station. The bolting station is used for removing and installing the TRUPACT-III cover and closure lid. The Payload Transfer Station is used for extracting the SLB2 payload from the TRUPACT-III and placing the SLB2 on a facility pallet. The TRUPACT-III Waste Handling equipment and process are described in Section 2.6.

Room 108 is served by the CH Waste Handling Ventilation System. An emergency egress door is located on the west wall of Room 108 that exits the WHB without an airlock.

2.4.1.1.5 Shielded Storage Room

The Shielded Storage Room, located in the southeast corner of the CH Bay, is approximately 19 feet long by 15 feet wide by 15 feet tall and is accessed from the CH Bay through thick steel shield doors. The walls, floor, and ceiling are approximately 2-foot-thick reinforced concrete. The Shielded Storage Room has a smoke detector alarm initiator and overhead wet-pipe sprinklers which are part of the CH Bay FSS. The Shielded Storage Room is used for the temporary storage of Waste Containers with discrepant paperwork, surface contamination, or higher dose rates. One facility pallet of CH Waste assemblies can be stored in the Shielded Storage Room.

2.4.1.1.6 Conveyance Loading Room

The CLR is located between the CH Bay and the Waste Shaft Collar Room and serves as an airlock between the two and the outside. The CLR contains an electrically powered conveyance loading car that rides on rails embedded in its floor. The rails extend from the CLR to the pivot rails on the west side of the Waste Shaft Collar. A battery-powered forklift or FTV transports a loaded facility pallet from the CH Bay into the CLR. A forklift places the pallet on the conveyance loading car, while the FTV uses its rail wheels to transport the loaded facility pallet into the Waste Shaft Collar Room. The airlock function of the room helps to maintain the Contact-Handled (CH) Waste Handling (WH) Confinement Ventilation System (CVS) pressure. The conveyance loading car or FTV transports a facility pallet into the Waste

Shaft Collar Room and onto the Waste Shaft Conveyance. CH Waste transport routes in the WHB are shown in Figure 2.4-8.

2.4.1.1.7 Waste Shaft Collar Room

The Waste Shaft Collar is enclosed with a fence to prevent inadvertent access to the shaft. The fence has gates that are interlocked such that if a gate is open, the conveyance cannot be moved, or if the conveyance is moving and a gate is opened, the conveyance emergency stop is actuated. Pivot rails at the Waste Shaft Collar are located in the rails serving the CLR and in the rails serving the FCLR. The motor/screw activated pivot rails must be in the horizontal position when loading or unloading the Waste Shaft Conveyance and in the vertical position any time the Waste Shaft Conveyance is not at the CLR/FCLR level. When the conveyance loading car or the FTV is loading CH Waste assemblies on the Waste Shaft Conveyance, the pivot rails serving the FCLR are in the vertical position; conversely, when the Facility Cask Transfer Car (FCTC) is loading the Waste Shaft Conveyance, the pivot rails serving the CLR are in the vertical position. The fence gate and pivot rails are electronically interlocked with the Waste Shaft Conveyance controls such that the conveyance cannot be moved until the gates are closed and both sets of pivot rails are in the vertical position.

2.4.1.2 Remote-Handled Waste Handling Facilities

2.4.1.2.1 Remote-Handled Bay

The RH Bay is a high-ceiling bay area for the receipt and handling of the RH-TRU 72-B shipping packages. The RH Bay can accommodate a maximum of two trailers and one trailer jockey or transport tractor at one time. Trailers are brought into the RH Bay through a set of double doors on the east end of the RH Bay. The doors remain open until the trailer jockey or transport tractor has exited the RH Bay. After the trailer jockey or transport tractor exits the RH Bay, the doors are closed before the RH shipping package is lifted from the transportation trailer and transferred to a Road Cask Transfer Car (RCTC). The RH Bay ceiling is higher than that of the CH Bay because the RH shipping packages are lifted from their transport trailers inside the RH Bay, whereas the CH shipping packages are removed from their transport trailer in the WHB parking area.

The RH Bay has an overhead 140/25-ton bridge crane, primarily used for lifting and moving RH shipping packages. The RH Bay floor has embedded railroad tracks extending from the WHB Parking Area Unit through the double entry doors and ending with rail stops located approximately 25 feet from the west wall of the RH Bay. The railroad tracks were originally designed to be used for railcar delivery of RH shipping packages. No railcars have been used to deliver any TRU Waste to the WIPP site and there is no plan to use them. Another set of rails, with rail stops at both ends, extend from the cask preparation stand into the CUR. These rails guide the electric-powered RCTC. An additional set of rails, embedded in the floor near the west end of the RH Bay, runs north and south through a pair of thick steel doors separating the RH Bay and FCLR to a turntable in the FCLR. The turntable can be positioned such that the rails can be used to guide the FCTC between the Facility Cask Rotating Device (FCRD) and the Waste Shaft Collar Room or between the RH Bay and the FCLR. There are rail stops in the RH Bay and at the FCRD.

Two types of RCTCs are used in the RH Bay. One RCTC is designed and constructed to support the RH-TRU 72-B shipping container during Waste Handling in the RH Bay and the CUR, while the other is designed and constructed to support the 10-160B shipping container. The RH Bay also contains storage stands for empty RH-TRU 72-B shipping containers and the empty shielded insert. The RH Waste Handling area is shown in Figures 2.4-9 and 2.4-10, with sectional views shown in Figures 2.4-11 and 2.4-12. The RH surface facilities Waste Handling equipment and process is described in Section 2.5.

The area ventilation is supplied based on constant volume and the exhaust airflow is controlled to maintain the room at a pressure at or below atmospheric pressure and a pressure differential of +0.05 inches in water gauge with respect to the CH Bay.

2.4.1.2.2 Hot Cell Complex

The Hot Cell Complex consists of several rooms, including the CUR, the Transfer Cell, the Operating Gallery, Lower Hot Cell, and the Upper Hot Cell. The Hot Cell Complex is constructed of concrete walls, floors, and ceilings up to 54 inches thick, which provide permanent radiation shielding for personnel whenever RH Waste Canisters are not in a shipping package, shielded insert, RH Waste Cask (either the Facility Cask or the Light Weight Facility Cask (LWFC)). The shielding is designed for an internal gamma surface dose rate of 400,000 rem per hour and for an internal neutron surface dose rate of 45 rem per hour (ECO 11611, *Evaluation for Hot Cell Structural Degradation*). Figure 2.4-11 and Figure 2.4-12 show the RH area arrangement. The Hot Cell Complex is located in the north side of the RH Bay. The Upper Hot Cell floor is 31 feet wide, 57 feet long, and located at reference elevation 123 feet. The ceiling of the Upper Hot Cell is at reference elevation 156 feet. The Upper Hot Cell Operating Gallery floor is at reference elevation 123 feet. The Manipulator Repair Room, located at the west end of the Upper Hot Cell Gallery, has a floor reference elevation of 127 feet. The Crane Maintenance Room is located directly above the Manipulator Repair Room. The Transfer Cell, approximately 10 feet wide and 79 feet long, is below the Upper Hot Cell at reference elevation 76 feet. The Transfer Cell Service Room, located toward the west end of the Transfer Cell, is at reference elevation 86 feet. The FCLR is located at the west end of the Hot Cell Complex.

The Hot Cell Complex has electronically controlled interlocks to ensure the system shielding and containment functions are maintained. Conditions are prevented that could allow a canister to be unshielded or damaged. The specific components that are interlocked include the Facility Cask, Transfer Cell Shuttle Car, Grapple Hoist, CUR and Hot Cell cranes, CUR Shield Valve, Hot Cell Shield Valve, and Transfer Cell Shield Valve.

2.4.1.2.3 Cask Unloading Room

The CUR has 54-inch-thick concrete walls, ceiling, and floor for radiation shielding. The 140-ton concrete-filled steel shield door at the entrance to the CUR, when closed, provides radiation shielding for personnel in the RH Bay during removal of RH Waste drums from the 10-160B shipping package. The CUR shield door is also closed during operations involving transfer of items between the Upper Hot Cell and the CUR when there is RH Waste in the Upper Hot Cell. The CUR shield door remains open when processing a RH-TRU 72-B shipping package from the CUR into the Transfer Cell. During RH-TRU 72-B processing, the 72-B Waste Canister is not removed from its cask until it is lowered into the Transfer Cell. The CUR has a 54-inch-thick concrete ceiling with two concentric shield plugs separating it from the Upper Hot Cell. A 54-inch-thick concrete floor and an 8-inch-thick steel shield valve separate the CUR from the Transfer Cell. The control panel for the CUR 25-ton crane is located in the southwest corner of the CUR. The CUR 25-ton crane is used to transfer the RH-TRU 72-B shipping package or the shielded insert between the CUR and Transfer Cell. Personnel are restricted from being in the CUR during the transfer of RH Waste drums from the 10-160B shipping container into the Upper Hot Cell.

The 140-ton concrete-filled CUR shield door is approximately 8 feet long by 22 feet high by 4 feet thick. The CUR shield door is guided by rollers that ride in a metal channel attached to the outer wall of the CUR. The CUR shield door is opened and closed at a rate of approximately 15 feet per minute (fpm) by a pneumatic cylinder/piston and, when moving, is supported by a cushion of air exhausting from the door bottom (an air bearing). If the door encounters an obstacle while it is in motion, the impact causes loss of the air bearing and the door settles to the floor. When closed, an inflatable seal is pressurized forming a partial seal between the inside of the door and the surface around the CUR door opening. When the door is closed, the air supply is removed and the door rests on the floor. The operator console for the CUR shield door is located such that there is direct visual access to the door travel area. The CUR shield door is interlocked with other shielding equipment as follows:

- The CUR shield door must be closed before the Upper Hot Cell shield plugs can be removed.
- The CUR shield door cannot be opened with the Upper Hot Cell shield plugs removed.
- The CUR shield door must be closed before the Upper Hot Cell crane grapple can be raised when it is positioned over the Upper Hot Cell floor shield plugs.

2.4.1.2.4 Upper Hot Cell

The Upper Hot Cell is a room with 54-inch-thick concrete walls that provides the following:

- A shielded location designed for unloading the RH Waste drums from their 10-160B drum carriage units.
- Temporary storage for RH Waste drums.
- Facility canister storage locations (floor wells): six canister storage wells on the east side, two canister storage wells at the northwest inspection station, and one at the northeast inspection station.
- An area for inspecting the physical integrity of the drums.
- An area for performing radiological contamination surveys and identification verification of each drum.
- An area for loading drums into facility canisters.

Details of the Upper Hot Cell area are shown in Figure 2.4-10, Figure 2.4-11, and Figure 2.4-12. The bridge-mounted overhead-powered manipulator operates in the Upper Hot Cell with rails at reference elevation 141 feet. The Upper Hot Cell crane operates above the overhead-powered manipulator, with its rails at reference elevation 148 feet. The Operating Gallery has space for operating personnel to monitor and control all operations in the Upper Hot Cell. Six shielded viewing windows between the Operating Gallery and the Upper Hot Cell allow nearly 100 percent visual observation of all operations in the Upper Hot Cell. A transfer drawer is provided at the radiological inspection station for transferring surface contamination assessment swipes from the Upper Hot Cell to the transfer drawer enclosure in the Operating Gallery.

Access to the Upper Hot Cell from the CUR is through two 54-inch-thick concrete shield plugs in the Upper Hot Cell floor. The large plug has an approximate diameter of 9 feet and contains a smaller concentric plug that has an approximate diameter of 3 feet. Both plugs must be in place before a shipping package can enter or exit the CUR. When installed, the plugs provide shielding corresponding to the level of radiation protection required by the CUR. The CUR functions as an airlock between the Upper Hot Cell and the RH Bay when the CUR shield door is closed. The Upper Hot Cell is maintained at the lowest negative pressure in the RH Complex and air leakage is from the RH Bay through the CUR into the Upper Hot Cell. Access to the Upper Hot Cell is controlled by locked doors and permitted only when there is no RH Waste present.

Structural degradation because of gamma and neutron exposure is not expected to occur in the Upper Hot Cell based on ECO 11611. Calculations performed in ECO 11611 showed that the expected radiation exposure did not approach the threshold for radiological damage to concrete or steel structural components.

2.4.1.2.5 Transfer Cell

The Transfer Cell, located beneath the CUR, the Lower Hot Cell, the Upper Hot Cell, and the FCLR, is separated from each by 54-inch-thick concrete and 8-inch-thick steel shield valves. The Transfer Cell contains the following:

- The shuttle car used to move the RH-TRU 72-B or shielded insert from beneath the CUR to below the FCLR.
- An RH-TRU 72-B shipping package inner lid bolt-detensioning robot.
- A radiological contamination swipe robot.
- A transport system for the radiological swipe samples.

Transfer Cell activities are monitored by closed-circuit television (CCTV) cameras. The Transfer Cell ceiling shield valve is located at the west end below the FCLR port. A light curtain is installed at the personnel entrance to the Transfer Cell for worker protection. If personnel enter the Transfer Cell, the light curtain beam is broken and the robots are deenergized. Normally, personnel are prohibited in the Transfer Cell when waste is in the Transfer Cell.

2.4.1.2.6 Transfer Cell Service Room

The Service Room, separated from the Transfer Cell by a 48-inch-thick concrete wall, contains a receive/send station for the radiological swipes from the Transfer Cell, a vent hood in which the swipe samples are removed from the transport carrier, the counting equipment for radiological analysis, a Continuous Air Monitor (CAM), the motor for the Transfer Cell Shuttle Car, and a grapple override tool for the Upper Hot Cell facility grapple. The Service Room is manned when transferring a RH Waste Canister from a RH-TRU 72-B shipping package in the Transfer Cell.

2.4.1.2.7 Crane Maintenance Room

The Crane Maintenance Room, at reference elevation 142 feet, is located above the Manipulator Repair Room at the west end of the Upper Hot Cell. The Crane Maintenance Room is located so that the Upper Hot Cell crane can be positioned directly into it for repair. The Crane Maintenance Room is separated from the Upper Hot Cell by a 30-inch-high, 54-inch-thick concrete shield wall that extends 21 feet before opening into the Upper Hot Cell, and a ceiling-mounted shield door. The shield door is approximately 34 feet wide by 12 feet tall and is constructed of steel beams with a solid steel cover approximately 2 inches thick. The shield door, weighing approximately 33,000 pounds, is opened and closed by a floor-mounted winch. The door overlaps the opening in the concrete shield wall to prevent radiation streaming into the Crane Maintenance Room from the Upper Hot Cell. Ventilation seal plates between the door and its jamb control airflow from the room into the Upper Hot Cell. The winch is operated by a key that remains with RH Waste Handling personnel. Access to the Crane Maintenance Room is administratively controlled such that the Crane Maintenance Room shield door cannot be opened when RH Waste is in the Upper Hot Cell. The Crane Maintenance Room is fire protected by an automatic sprinkler system.

2.4.1.2.8 Facility Cask Loading Room

The FCLR, part of the Shaft Access Area, has a 54-inch-thick concrete floor and contains the FCRD, the turntable, the shield bell, the telescoping port shield, and a grapple hoist. The equipment is used to transfer RH Waste Canisters from the Transfer Cell into the RH Waste Cask and to transport the loaded RH Waste Cask onto the Waste Shaft Conveyance. An operating console, located behind a thick concrete shadow shield with a shield window in the north portion of the room, is used to control the FCLR and Transfer Cell Waste Handling activities. The FCLR is fire protected by an automatic overhead sprinkler system, part of the RH Bay FSS, and functions as an airlock between the Waste Shaft Collar Room and the Transfer Cell and RH Bay.

The FCLR grapple hoist is ceiling mounted. The grapple is in the shield bell. When the grapple is lowered to engage the pintle of an RH Waste Canister in the Transfer Cell, the shield bell is also lowered until it rests on the top shield valve of the RH Waste Cask. The shield bell provides radiation shielding while the RH Waste Cask top shield valve is open.

The FCRD is used to rotate the RH Waste Cask between the horizontal and vertical positions. The RH 72-B canisters are lifted into the RH Waste Cask when the cask is in the vertical position.

The FCLR has a pair of rails on which the electrically powered FCTC transfers the RH Waste Cask between the FCRD and the Waste Shaft Conveyance.

2.4.1.3 Waste Hoist Tower

The Waste Hoist Tower, located between the CH and RH portions of the WHB, is five floors high. The first floor is the Waste Shaft Collar Room. The Waste Hoist Master Control Station is on the second floor. The Waste Hoist, motor, brakes, maintenance cranes, and associated hydraulic systems are located on the fifth floor. The Waste Hoist Tower is fire protected by a wet-pipe sprinkler system that is part of the CH Bay FSS.

The maintenance cranes are parked away from the hoist drum. The manually powered 2-ton crane is parked with the wheels blocked. The electrically powered 30-ton crane is deenergized when parked. The Waste Hoist Tower structure prevents either crane from falling down the Waste Shaft.

2.4.1.4 Waste Handling Building Mechanical Equipment Room

The WHB Mechanical Equipment Room is on the second floor of the CH portion of the WHB. The room contains the CH Waste Handling areas and RH Bay CVS's heating, ventilation, and air conditioning (HVAC) equipment and controls, HEPA filters and exhaust fans. The Hot Cell Complex HVAC controls are also located in the Mechanical Equipment Room. The WHB vacuum system equipment and controls are located in Room 201 adjacent to the WHB Mechanical Equipment Room.

2.4.2 Building 412

Building 412 (the TMF) is located to the west side of the WHB (Figure 2.4-4) and shares a common wall with the CH Bay. Structural portions of the building are designed to withstand the DBE and DBT because of its interface with the WHB. The equipment in the TMF is not seismically restrained. The TMF roof is designed to withstand a snow load of 27 lb/ft^2. The TMF is used to store material and equipment and has battery-charging stations for charging battery-operated vehicles.

2.4.3 Exhaust Filter Building

The Exhaust Filter Building (EFB) contains the UG Ventilation Exhaust HEPA filtration equipment and is located north of the Exhaust Shaft. The EFB provides for walk-in HEPA filter change-out. During normal operations, air is pulled into the UG from the Air Intake Shaft, Salt Handling Shaft, and Waste Shaft. Use of the Supplemental Ventilation System (SVS) will alter this flow pattern as described in Section 2.7.3.8.3. Air is drawn up the Exhaust Shaft and then filtered before discharging to the atmosphere. Approximately 60,000 actual cubic feet per minute (acfm) is pulled through the EFB HEPA filtration equipment by one of three 860 fans.

Two interim skid-mounted HEPA filter and fan units (the Interim Ventilation System (IVS)) can be used to add approximately 54,000 acfm filtered airflow from the UG. The skid-mounted units provide for bag in and bag out HEPA filter change-out and the capability to take down the EFB HEPA filtration equipment for maintenance. The interim HEPA filter system is located east of the Exhaust Shaft. The inlet plenum of the interim HEPA filter system is connected using the ductwork of the disconnected 41-B-700A exhaust fan. The discharge from both skid-mounted HEPA filters and fan units is connected using ductwork to the existing monitored discharge. The EFB layout is shown in Figure 2.4-13.

The EFB also contains the EFB HVAC equipment, UG and EFB ventilation control panels, and supporting electrical motor control centers and distribution panels. The interim ventilation in the Electrical Building contains control panels, motor control centers, and variable frequency drivers for supporting the IVS. The EFB, IVS, and associated ductwork are protected from inadvertent vehicle impacts by moveable physical barriers. The barriers are positioned and maintained in accordance with the appropriate safety management program.

2.4.4 WIPP Shafts and Underground Facilities

2.4.4.1 WIPP Shafts

There are four WIPP shafts: Air Intake, Salt Handling, Waste, and Exhaust. The principal components of the four WIPP shafts are the Shaft Collar, the lined portion of the shaft, the concrete key portion, the unlined portion, the Shaft Station, the shaft conveyances, and the shaft conveyance support furnishings.

Shaft collars are located at the surface, which is approximately 400 feet above the historic floodplain of the Pecos River. Shaft collars are raised above surrounding ground to prevent water running into the shafts. The shaft collars, except for the Exhaust Shaft, are surrounded by fencing and gates to prevent unauthorized entry and to minimize the possibility of items falling into the shafts.

The lined portion of each shaft extends from the top of salt to the surface. The salt sections of the Waste and Exhaust Shafts are rock bolted and have wire mesh, as are portions of the salt sections of the Air Intake and Salt Handling Shafts.

The Salt Handling Shaft extends about 110 feet below the disposal level to provide a salt loading pocket and a sump. The Waste Shaft extends about 118 feet below the disposal level to accommodate tail rope dividers, guide rope weights, and a sump.

The Salt Handling Shaft is the only means of hoisting mined salt, is a secondary source of intake air, exhausts air for SVS operation, and is a route for power, control, and communications cables from the surface to the UG. The Air Intake Shaft is the primary source of intake for UG ventilation. The Waste Shaft provides the only means of lowering TRU Waste for disposal, is the source of air for ventilating the Waste Shaft Station, and is a route for power, control, and communications cables from the surface to the

UG. The Waste Shaft has an Auxiliary Air Intake Tunnel to provide additional airflow to the Waste Shaft Station by adjusting dampers and balancing pressure in the Waste Hoist Tower.

The Exhaust Shaft provides the only path for the exhaust of air from the UG emplacement areas. SVS operation upcasts uncontaminated air from the north and construction circuits through the Salt Handling Shaft. A metal elbow approximately 14 feet in diameter connects the Exhaust Shaft to the surface fan ducting.

The SVS is designed to provide supplemental ventilation to the uncontaminated areas of the UG. This is achieved through upcasting in the Salt Handling Shaft. Air will draw through the Air Intake Shaft for the uncontaminated area and be discharged through the Salt Handling Shaft or air leakage into the disposal area is filtered before exhaust to atmosphere. The increased ventilation through upcasting in the Salt Handling Shaft will provide the capability for mining and other maintenance and construction activities. Airflow during SVS operation is shown in Section 2.7.3.8.3 (Figures 2.7-10 and 2.7-11).

Air flow in the UG repository and waste hoist ventilation split is primarily driven by the negative pressure induced by the suction created by the exhaust fans. There is also a secondary driving force resulting from differences in air density between the various shafts and the UG. This is called the natural ventilation pressure (NVP).

During hot weather, the air normally flowing from the surface to the UG is warmer and less dense (lighter) than the cooler underground air. The potential in low exhaust flow or low fan pressure configurations, with the Air Intake Shaft covered, is to cause a relatively small amount (generally less than 10,000 cfm) of upcasting to occur at the Air Intake Shaft. The small quantity of upcast air is not contaminated as it is supplied by the Salt Shaft. Since the Waste Shaft is enclosed, the air is generally cooler than the ambient air in summer time conditions. The cooler air in the Waste Shaft wants to downcast. This helps ensure that the Waste Shaft is downcasting and air is flowing from the Waste Shaft toward the Exhaust Shaft.

During cold weather, the ambient air entering the UG is colder and denser (heavier) than the underground air. Hence, in cold weather the NVP augments the exhaust fan suction pressure. The positive NVP increases the downcast air flow in one or more shafts and increases the difference in pressure between the Construction and Waste Handling ventilation circuits. In low exhaust flow or low fan pressure configurations a positive NVP can cause more air to enter the UG than is being exhausted. In this situation one of the intake shafts can start upcasting. In general, the Air Intake Shaft will remain the downcast shaft while the Salt Shaft and/or Waste Shaft become upcasting shafts. The Air Intake Shaft can be partially or completely covered at the surface to reduce the potential for the Waste Shaft to upcast.

2.4.4.1.1 Waste, Salt Handling Shaft, and Air Intake Shaft Hoists and Shaft Conveyances

The WIPP hoists, conveyances, and shaft appurtenances were designed and constructed, and are maintained and operated, in accordance with the requirements of 30 CFR 57 Subpart R, “Personnel Hoisting.” A description of the components and operation of each of the WIPP hoists, and shaft conveyances and appurtenances are provided in the *Underground Hoisting System Design Description* (SDD UH00).

The Salt Handling Shaft Hoist is an electrically driven double-drum hoist but is operated in a single-drum unbalanced configuration. The Salt Handling Shaft Hoist motor is a 2,300-horsepower direct current motor. Each hoist drum has a parallel post brake. The brakes are normally applied and are released by applying pressurized air to the brake engines. The Salt Handling Shaft Hoist rope speed is approximately 1,800 fpm when transporting material and approximately 800 fpm when transporting personnel.

The Salt Handling Shaft Conveyance transports mined salt to the surface, material, and personnel between the surface and the UG disposal horizon. The Salt Handling Shaft uses wooden guides in the shaft and the headframe is constructed of structural steel.

The Air Intake Shaft Hoist is an electrically driven unbalanced single-drum hoist. The Air Intake Shaft Hoist motor is a 400-horsepower 480-volt, three-phase motor. The Air Intake Shaft Hoist has brakes on the Air Intake Shaft Hoist drum and two thruster brakes on the pinion shaft. All brakes are normally applied and are released by separate brake engines.

The Air Intake Shaft Conveyance is used for emergency egress for personnel working in the WIPP UG, such as maintenance, operations support, and support of scientific inquires. In the event of loss of electrical power, the Air Intake Shaft Hoist motor can be electrically powered by the WIPP site backup diesel generators.

The Waste Hoist is an electrically driven friction hoist. The Waste Hoist motor is a direct-connected 600-horsepower direct current motor. The Waste Hoist maximum rope speed is 500 fpm. There are two brake units acting on each of the two brake discs on the hoist drum. The brake units are normally applied and are spring set and hydraulically released. Either set of brakes can stop a fully loaded conveyance under all conditions. In the event of a control failure, power failure, or loss of hydraulic pressure, the brake units automatically return to their normal applied position. There are two separate brake hydraulic systems and if there is a loss of pressure in the primary system, the hoist brake system will automatically switch to the standby system. The hoist control system will set the brakes by dumping the brake hydraulic system pressure if for any reason the brake hydraulic pressure is not released within a few seconds after the application of the brake set signal. The hoist control system is equipped with indications for brake set, brake released, and brake wear.

The Waste Hoist Control System monitors system operations and conditions and, if it detects malfunctions or abnormal operations (such as over-travel, over-speed, power loss, circuitry failure, or starting in the wrong direction), it actuates an alarm for that condition and shuts down the hoist. Eleven signals, two analog and nine contacts, are generated by the Waste Hoist Control System during Waste Hoist operations. These signals provide local indications and are transmitted to the Central Monitoring Room (CMR) for remote monitoring.

The main purpose of the Waste Shaft Conveyance is to transport TRU Waste from the WHB to the Waste Shaft Station. It could be used to transport TRU Waste from the Waste Shaft Station to the WHB. It is also used to transport personnel, material, and equipment. Personnel, material, and equipment are not transported at the same time TRU Waste is transported. The Waste Hoist Tower structure fully supports the Waste Hoist motor and drum, control system, brake system, deflection sheave, and electrical power system (transformer, power supply, etc.) and is designed to withstand the DBE. The Waste Hoist systems in the shaft and all shaft furnishings are designed to resist the dynamic forces of the hoisting operations (the dynamic forces are greater than the seismic forces on the UG facilities). The Waste Shaft Conveyance is designed for a maximum payload of 90,000 pounds. During loading and unloading operations, the conveyance is steadied by fixed guides. A chairing device, located at the Waste Shaft Station, prevents the conveyance from moving up or down because of rope stretch when heavy loads are removed from or added to the conveyance.

Hoist, tail, and guide ropes are provided for the safe operation of the Waste Shaft Conveyance and the counterweight. There are six hoist head ropes, any two of which can support the weight of the shaft conveyance, the counterweight, and the maximum shaft conveyance load. The three tail ropes are used to approximately balance the weight of the six head ropes. There are four guide ropes for the conveyance and two guide ropes for the counterweight. Tension on the guide ropes is maintained by weights on the bottom of each rope.

A conveyance and counterweight over-travel arrester system will stop movement if the normal control system fails. Four timbers are provided at the tower and the sump regions for both the conveyance and the counterweight to assist in absorbing energy to stop an over-traveling conveyance or counterweight. Retarding frames rest in notches either at the top of the wood arresters (sump area) or at the bottom of the wood arresters (tower area). The retarding frames have knives that cut into the timbers if driven by the conveyance or the counterweight.

If the conveyance over-travels against the upper crash beams and the head ropes fail, safety lugs on the conveyance mate with pivoting dogs on the catchgear mounted in the head frame to prevent the conveyance from falling if the head ropes break. The counterweight catchgear system functions in a similar fashion to stop the counterweight from falling. Each catchgear frame is mounted on a hydraulic shock absorber that absorbs energy from a descending conveyance or counterweight.

Emergency stop buttons are provided at the Master Control Station and the control stations at the Waste Shaft Collar, at the Waste Shaft Station, and on the conveyance. The emergency stop buttons are operable in all modes of hoist operation, and when pressed, will deenergize power to the hoist motor and the hoist brake hydraulic systems, setting the hoist brakes.

At the beginning of each shift, inspections of the Waste Shaft Conveyance, rope attachments, cage doors, and collar doors are made. The hoist operator visually inspects the hoist and hydraulic systems for general condition and possible leaks. The communication systems between the hoist operator, top lander, bottom lander, and the conveyance are tested and verified to be operational. Finally, the operator confirms the correct operation of the emergency stop tripping logic, limit switches, over-travel, position indicator, and braking mechanisms and the empty conveyance is operated through one round-trip. If all inspections and tests are satisfactory, the Waste Hoist system is released for operation.

The Waste Shaft is inspected weekly to detect fracturing, corrosion, deterioration, and water intrusion. A comprehensive preventive maintenance program, including all required MSHA inspections, is in place. Additional testing and inspections are identified in the *Underground Hoisting System Design Description* (SDD UH00). The Waste Shaft, Waste Hoist, and Waste Shaft Conveyance arrangement is shown on Figure 2.4-14.

2.4.4.2 Underground Facilities

2.4.4.2.1 General Design

The WIPP UG facilities provide the access, space, facilities, and equipment that directly support scientific programs; waste transport, emplacement, and disposal; and the mining, construction, and maintenance processes performed in the UG. The UG facility is centrally located within the 16-section WIPP site boundary and covers a footprint of approximately 550 acres. The UG facility is located 2,150 feet below the surface in bedded salt of the Permian Salado Formation. The Salado Formation extends from about 850 feet below the surface to about 3,000 feet below the surface. Halite is the most abundant mineral in the Salado Formation. A potash zone exists about 200 feet above the facility level. The facility horizon lies within a 40-foot-thick unit of halite, argillaceous halite, and polyhalitic halite.

This UG facility is maintained and operated in accordance with the applicable portions of 30 CFR 57, and the New Mexico Mine Safety Code for All Mines administered by the New Mexico Bureau of Mines

(19.6.5 NMAC). The WIPP UG facility is an MSHA Category IV, or a noncombustible and non-gassy mine.

Locations in the UG are identified with a coordinate system centered on the Salt Handling Shaft. A drift that runs north and south that is located 300 feet east of the Salt Handling Shaft is identified as E-300. A location in Drift E-300 that is 90 feet south of the Salt Handling Shaft is identified as E-300/S-90. The Exhaust Shaft is at S-400/E-475, the Air Intake Shaft is at N-0/W-625, and the Waste Shaft is at S-400/E-25.

The various areas are separated by salt pillars and ventilation system bulkheads. Bulkheads, overcasts, and airlocks are constructed of noncombustible materials except for flexible flashing used to accommodate salt movement. Some mining construction activities may be required in an active Disposal Room; however, the activities can be separated from the disposal processes and areas by schedule or time, ventilation controls, and temporary bulkheads. UG mining procedures and cavity dimensions incorporate the results of the salt creep analysis in the *Waste Isolation Pilot Plant Design Validation Final Report* (DOE/WIPP 86-010).

The UG support facilities and their ventilation flows in the shaft pillar area are shown in Figure 2.4-15. The support facilities include a maintenance area, vehicle parking area with plug-in battery charging, sanitary waste transfer station, electrical substation, welding shop, offices, materials storage area, emergency vehicle parking alcoves, oil storage area, a diesel equipment fueling station (W-170, near N-150), and a mechanical shop. When oil and fuel are not in-transit or being used, they are stored in the designated areas.

2.4.4.2.2 Experiments in Experimental Facilities Area

The Experimental Facilities Area was initially used for evaluating the interaction of simulated waste and thermal sources on bedded salt under controlled conditions. Portions of this area are now used for conducting scientific experiments, including the Enriched Xenon Observatory, the Segmented Enriched Germanium Assembly and Multiple Element Germanium Array, and the Copper Electro Forming Project.

The Enriched Xenon Observatory experiment investigates neutrino-less double-beta decay, a rare type of nuclear process that may allow measuring the mass of neutrinos. The Enriched Xenon Observatory facilities are at E-300 between N-1100 and N-1400.

The Segmented Enriched Germanium Assembly and Multiple Element Germanium Array experiments investigate double-beta decay to determine the mass of the neutrino. The terms Segmented Enriched Germanium Assembly and Multiple Element Germanium Array refer to a collection of counting stations that support the research goals for the experiment originally called the Majorana experiment. The developmental work of the Segmented Enriched Germanium Assembly and Multiple Element Germanium Array collaboration is conducted at the western end of the S-90 Drift, at approximately W-850 in the Room Q alcove.

The Copper Electro Forming Project, located in the Room Q alcove, is an experiment to measure the natural activity present in copper parts fabricated in the UG using electroforming techniques. Limited amounts of chemicals, cryogenic materials, and refrigerants used to support the experiments are stored and used in the experiment location.

The Experimental Facilities Area is also the location of the Salt Disposal Investigations. The Salt Disposal Investigations includes a proof-of-principle field test for the disposal of heat-generating nuclear waste. The proposed field test portion will directly test a safe disposal arrangement in the salt formation that balances heat loading with waste and repository temperature limits. The test program will provide knowledge of the behavior of the thermomechanical, hydrological, and chemical behavior of salt and wastes disposed in salt to form the technical foundation for design, operation, coupled process modeling, and performance assessment of future salt repositories for heat-generating waste (DOE/CBFO 11-3470, *A Management Proposal for Salt Disposal Investigations with a Field Scale Heater Test at WIPP*).

The Salt Defense Disposal Investigations area shares the Salt Disposal Investigations area. Salt Defense Disposal Investigations will test the disposal of cooler DOE-Environmental Management (DOE-EM) managed wastes, which covers an intermediate heat range relevant to Defense High-level Waste, most of the defense Spent Nuclear Fuel (SNF) inventory, and some of the commercial Spent Nuclear Fuel inventory.

2.4.4.2.3 Personal Emergency Equipment

Self-contained Self Rescuers

WIPP is required by New Mexico State Mining Law 69-8-16 to provide self-contained self-rescuers in the UG. A self-contained self-rescuer must be available for each person in the UG. A self-contained self-rescuer unit, which is enclosed inside polycarbonate housing, contains a small cylinder of pressurized oxygen and a carbon dioxide scrubber.

The self-contained self-rescuers are stored in metal enclosures that are either at fixed locations or on movable skids.

Trauma Kits

Trauma kits are placed in the UG to assist in medical emergencies. These kits consist of a metal container containing emergency medical supplies including a small cylinder of pressurized oxygen. The trauma kits are placed near the Waste Shaft Station and toward the southern end of E-140, located such that they are not in the path of vehicular traffic.

2.4.4.2.4 Underground Mining Methods, Layout, and Development

Mining Methods

Mining at WIPP is performed by continuous mining machines. One type of continuous mining machine is a road header or boom-type continuous miner operating a milling head. The milling head rotates in line with the axis of the cutter boom, mining the salt from the face. The mined salt is picked up from the floor by the loading apron. The mined salt is pulled through the miner on conveyers and loaded into haul vehicles.

Another type of continuous mining machine is a drum miner operating a head that rotates perpendicular to the axis of the cutter boom. The mined salt is pulled through the miner on a chain conveyor and then loaded into haul vehicles. Before mining in new areas, probe holes are drilled to relieve any pressure that may be present. After mining, vertical pressure-relief holes are drilled up at the main intersections of drifts and crosscuts.

During and immediately after mining, a sounding survey of the excavation ceilings is made to identify areas of weakness, which might represent safety or stability problems. Routine sounding of the roof, especially in unbolted areas, is commonly performed throughout the life of an opening. Ground control inspections and maintenance procedures for the UG are described in UG openings inspections.

Hand scaling, removal of salt with the continuous miners, or rock bolting may be accomplished if an area is identified as potentially unstable. Specific work packages are developed, as necessary, for mining and ground control.

Development of waste Disposal Rooms is based on the planned waste receipt rate. A panel is completed several months before initial waste disposal operations, to minimize the time a panel is open. Reducing the time a panel is open reduces required ground control activities within an active waste Disposal Room. Waste receipt is dynamic and varies depending on generator site operations and weather along transportation routes. Panel completion, however, is determined on a panel-by-panel basis. The rate a panel is mined depends on several factors, including ground conditions encountered, mining equipment availability, and hoisting capacity.

Mined Material

The salt removed during UG mining is brought to the surface by the Salt Handling Shaft Conveyance. Mined salt is loaded into the 8-ton Salt Handling Skip with a skip measuring and loading hopper, the skip is raised to the surface, and the salt is dumped through a chute to surface haulage equipment, which transports the salt to the surface salt pile.

Interface between Mining and Waste Disposal Activities

Separate mining ventilation and disposal ventilation circuits are maintained by means of bulkheads, overcasts, and airlocks made of noncombustible material, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57. The use of noncombustible materials along with salt surfaces minimizes the likelihood of a fire in one area of the UG propagating to another area. Air pressure in the mining ventilation circuit is maintained higher than in the disposal ventilation circuit to ensure that any leakage will result in airflow to the disposal side. The Underground Ventilation System (UVS) is discussed in Section 2.7. Panels being mined are in the mining ventilation circuit and panels with active waste emplacement are in the disposal ventilation circuit. Any mining necessary in the disposal circuit (to address ground control issues) is planned such that it is unlikely to be necessary at the active Waste Face and is not done in the Transport Path when waste is in transit to the Disposal Room.

2.4.4.3 Ground Control Program

The Ground Control Program at WIPP mitigates the potential for unplanned rock fall from the ceiling or ribs of openings. Ground control is in accordance with 30 CFR 57, Subpart B, “Ground Control.” From the time an opening is mined and throughout the life of the opening, action is taken to identify and remove or restrain any loose or potentially unsafe ground. Ground control is based on the following:

- Ground stability is maintained as long as access is not restricted or barricaded.
- Ground control maintenance efforts increase with the age of the openings.
- Ground control plans are specific but flexible.
- Regular ground control maintenance is required.

The WIPP Ground Control Program uses observational experience and analysis of salt behavior to anticipate future ground support requirements. To provide long-term ground support, the WIPP ground control system must accommodate the continuous creep of salt and retain broken fractured rock in the roof or walls. To aid in ground control activities, the WIPP UG is divided into over 100 zones. A database containing the current status of each UG excavation zone is maintained and includes the physical state of the zone with respect to geometry, excavation age, ground support, and operational use.

The *Ground Control Annual Plan for the Waste Isolation Pilot Plant* (DOE/WIPP 02-3212) addresses technical aspects of the UG facility that are concerned with the design, construction, and performance of the UG structures and support systems. Each year, the Ground Control Annual Plan is updated to reflect developments in the WIPP ground support practices, materials, and any changes in operational requirements. The WIPP Ground Control Plans are living documents that keep ground control practice at the WIPP both current and responsive.

The WIPP Ground Control Program includes continuous visual inspections of openings, geotechnical monitoring, installation of ground support components, and analysis of ground support component failures. Ground control support systems may vary as different conditions are encountered. Support systems may be subjected to longitudinal and lateral loading because of the rock deformation. The anchorage components may undergo lateral deformation because of offsetting along clay seams or fractures and increasing tensile loading.

Visual examinations are performed by Waste Operations personnel. Inspections are performed at the beginning of each shift, weekly, monthly, and annually. Geotechnical field activities include data collection from geotechnical instrumentation, fracture surveys, and observations. Monitoring results are analyzed in comparison with established design criteria and are used in a variety of computer models. Analyses are performed to ensure that rock mass behavior is understood and proper ground control measures are instituted. Ground support is designed and specified to meet the requirements of 30 CFR 57, Subpart B. Maintenance activities ensure that ground conditions presenting a potential hazard are rectified.

Ground support at the WIPP includes spot bolting, pattern bolting, and supplemental bolting. Spot bolting as its name implies involves bolting of the ceiling or ribs, typically with mechanically anchored bolts, to address localized “spot” areas of potential ground instability. Pattern bolting generally involves the installation of a systematic mechanical anchored bolt pattern, in many cases accompanied by chain link mesh, over a larger area. Supplement bolting refers to the installation of additional bolts, beyond the initial pattern bolting, to provide additional support to an area with potential instability, and may consist of resin anchored bolts, chain link mesh and roof mats. The bolts used in bolting activities meet the requirements of 30 CFR 57, Subpart B. Periodic inspections of the ground conditions by MSHA provide an independent check making certain that the ground support is adequate for the ground conditions.

Ground control measures in an active panel may include removal of rock, bolting, and floor milling in portions of the panel that do not contain waste. Pattern bolting minimizes the need to remove rock from the ceilings of Disposal Rooms; however, milling the floor is expected to ensure the proper room dimensions and to ensure a smoother surface for waste transport and disposal. In the event that ground control measures are not sufficient to ensure safety, rooms may be closed.

The roof beam may be removed by mining if it is a cost-effective alternative to bolting or if the roof is highly fractured and removal will result in a safer working environment. The roof beam is that portion from the roof up to the next competent layer, typically just above the overlying clay and anhydrite layers. This option has been exercised in portions of E-140 south and areas in the north end of the UG. In the waste disposal area, no removal or remediation of the roof beam is possible after waste is emplaced.

The time expected for the roof beam to contact the waste stack in a panel will vary based on the height of a room, the closure rate, and the waste stack configuration. The typical waste stack height for three seven-packs of 55-gallon drums and a sack of magnesium oxide (MgO) is approximately 130 inches. The repository stratigraphy for Panels 1, 2, 7, and 8 are different than for Panels 3, 4, 5, and 6. Roof falls were actually observed in Site Preliminary Design Validation and consisted of a triangular section of roof extending nearly the length and width of the room with its apex 7 feet high (SDD UH00). The Site Preliminary Design Validation had minimal installed ground support. If no waste was emplaced in a room, this type of roof failure could be expected for Panels 1, 2, 7, and 8. However, with waste placed in a uniform array it is likely that ground movement will reduce the distance from the ceiling to the waste stack such that the salt in the immediate roof becomes supported by the stack and no fall occurs. The ground control measures installed in Disposal Rooms have been effective because no roof fall in the active Disposal Rooms has occurred. However, roof bolts do, and are expected to fail. Bolt failure is based on stratigraphy, when the bolts were installed after mining an opening, and the length of the bolt. A database on roof bolt failures is maintained and failed bolts in accessible areas are replaced or remediated in a timely manner.

A roof separation was discovered in January 2015 in the Panel 3 access drift. The area involved had been identified for inclusion in the February 2014 outage re-bolting campaign, and the re-bolting was deferred due to the February 2014 events. The area was restricted from access in November 2014 due to ground control concerns prior to the separation. The area has since been addressed in the re-bolting campaign which was resumed in November 2014.

2.4.4.4 Disposal Facilities

The disposal facilities provide space for a maximum of 6.2 million ft^3 of TRU Waste in TRU Waste Containers. Figure 2.4-16 shows a typical Waste Container disposal configuration. The main entries and crosscuts in the repository provide access and ventilation to the disposal area. The main entries link the shaft pillar/service area with the disposal area and are separated by pillars. Typical entries are 13 feet high and 14 to 16 feet wide. The waste disposal area is designed so that each panel contains seven rooms. The locations of the panels are shown in Figure 2.4-2. Rooms within a panel have approximate dimensions of 13 feet high by 33 feet wide by 300 feet long. The rooms are separated by 100-foot-wide pillars. Boreholes are used for disposing of RH Waste Canisters. Boreholes are drilled into the ribs of the Disposal Rooms and room entries, to a depth of approximately 17 feet with a diameter of approximately 30 inches. The access and exhaust drift boreholes are approximately 34 feet from the corners of salt pillars that separate Disposal Rooms. Inside the Disposal Rooms, boreholes are located approximately 26 feet from the corner.

The amount of TRU Waste in each panel/room is limited by thermal, structural, and physical considerations, and emplacement is arranged not to exceed 10 kilowatts per acre. Based on criticality analysis, a spacing of 30 inches or greater between centers for RH Waste Canisters is allowed. Typical spacing will be 8 feet center-to-center for canister emplacement. A shield plug and shield ring, as required, provide shielding between the RH canister in the borehole and the room.

CH Waste is received at the WIPP site in drum assemblies, SWBs, SLB2s, or TDOPs. Drum assemblies and SWBs are stacked up to three high, and may be intermixed within rows and columns. Shielded containers will be received in a HalfPACT, in a three-pack configuration on a triangular pallet, surrounded by radial and axial dunnage components. The three-packs are stacked on a slip-sheet made of high-density polyethylene or cardboard, a maximum of two high of the same three-packs, in the interstitial spaces among the CH TRU Waste. No other waste assemblies or backfill MgO sacks will be placed on the top of a three-pack assembly of shielded containers. SLB2s are placed directly on the ground along the ribs or across the Waste Face and may also be intermixed within rows and columns. TDOPs are placed on the bottom row. Four-packs of 85-gallon drums and three-packs of 100-gallon drums are placed on top of assemblies of the same type or placed on the top row for stability reasons.

One waste assembly, with the exception of TDOPs and SLB2s, may be stacked on top of an SLB2 to form a two-tiered stack.

If waste volumes disposed in the eight panels fail to reach the design capacity, the DOE may use the four main entries and crosscuts adjacent to the waste panels. Drifts E-300, E-140, W-30, and W-170 from S-1600 to S-3650 are approximately 2,050 feet long. East–west crosscuts in this area are approximately 470 feet long. The layout of these excavations, labeled as Panel 9 and Panel 10, is shown on Figure 2.4-2.

2.4.4.5 Magnesium Oxide Backfill

"Assurance Requirements" (40 CFR 191.14, Subparagraph d), requires disposal systems to use different types of barriers (engineered and natural) to isolate the wastes from the accessible environment. "Engineered Barriers" (40 CFR 194.44) states that disposal systems shall incorporate engineered barrier(s) designed to prevent or substantially delay the movement of water or radionuclides toward the accessible environment. MgO is used to provide an engineered barrier that decreases the solubility of the actinide elements in TRU Waste. MgO essentially consumes the carbon dioxide that would be produced by microbial consumption of cellulose, plastic, and rubber in the emplaced CH Waste.

The WIPP receives the MgO in woven polypropylene super sacks, each containing approximately either 3,000 or 4,200 pounds of MgO. The super sack is constructed with woven polypropylene and reinforcing inserts (e.g., cardboard) such that it retains its contents for at least two years after emplacement without rupturing from its own weight. The super sacks are delivered to the UG using current shaft and material handling processes. Forklifts with push/pull attachments emplace the super sacks in the waste stack. In the event a super sack is breached, MgO is nonhazardous. MgO is an acceptable fire-extinguishing agent in the DOE complex where the potential for metal fires is present, such as in glovebox operations at generator sites (DOE-STD-1066-99, *Fire Protection Design Criteria*). While the use of MgO in the WIPP UG is not based on its acceptability as a fire extinguishing agent, in the event of a fire that may impact the disposal array, the powdered MgO would tend to suppress a fire in the waste array.

A super sack of MgO is placed on top of or on the floor next to Waste Containers in the disposal array. One super sack of MgO is typically placed on every other column and is typically sufficient to eliminate the carbon dioxide produced from the cellulose, plastic, and rubber contained in non-compacted waste. Additional MgO super sacks may be required for emplacement of compacted waste or other engineering-approved configurations because of the increased amount of cellulose, plastic, and rubber in the compacted waste.

2.4.4.6 Panel Closure System

On completion of waste emplacement in each Disposal Room, ventilation in that panel is no longer necessary. The installation of a panel closure system is a requirement of the HWFP. Figure 2.4-17 shows the approved panel closure system that isolates a filled panel from the active portions of the disposal area. There is also an interim panel closure system that may be used.

The panel closure system is a 12-foot-thick block and mortar explosion-isolation wall and a concrete barrier. The explosion-isolation wall component has been installed in the entries to Panels 1, 2, and 5. Panel closure removes the panel from active ventilation such that there is no ready path for radiological or hazardous releases to propagate to areas outside the panel. Panel closure also prevents events outside the panel from breaching Waste Containers inside the closed panel.

The interim closure system (Figure 2.4-18) consists of a substantial barrier and isolation bulkhead which has been installed in Panels 3 and 4 and may be used in subsequent panels. This type of barrier allows monitoring of gas generation in a filled panel. The substantial barrier consists of a run of mine salt (or other suitable nonflammable fill material) placed against the Waste Face such that the height is halfway up the top tier of waste at the face and extends at least 10 feet beyond the base of the waste array into the panel entries. The chain link and brattice cloth are secured to the roof, ribs, and substantial barrier to minimize airflow through the filled panel. The substantial barrier prevents the top tier of waste from falling the full height of the waste stack. An isolation bulkhead or ventilation bulkhead is installed on the entry side of the substantial barrier to further reduce airflow and prevent human access to the filled panel. Sample lines for gas sampling and cables for geotechnical monitoring equipment pass between the flashing of the isolation bulkhead and the salt. The substantial barrier and isolation bulkhead protect the Waste Face from operational events in the entries such as vehicle collisions and fires.

The substantial barrier and isolation bulkhead restricts airflow through closed panels to minimize the motive force for radioactive or non-radioactive HAZMAT transport. Ground movement over time will further reduce airflow through a filled panel.

Gas generation rates in a filled panel are expected to be low, less than 1 percent methane (20 percent of the lower explosive limit) and less than 1 percent hydrogen (25 percent of the lower explosive limit) after five years (Golder, pers. comm. 2006; WTS, pers. comm. 2006). If gas generation rates are observed to be increasing more than expected or ground conditions in the panel entries becomes unfavorable, then a substantial barrier and isolation bulkheads or the explosion-isolation wall can be installed.

2.4.4.6.1 Panel 6 and Panel 7, Room 7 Closure

The State of New Mexico, Environment Department, *Administrative Order Under the New Mexico Hazardous Waste Act 74-4-13*, dated May 20, 2014, directed the closure of Panel 6, and Panel 7, Room 7. The closure barrier for Panel 7, Room 7 is planned without the substantial salt barrier since there are double bulkheads at the outlet and a large separation distance (~400 feet) to the inlet barrier. Panel and room closures were installed to block the inlet first.

The location of the isolation bulkhead for the Interim Closure of Panel 6 is very close to the “inby” (side closest to mine entrance) steel bulkhead of the Permanent Closure. The design for Interim Closure in Room 7 of Panel 7 consists of isolation bulkheads that are installed in the air intake and air exhaust entries of Room 7. On the air intake side (S-2520) these components are more than 400-feet away from the closest waste drums. On the air exhaust side (S-2180), the steel bulkhead is approximately 10 feet from the Waste Face.

In addition to the generator site emplaced Waste Containers in Panel 7, site-derived waste generated during mine recovery operations may be placed in approved CH Waste Containers, sealed, and added to Panel 7 prior to closure. This site-derived waste includes but is not limited to, vehicle/equipment cleaning cloths and materials and other materials used during UG decontamination activities. Contaminated vehicles/equipment may be moved into Panel 7 for closure. Vehicles and equipment in Panel 7, meet specific DOE Carlsbad Field Office (CBFO) approved recovery plan requirements for removal of combustible liquids, including fuel and hydraulic fluids.

2.4.4.7 Geotechnical Monitoring Program

The safety of the UG excavations is evaluated based on criteria established from actual measurements of rock behavior. The Geotechnical Monitoring Program provides measurement of rock mass performance for design validation, routine evaluation of the safety and stability of the excavations, and information necessary to predict the short- and long-term behavior of UG excavations. The criteria are regularly evaluated and modified as more field data are collected from the actual performance of the UG openings.

The instrumentation for open panels includes at least one borehole extensometer installed in the roof at the center of each Disposal Room. The roof extensometers monitor the dilation of the immediate salt roof beam and possible bed separations along clay seams.

Data collection, analyses, and evaluation criteria indicate changes in measured room closure rates over time and when those measured room closure rates exceed projected values. Areas where observed rates vary significantly from projected values are monitored more closely to determine the cause of the variance. If the cause is not related to mining activity, additional field investigation is undertaken to characterize the conditions. If the field data indicate ground conditions are deteriorating, corrective actions are performed. If ground conditions in a Disposal Room deteriorate and cannot be cost-effectively remediated, the room may be closed.

Geologic investigations also include geologic and fracture mapping and seismic monitoring. Borehole inspections can detect displacements, fractures, and separations occurring in the strata immediately surrounding the excavations. The results of geologic investigations provide continued confidence in the performance and geology of the site with respect to site characterization. The seismic monitoring system detects and records data for ground motion earthquakes that occur in the vicinity of the site. It provides computer analysis of the recorded data to generate response spectra plots of the events and provides initiation signals for the closure of dampers in the WHB ventilation systems.

Geotechnical data and the results of the geotechnical investigations are reported annually in the WIPP *Geotechnical Analysis Report for July 2009–June 2010* (DOE/WIPP 11-3177). The report describes monitoring programs, geotechnical data collected during the previous year, and the techniques used for data acquisition. The report details the geotechnical performance of the UG excavations, including shafts, and provides an evaluation of the geotechnical aspects of performance with respect to relevant design criteria.

2.4.5 Support Building

The Support Building is located on the south side of the main east to west road, and north of the WHB. The Support Building provides housing for administrative activities, change rooms, laboratories, operational support activities, and the CMR. The CMR is located on the second floor and provides space for the Central Monitoring System (CMS). The CMS is a computerized system that monitors specific equipment functions and conditions of the UG, the WHB, and its support systems such as HVAC and fire alarms.

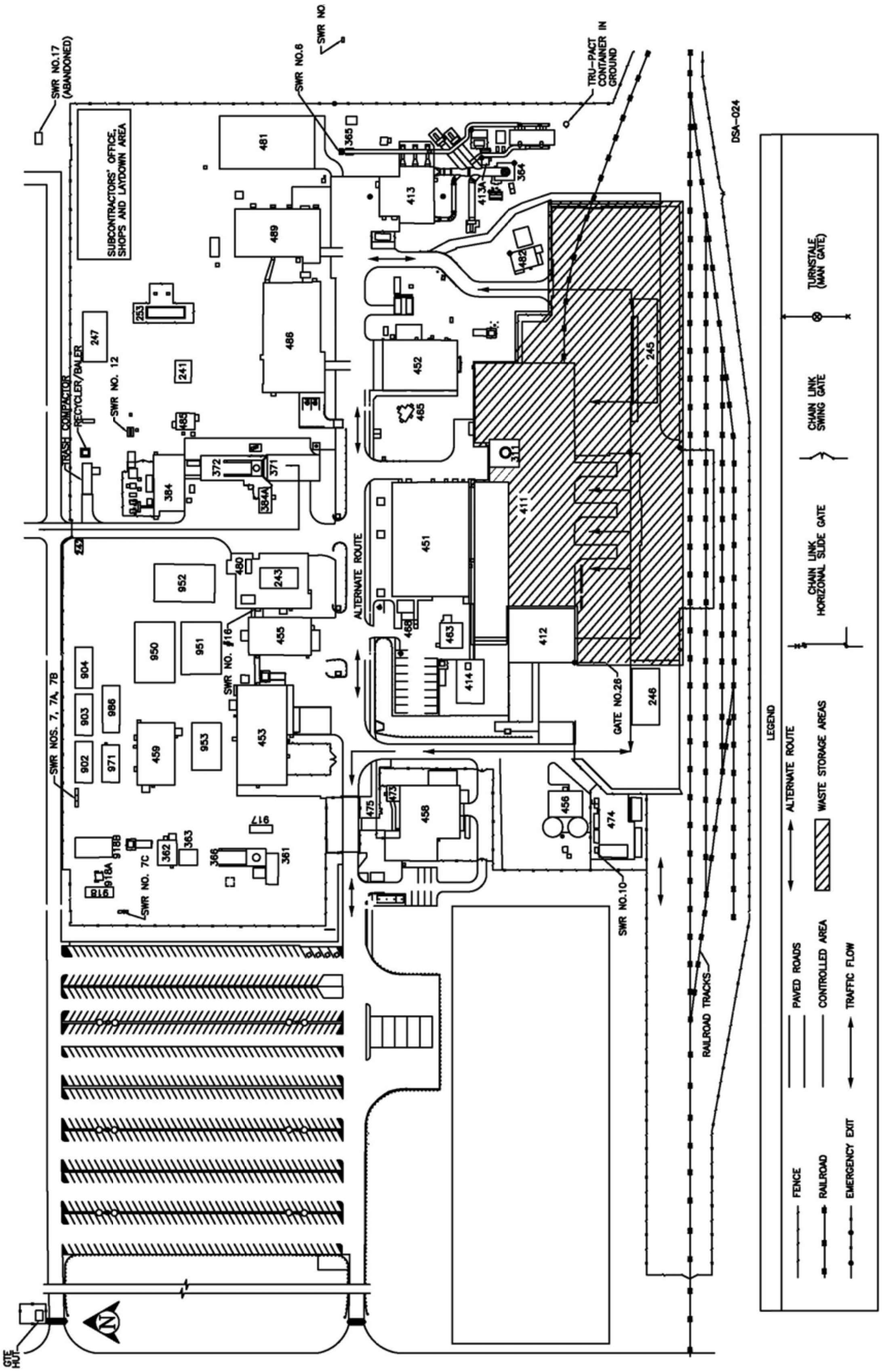


Figure 2.4-1. WIPP Surface Structures

Building / Facility	Description	Building / Facility	Description
241	Equipment Shed	453	Warehouse / Shops Building
242	North Gatehouse	455	Maintenance Shop
243	Salt Hauling Trucks Shelter	456	Water Pumphouse
245	TRUPACT Trailer Shelter	457N	Water Tank 25-D-001B
246	MgO Storage Shelter	457S	Water Tank 25-D-001A
247	North Maintenance Shop	458	Guard and Security Building
255.1	Diesel Generator #1 25P-E-503	463	Compressor Building
255.2	Diesel Generator #2 25P-E-504	465	Auxiliary Air Intake
311	Waste Shaft	473	Armory
351	Exhaust Shaft	474	Hazardous Waste Storage Facility
361	Air Intake Shaft	475	Gatehouse
362	Air Intake Shaft / Hoist House	480	Vehicle Fuel Station
363	Air Intake Shaft / Winch House	481	Auxiliary Warehouse
364	Effluent Monitoring Instrument Shed A	485	Compressor Building
365	Effluent Monitoring Instrument Shed A	486	Engineering Building
366	Air Intake Shaft Headframe	489	Training Building
371	Salt Handling Shaft	902	Office Trailer
372	Salt Handling Shaft Headframe	903	Office Trailer
384	Salt Handling Shaft Hoist House	904	Office Trailer
384A	Salt Hoist Operations	917	Connex
411	Waste Handling Building	918A	Volatile Organic Compound (VOC) Air Monitoring Station
412	TRUPACT Maintenance Facility	950	Work Control Trailer
413	Exhaust Filter Building	951	Office Trailer
413A	Effluent Monitoring Room A	952	Office Trailer
413B	Effluent Monitoring Room B	953	Security and Procurement Office
414	Water Chiller Facility and Building	971	Office Trailer
451	Support Building	986	Office Trailer
452	Safety and Emergency Services Building		

Figure 2.4-1. WIPP Surface Structures (continued)

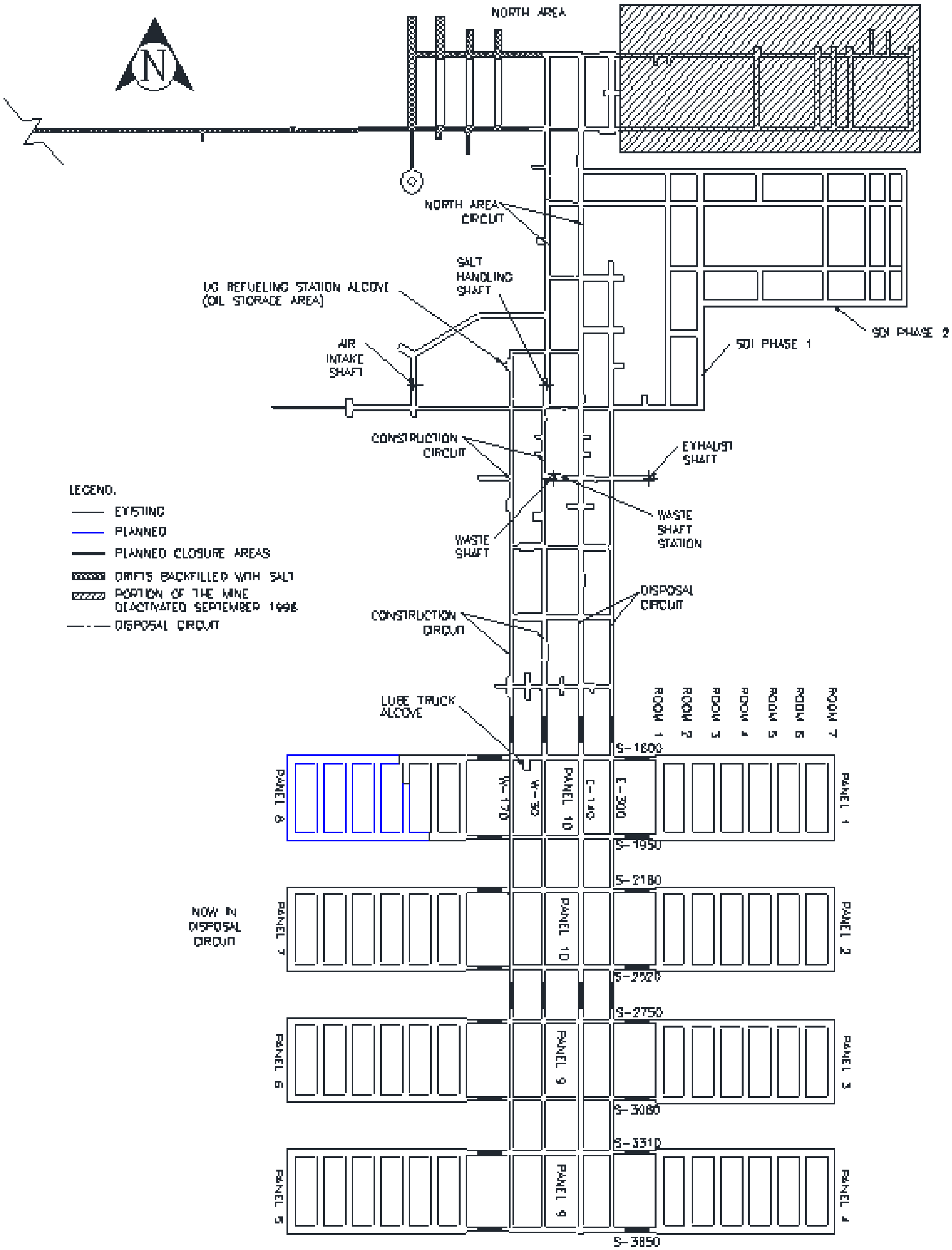


Figure 2.4-2. Underground Facilities

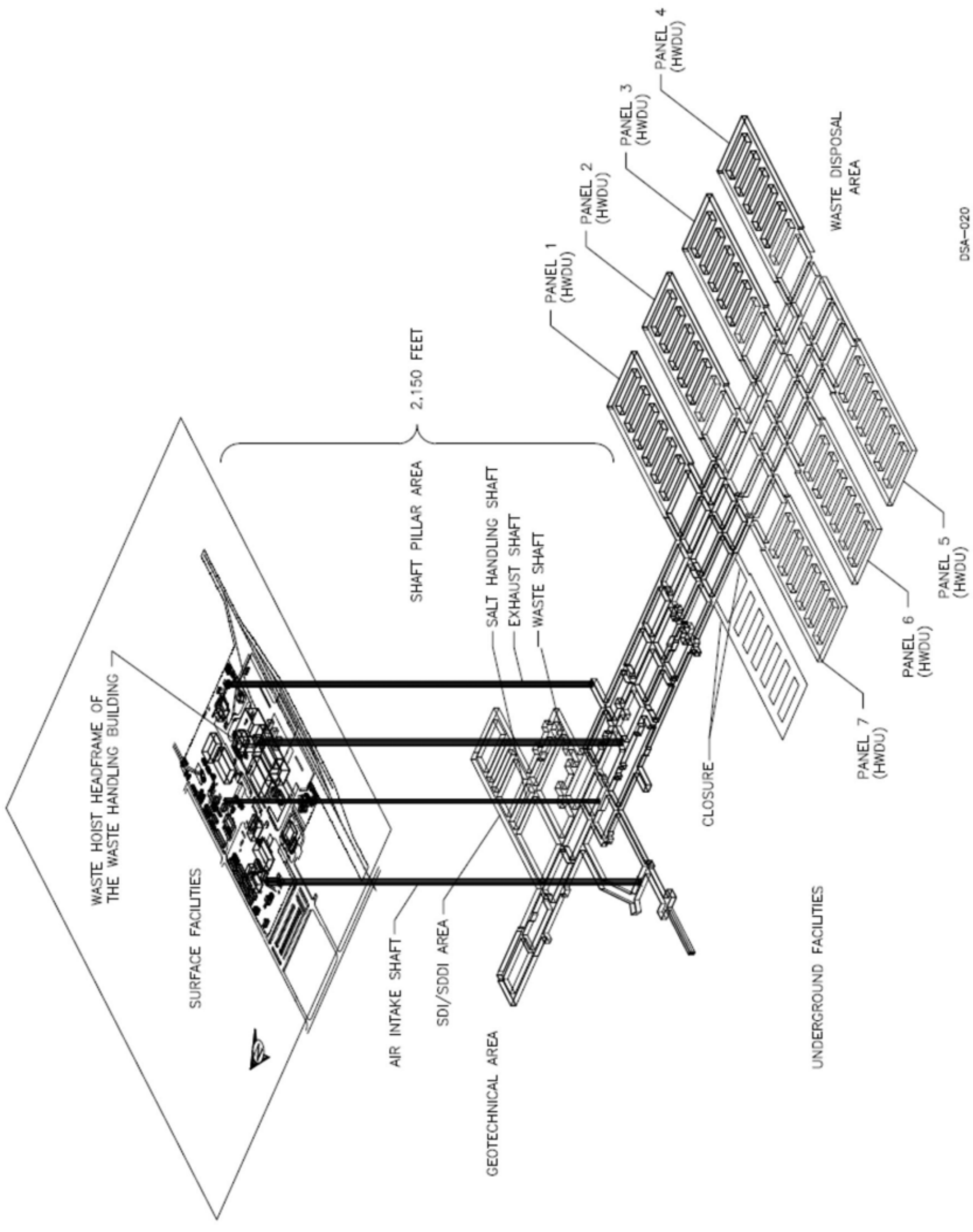


Figure 2.4-3. Spatial View of the WIPP Underground Facilities

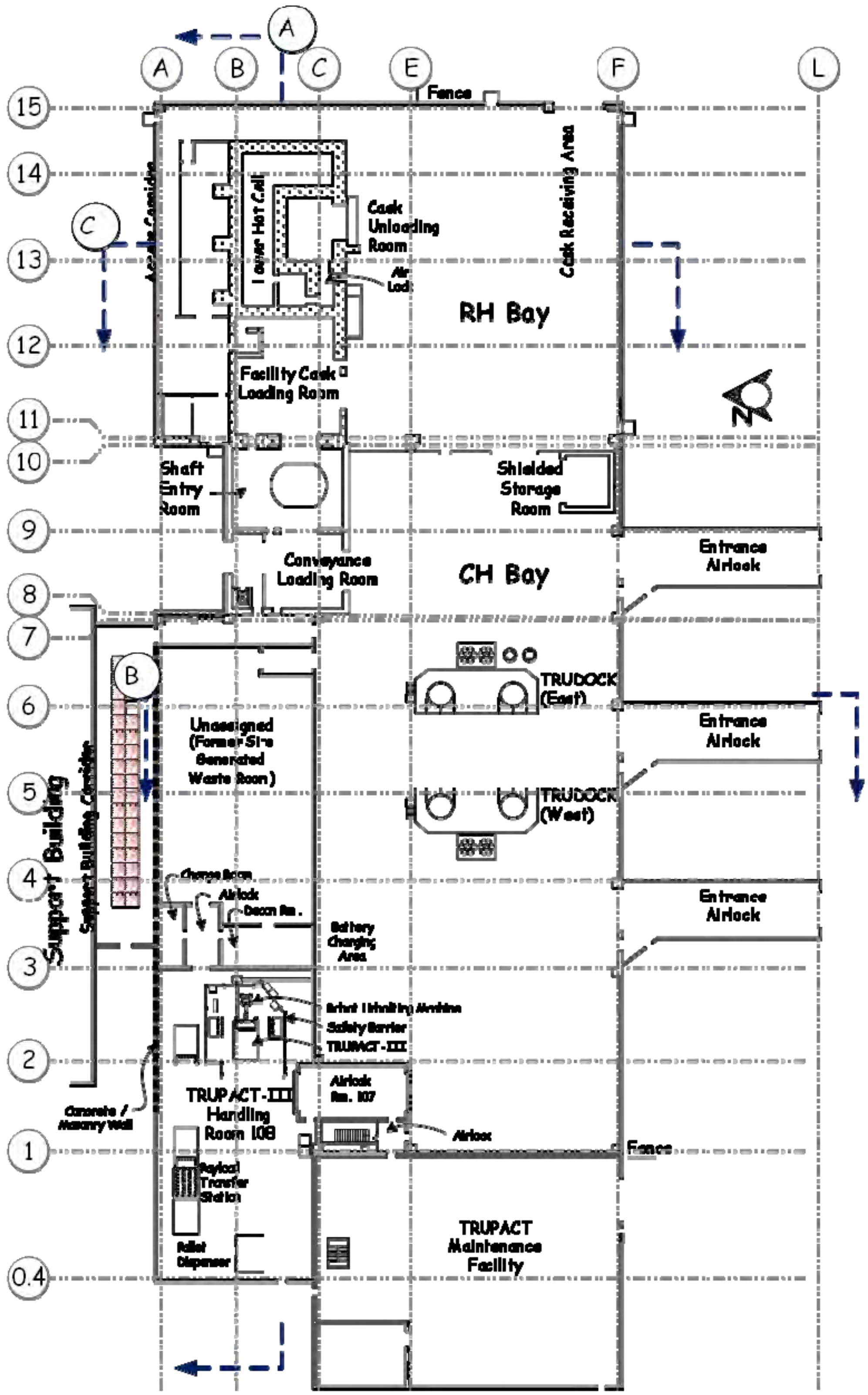


Figure 2.4-4. Waste Handling Building Plan (Ground Floor)

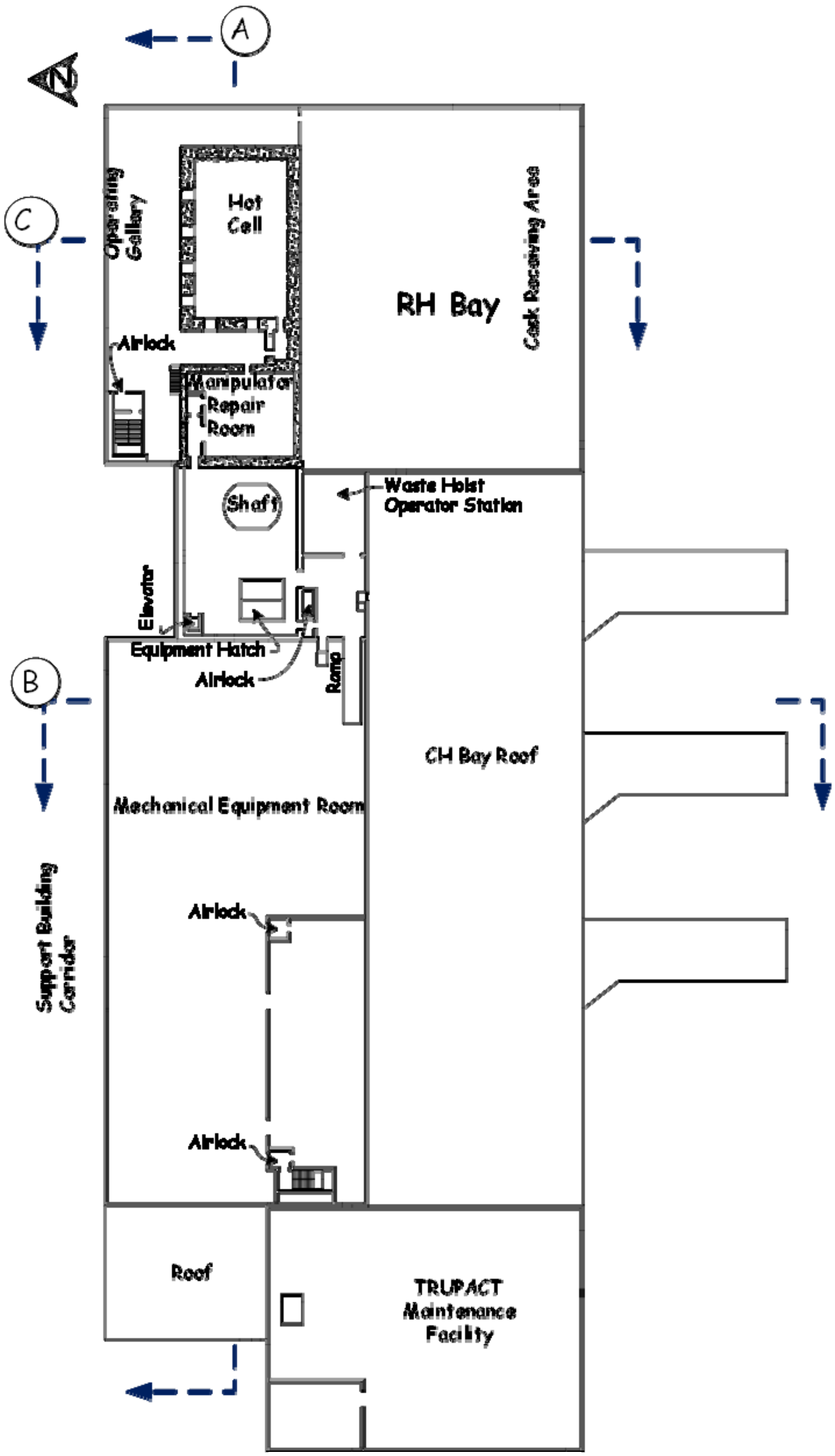


Figure 2.4-5. Waste Handling Building Plan (Upper Floor)

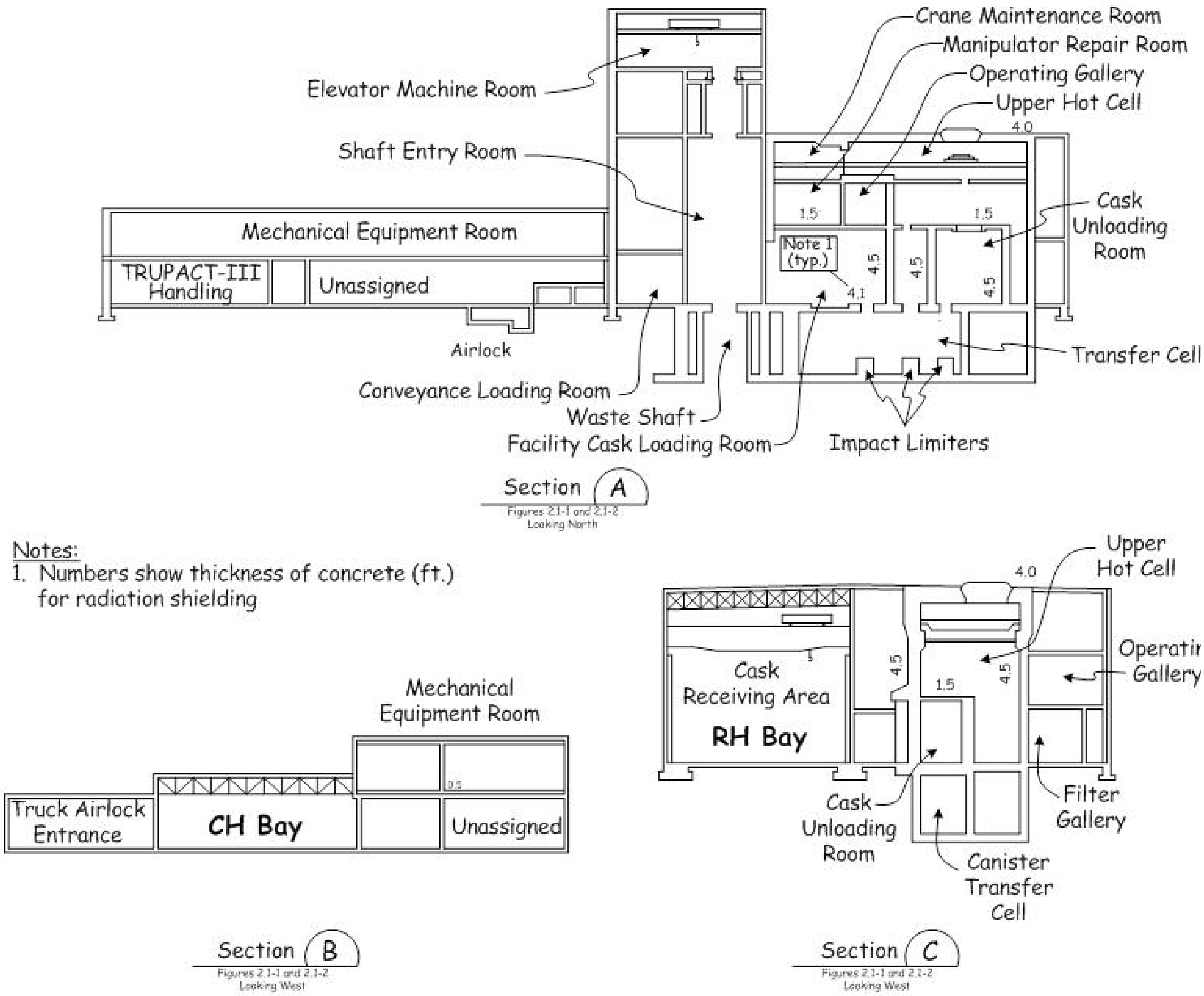


Figure 2.4-6. Waste Handling Building (Sections)

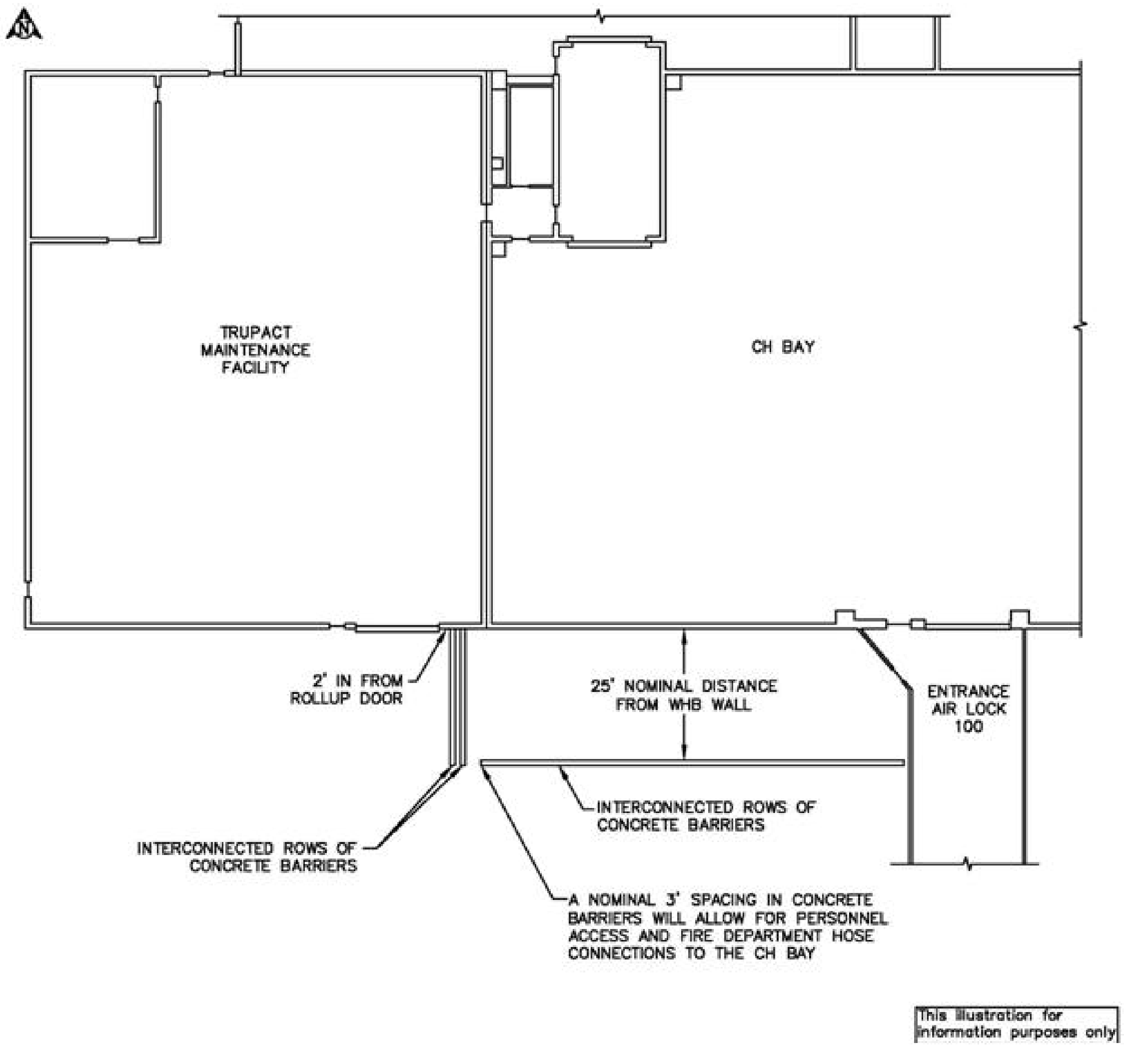


Figure 2.4-7. Waste Handling Building South Wall Vehicle Barrier Configuration

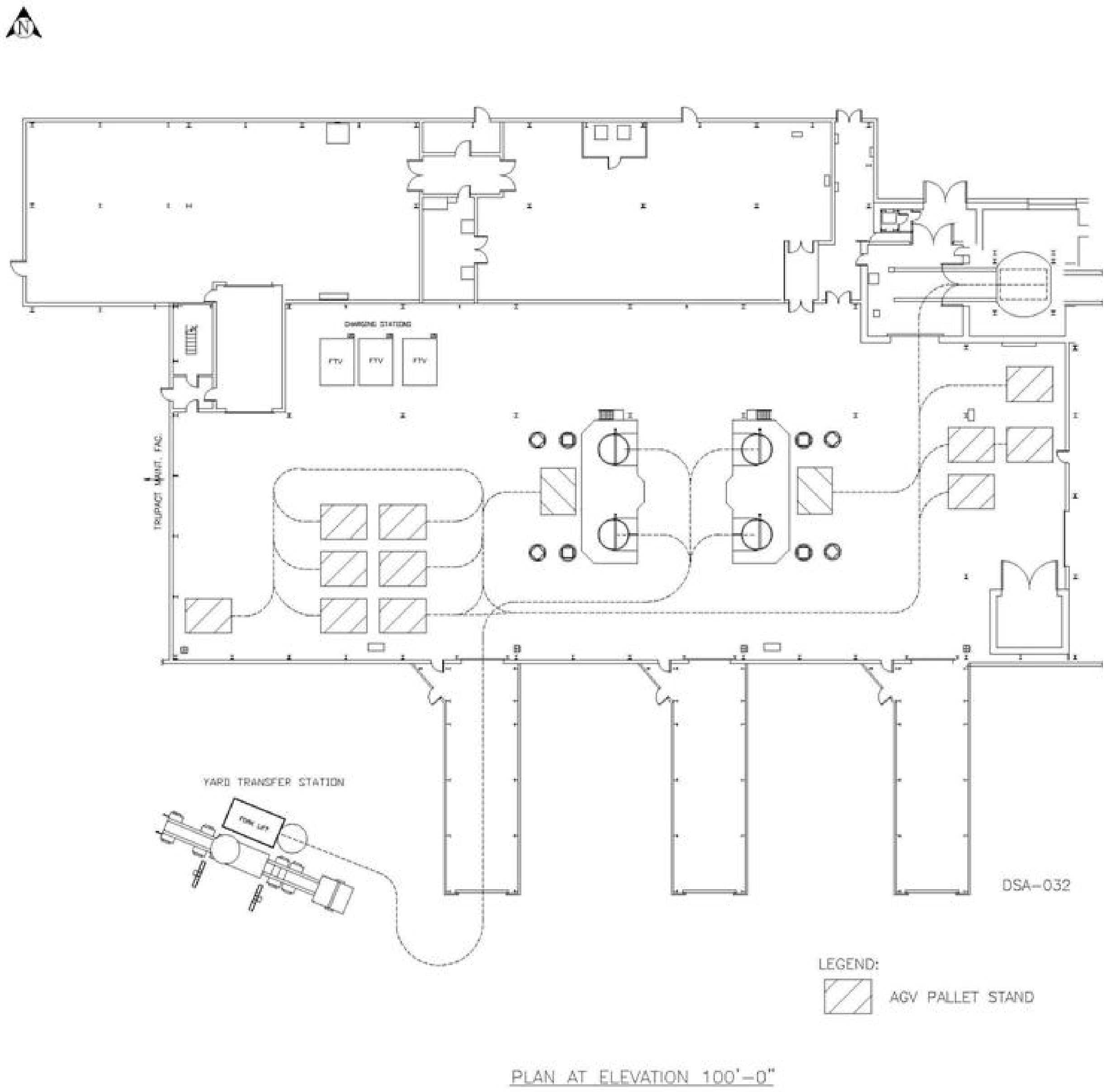


Figure 2.4-8. Contact-Handled Waste Transport Routes in the Waste Handling Building

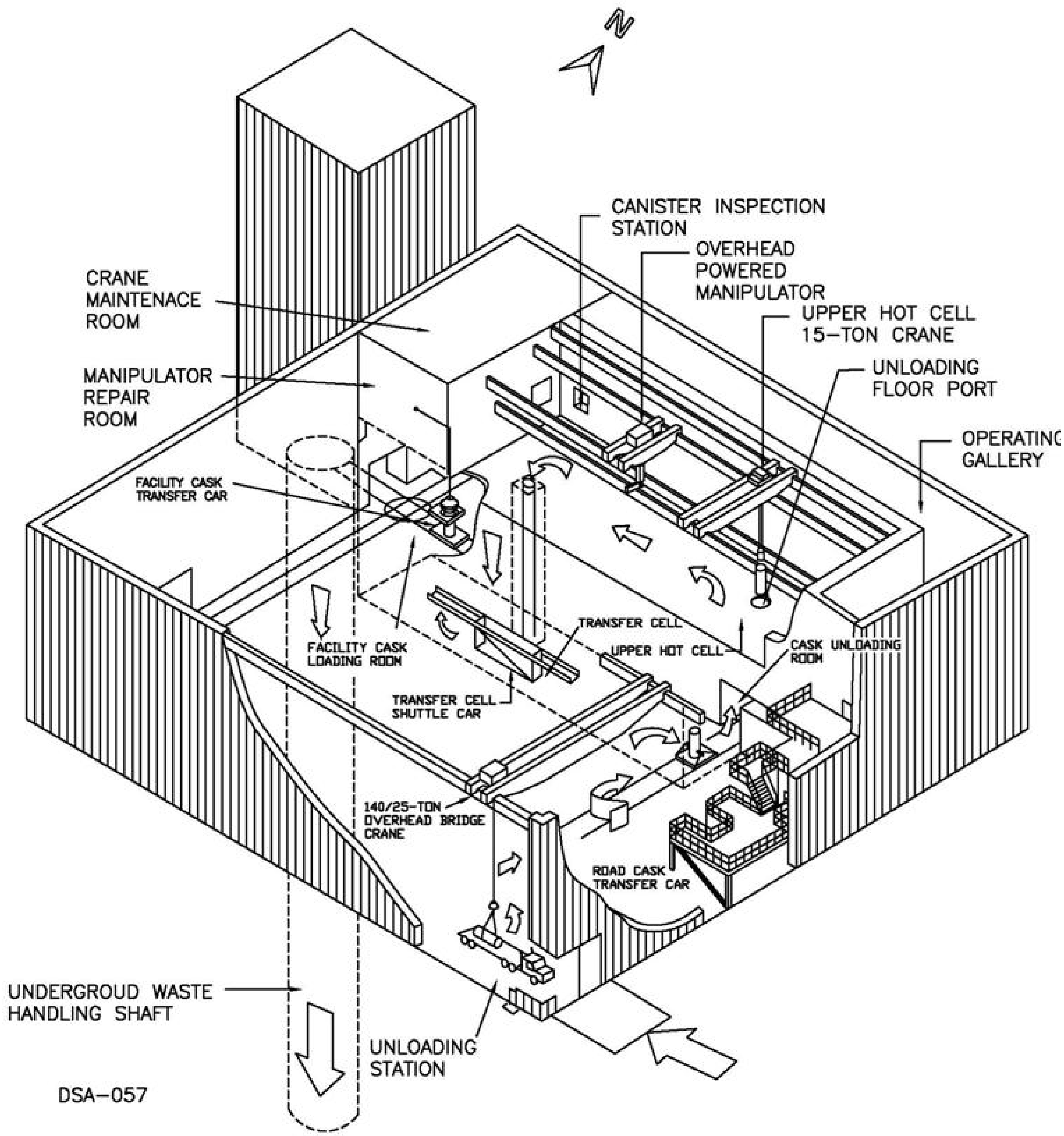


Figure 2.4-9. Pictorial View of the Remote-Handled Surface Facilities and Flow of 10-160B Process

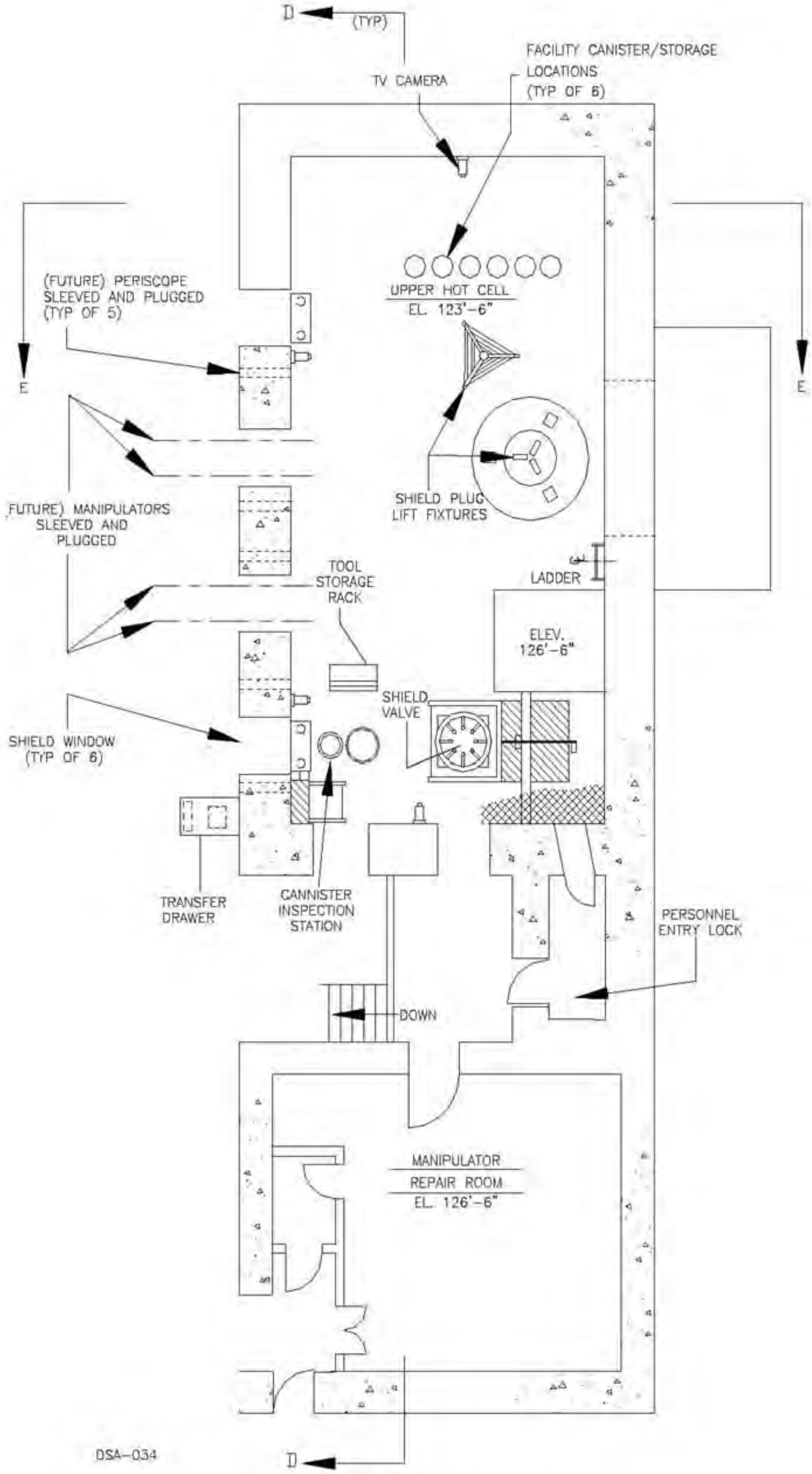


Figure 2.4-10. Details of Upper Hot Cell

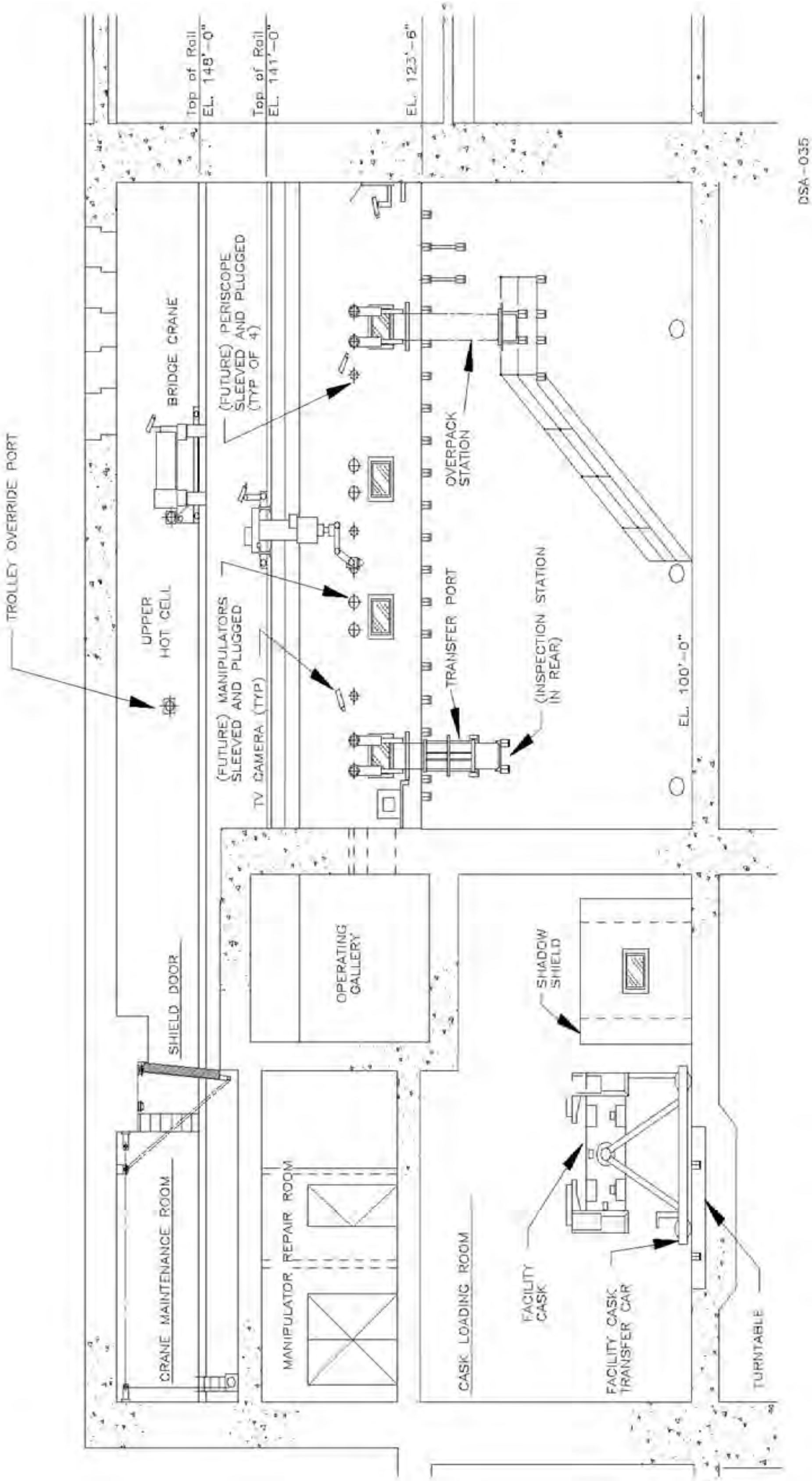


Figure 2.4-11. Details of Upper Hot Cell Complex at Cross Section D-D

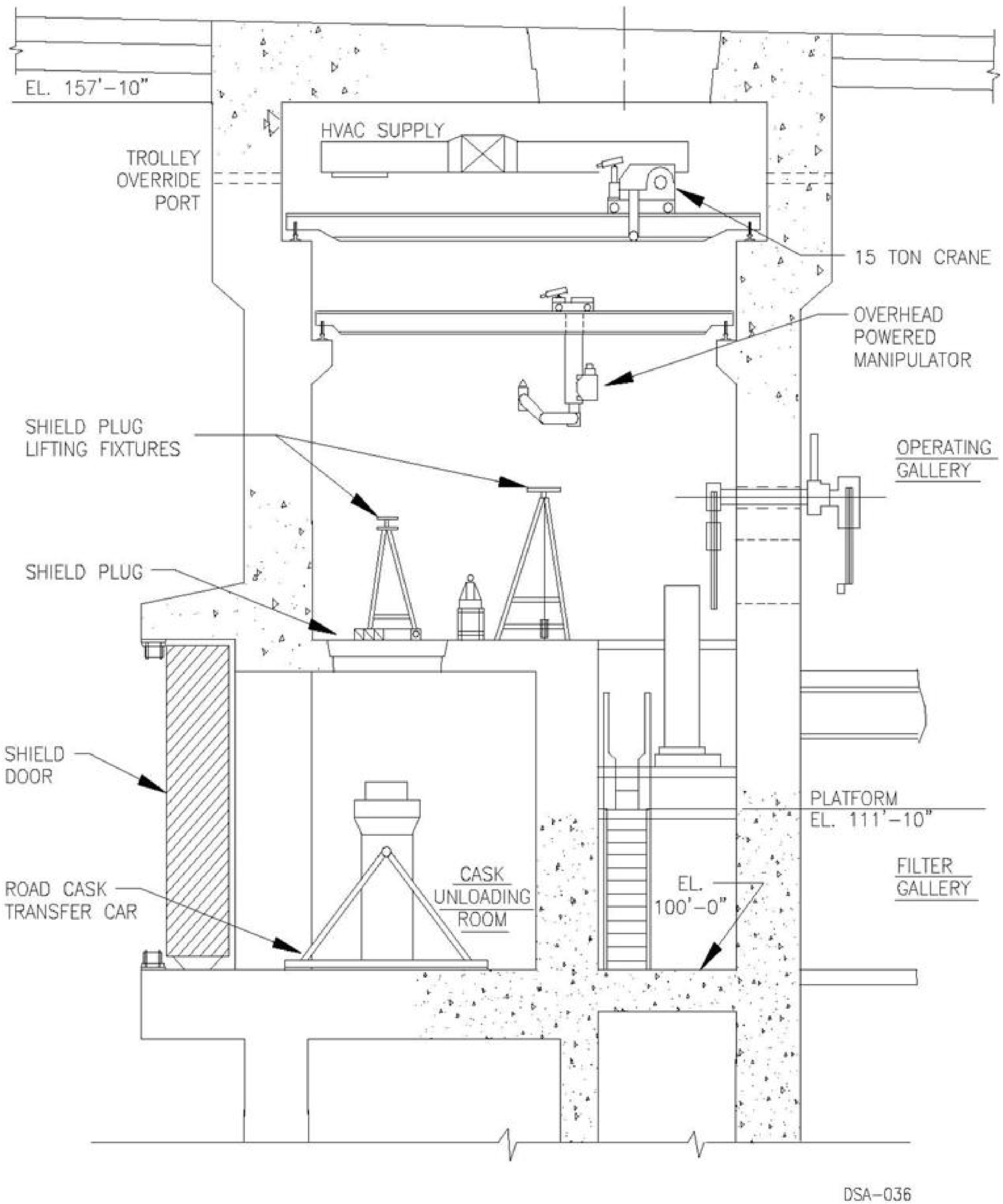


Figure 2.4-12. Details of Upper Hot Cell Complex at Cross Section E-E

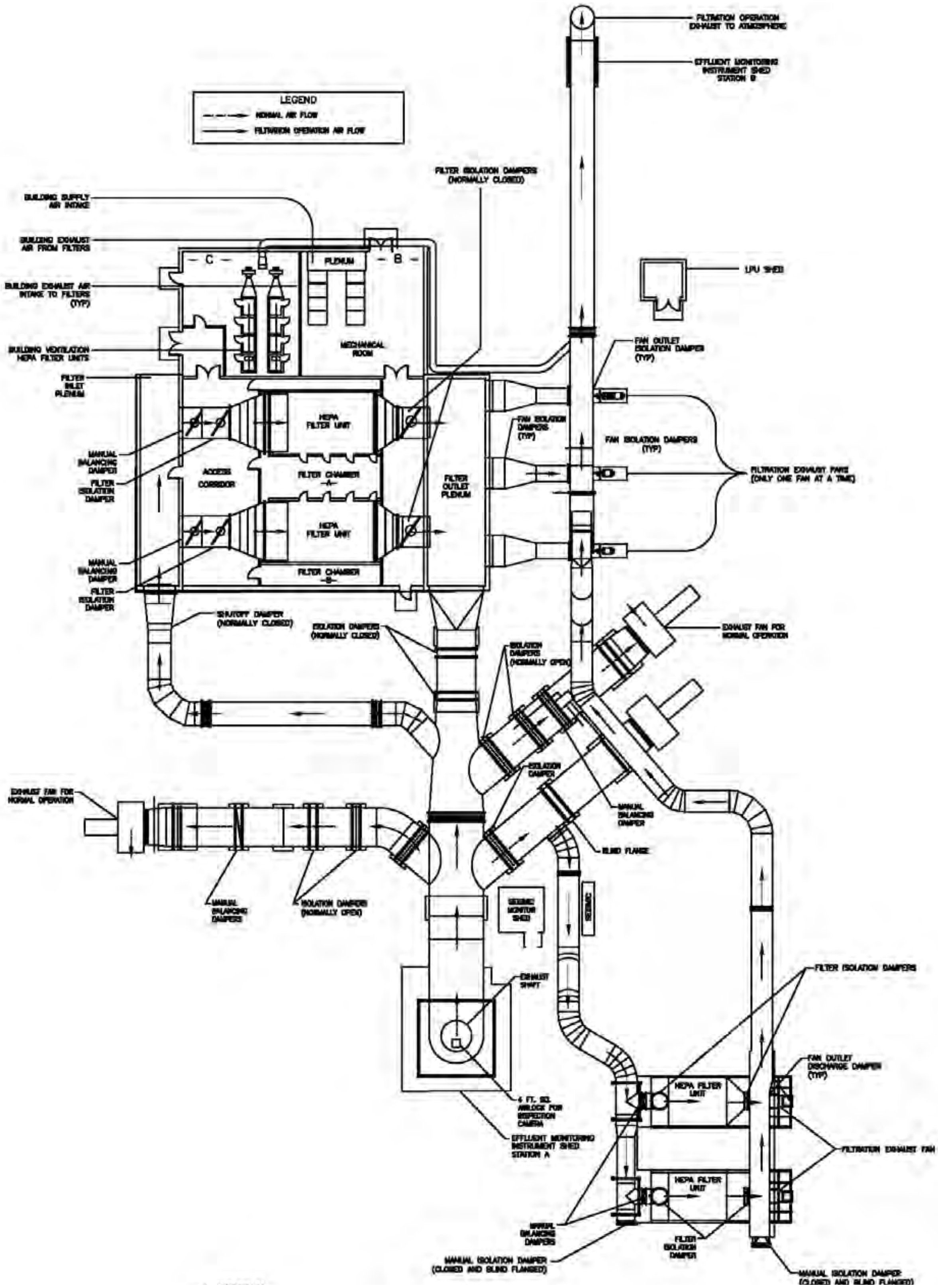


Figure 2.4-13. Exhaust Filter Building

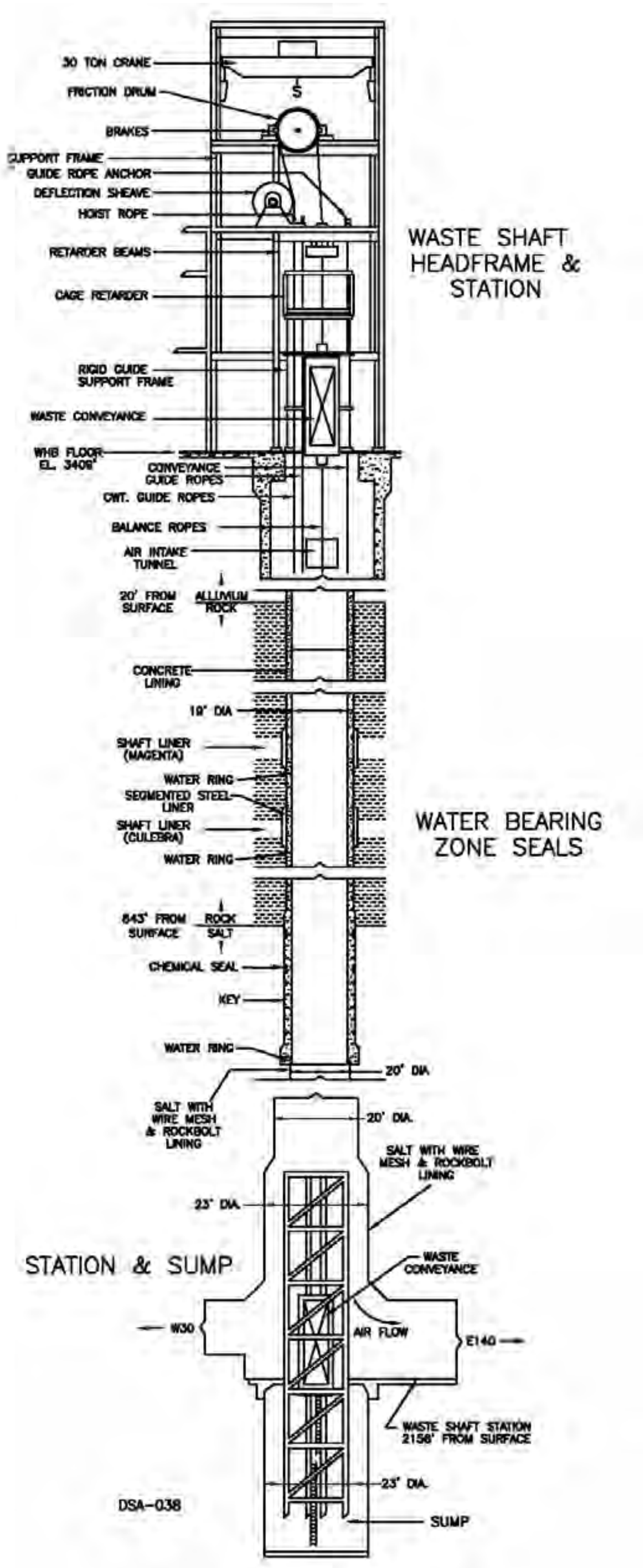


Figure 2.4-14. Waste Shaft, Hoist, and Conveyance Arrangement

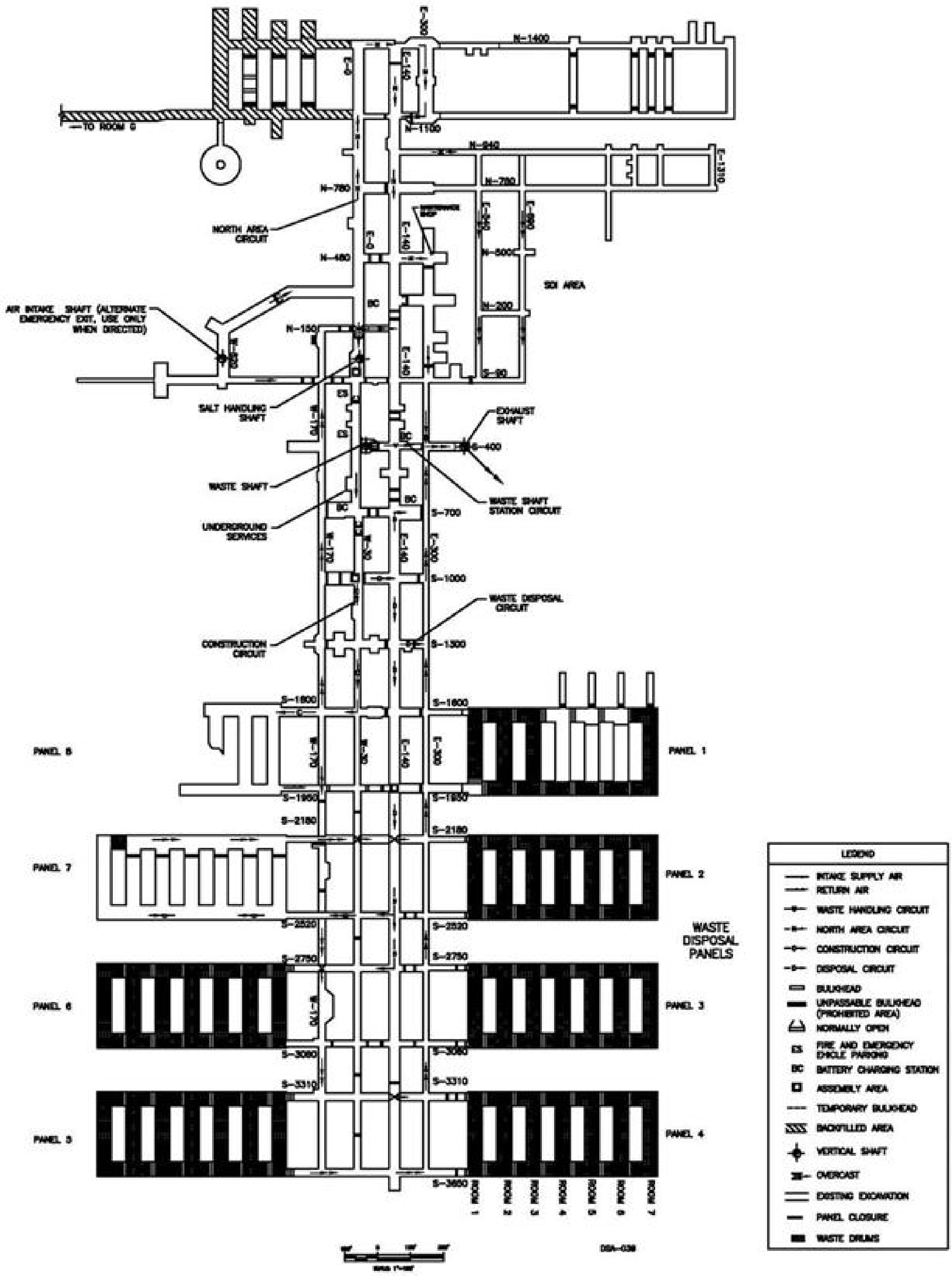


Figure 2.4-15. Underground Layout and Ventilation Flow

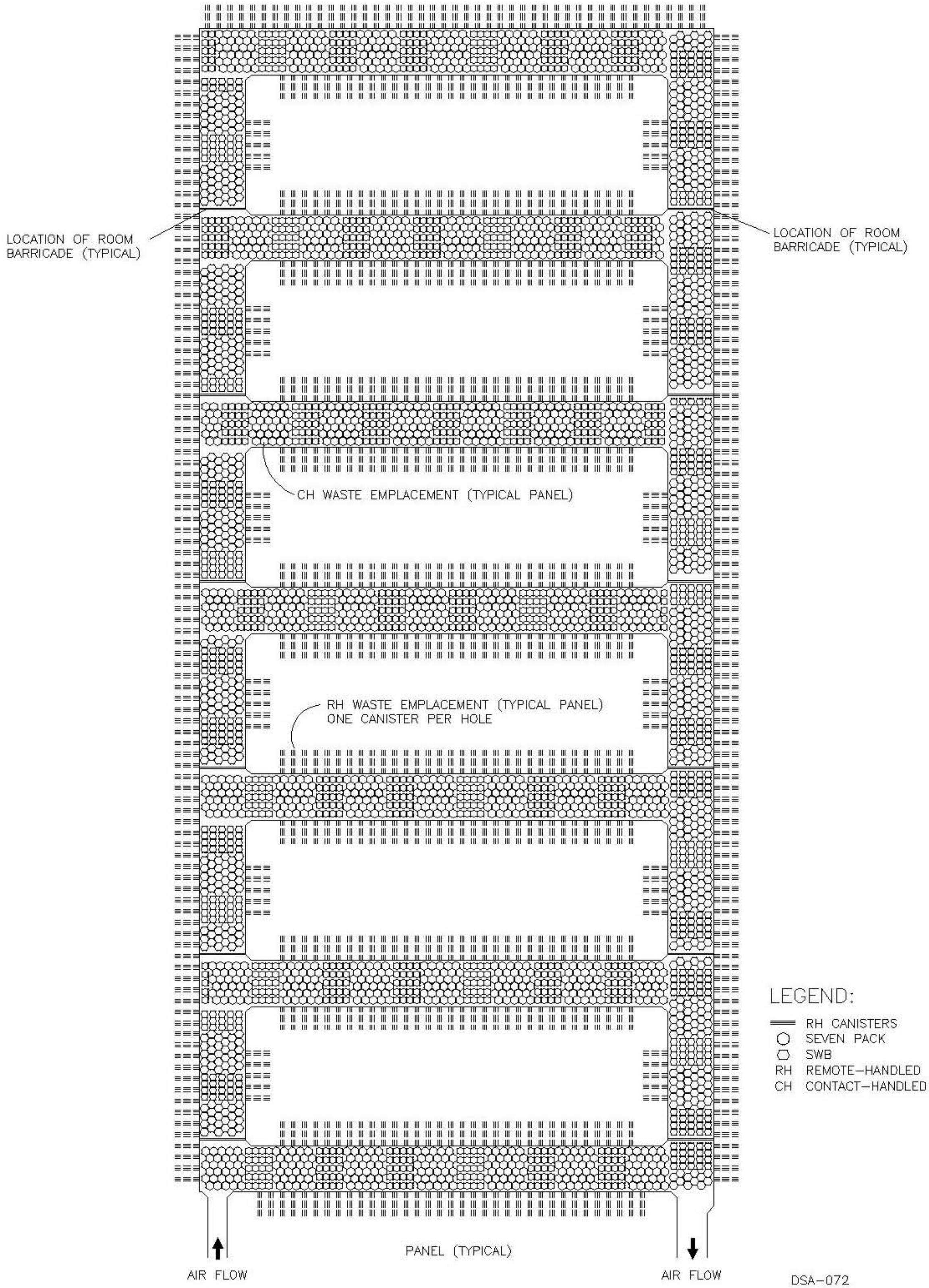


Figure 2.4-16. Typical Waste Disposal Configuration

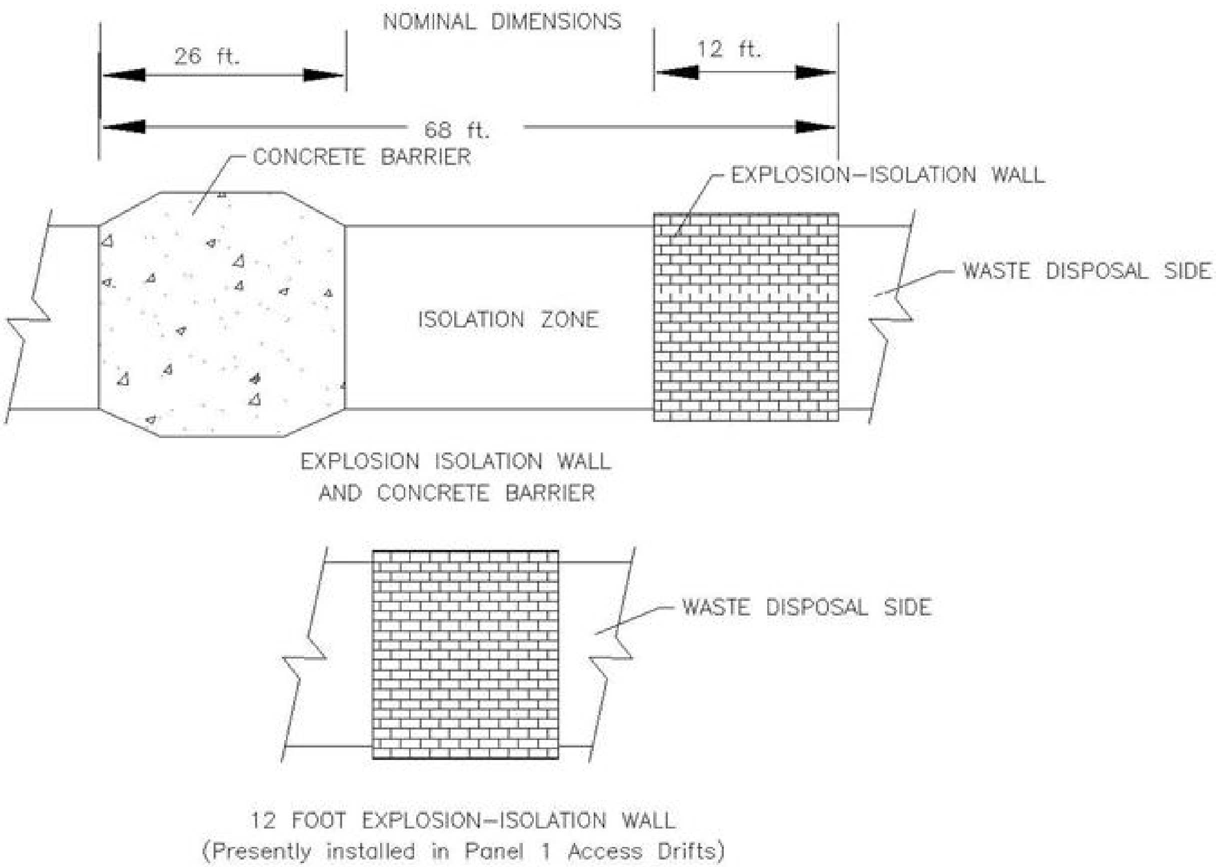


Figure 2.4-17. Panel Closure System

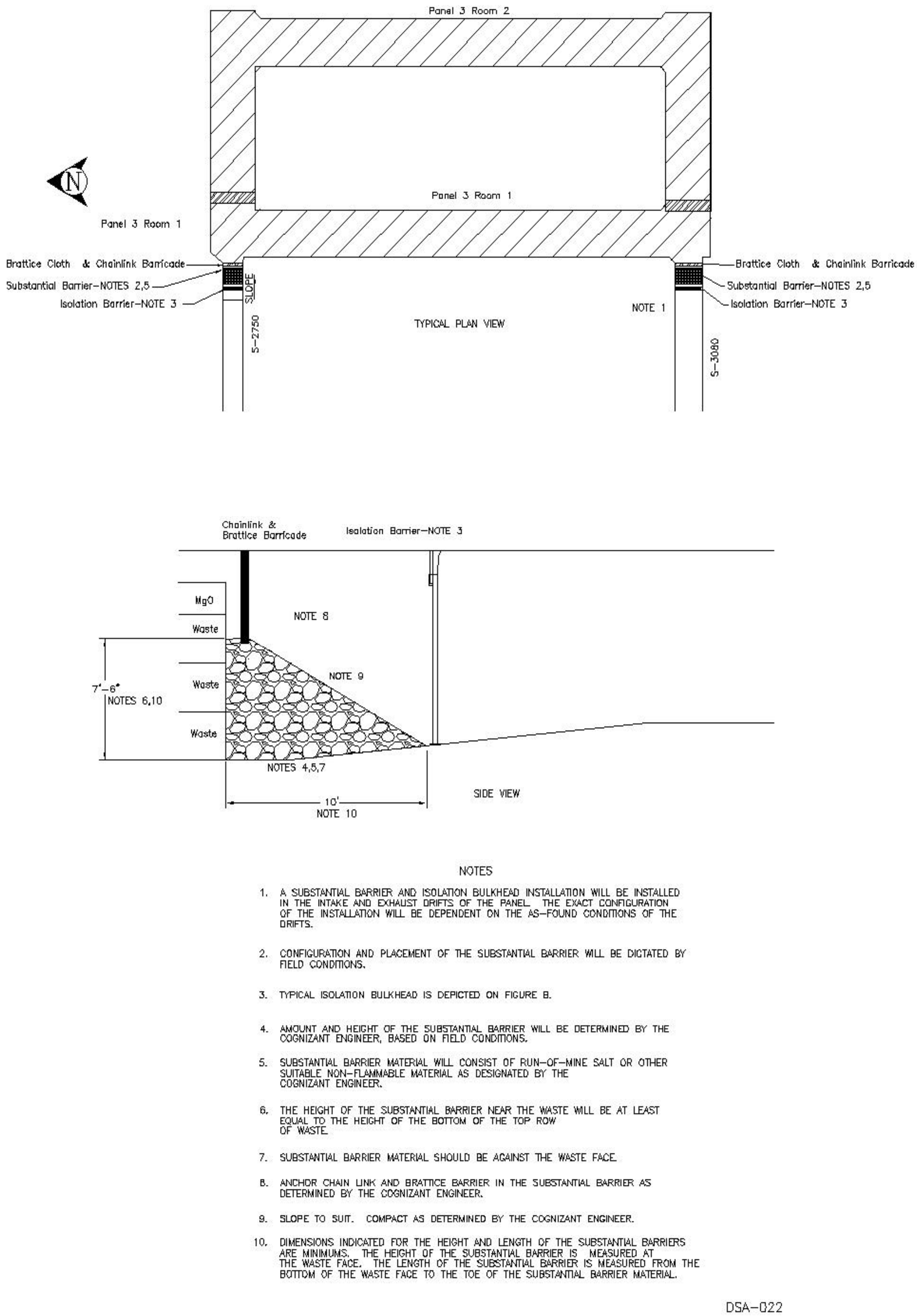


Figure 2.4-18. Substantial Barrier and Isolation Bulkhead

2.5 REMOTE-HANDLED WASTE HANDLING EQUIPMENT AND PROCESS DESCRIPTION

The RH TRU process is not being authorized under Revision 5a of the DSA as this activity will not be implemented as part of CH waste emplacement restart. While the RH process has been included in the hazard analysis and consequence calculations, together with partial descriptions in various sections of the DSA, the RH process did not drive any of the required safety significant controls. Future authorization of the RH TRU process will require revalidation of the RH analysis and must include a resolution for the vulnerabilities of the RH crane in a seismic event and other comments on the RH hazard evaluations.

This section describes the WIPP RH Waste Handling equipment and process, which begins at the gate of the WIPP facility where RH Waste arrives by truck (Figure 2.5-1). Two types of trailers may be used to ship the RH-TRU 72-B shipping package: one where the package is rotated from horizontal to vertical using an overhead crane and one that uses hydraulics to rotate the RH-TRU 72-B shipping package. The 10-160B shipping package did not require rotation to remove it from its trailer. Either type of trailer is positioned in the RH Bay of the WHB using a trailer jockey or the transport tractor. Specific details of acceptable quantities and forms are provided in the WIPP WAC and the HWFP. Diagrams of the RH Waste Handling processes are shown in Figure 2.5-2 and Figure 2.5-3.

2.5.1 Remote-Handled Waste Shipping Packages

2.5.1.1 Remote-Handled Transuranic 72-B Shipping Package

The RH-TRU 72-B shipping package is a stainless-steel, lead-shielded package designed to provide double containment for shipment of TRU Waste materials (Figure 2.5-4). The packaging consists of a cylindrical stainless-steel and lead package body, a separate inner stainless-steel vessel, and foam-filled impact limiters at each end of the package body. The shipping package is designed to safely transport a single RH Waste Canister. The three types of RH Waste Canisters are the RH-TRU 72-B (fixed-lid and removable lid canisters), the NS15, Neutron Shielded Canister, and the NS30, Neutron Shielded Canister. The maximum payload weight is 8,000 pounds.

The RH-TRU 72-B shipping package body consists of a 1.5-inch-thick, 41.1-inch outer diameter stainless-steel outer shell, and a 1.0-inch-thick, 32.4-inch inside diameter stainless-steel inner shell, with 1.9 inches of lead shielding between the two shells. A 5-inch-thick bottom forging is welded to the outer package. The outer package is closed by a 6-inch-thick stainless-steel lid with 18 evenly spaced 1.25-inch-diameter bolts. The main closure lid has a double-bore-type O-ring seal. The containment seal is the inner butyl O-ring seal, which is leak testable. The outer package lid has a seal test port and a vent/sampling port sealed with butyl O-rings. The approximately 27,900-pound outer package provides a containment boundary for the payload and acts as an environmental barrier. The lead shielding ensures the surface radiation levels are below DOT limits.

The separate inner vessel is constructed of a 1.5-inch-thick bottom forging welded to a 0.4-inch-thick, 32-inch outside diameter shell. The 6.5-inch inner vessel lid is secured by eight evenly spaced 7/8-inch-diameter bolts and has three test ports, one of which is designated as the vent/sampling port. The inner vessel cavity has a minimum diameter of 26.5 inches and is 121.5 inches long. The approximately 4,000-pound inner vessel provides a containment boundary for the RH Waste Canister.

The RH-TRU 72-B shipping package is certified by the NRC in accordance with “Special Requirement for Plutonium Shipments” (10 CFR 71.63) and *RH-TRU 72-B Certificate of Compliance* (NRC 2011). The general shipping package arrangement, shown in Figure 2.5-4, includes impact limiters, weighing approximately 2,500 pounds each, at each end of the shipping package that function to provide protection of the seal areas during the hypothetical transport accident events. Each impact limiter is constructed of polyurethane foam-filled stainless steel attached to the outer container with six evenly spaced 1.25-inch-diameter bolts. The maximum gross weight of an RH-TRU 72-B shipping package with impact limiters and a fully loaded RH Waste Canister is 45,000 pounds.

The impact limiters are provided with lifting lugs, allowing the use of rigging for handling. Both of the shipping package lids have bayonet sockets in the outside center for insertion of lifting fixtures. Both lids are also provided with threaded holes for insertion of lifting bolts or eyes. The shipping package has two transport trunnions, used for support during transport and as a mounting point for the RH-TRU 72-B RCTC. It also has four handling trunnions, located 90 degrees apart at the lid end, used for lifting in the RH Bay and CUR. There are two trunnions located at the opposite end used for rotating the package from the horizontal to the vertical position.

2.5.1.2 10-160B Shipping Package

The 10-160B shipping package is a steel, lead-shielded package designed to provide single containment for shipment of 55-gallon drums of RH Waste. The packaging consists of a cylindrical carbon-steel and lead body with an impact limiter at each end. The 10-160B is designed to safely transport ten 55-gallon drums of RH Waste in two-stacked drum carriage units holding five drums each. The maximum payload weight is 14,500 pounds.

The package body consists of a 2.0-inch-thick, 78.5-inch outer diameter carbon-steel outer shell, and a 1.1-inch-thick, 68-inch inside diameter carbon-steel inner shell, with 1.9 inches of lead shielding between the two shells. A 5.5-inch-thick flat circular steel bottom plate is welded to the inner and outer shells. The lead shielding ensures that the surface radiation levels are below DOT limits. The internal cavity has a diameter of 68 inches and is 77 inches high. The overall length of the package without impact limiters is 88 inches. An 11-gauge stainless-steel thermal shield surrounds the package outer shell in the region between the impact limiters. The container is closed by a 5,300-pound, 5.5-inch-thick steel primary lid that is attached to the package with 24 evenly spaced 1.75-inch-diameter bolts. The lid closure is made in a stepped configuration to eliminate radiation streaming at the lid/package body interface. A double O-ring provides the lid-to-package seal.

The primary lid has a 31-inch-diameter opening that is equipped with a secondary lid. The 2,150-pound, 5.5-inch-thick, 46-inch-diameter steel secondary lid is attached to the center of the primary lid with 12 evenly spaced 1.75-inch-diameter bolts. The secondary lid has multiple steps machined in its periphery that match those in the primary lid, eliminating radiation-streaming pathways, and is sealed to the primary lid by a double O-ring.

The 10-160B shipping package is certified by the NRC in accordance with 10 CFR 71.63 and *10-160B Certificate of Compliance* (NRC 2010). The 10-160B shipping package arrangement includes impact limiters at each end of the shipping package. The upper (lid end) impact limiter weighs 5,300 pounds and the lower weighs 5,200 pounds. Both impact limiters extend about 12 inches beyond the outside wall of the shipping package and are installed before transport. Each 102-inch outside diameter impact limiter is constructed of polyurethane foam-filled stainless steel. The impact limiters are secured to each other around the package by eight ratchet binders. The maximum gross weight of a loaded 10-160B shipping package with impact limiters is 72,000 pounds and its overall length is 130 inches. The impact limiters are provided with lifting lugs, allowing the use of rigging for handling. The 10-160B shipping package is equipped with four tie-down lugs welded to the outer shell, which also has two lifting lugs and two redundant lifting lugs, which are removed during transport and reinstalled for Waste Handling operations.

The secondary lid is equipped with three lifting lugs used to lift both lids. Both lids are covered by the top impact limiter and rain cover during transport.

2.5.2 Remote-Handled Waste Containers and Canisters

RH Waste Containers approved for disposal at the WIPP include 55-gallon drums shipped in a 10-160B shipping package and RH Waste Canisters inside an RH-TRU 72-B shipping package. The RH Waste Canisters and 55-gallon drums are equipped with filtered vents that allow aspiration, preventing internal pressurization of the container and minimizing the buildup of flammable gas concentrations, and preventing the escape of radioactive particulates.

2.5.2.1 Remote-Handled Waste Canister

The RH Waste Canister can be a fixed lid or a removable lid type. The fixed lid canister is a carbon- or stainless-steel single-shell container with an outside diameter of 26 inches, a wall thickness of 0.25 inch, an overall length of approximately 121 inches, weighs approximately 1,760 pounds empty, and has a maximum gross weight of 8,000 pounds (Figure 2.5-5). It has an inside diameter of approximately 25.5 inches with an inside length of approximately 108 inches. The dished head with an integral WIPP standard lift pintle is attached to the shell after the canister is filled with waste. The canister is vented using a suitable filter and can be direct loaded or loaded with three drums of radioactive waste, each with a vent filter. The removable lid canister has approximately the same dimensions, except it weighs approximately 1,100 pounds empty. The RH Waste Canister may have either a welded or a mechanically attached lid.

2.5.2.2 Neutron-shielded Waste Canisters

The neutron-shielded Waste Canister is an augmented RH-TRU 72-B Waste Canister and is available in two new configurations: NS15 and NS30. A neutron-shielded Waste Canister incorporates internal neutron shielding components that provide two levels of supplemental shielding for approximately 15- and 30-gallon inner containers (drums), respectively. The additional neutron shielding ensures that any surface level dose rates on the outer shipping package are below DOT transportation limits. The canisters are designed to be used for the shipment of specific TRU Waste forms in the RH-TRU 72-B shipping package. The RH-TRU 72-B shipping package accommodates one neutron-shielded Waste Canister.

The NS15 Waste Canister (Figure 2.5-6) is essentially identical to the NS30 with appropriate modification to accommodate a thicker neutron shielding insert (with minimum pipe thickness of 3.288 inches) and weighs approximately 2,070 pounds empty. The NS15 is designed to carry three 15-gallon steel payload drums with each drum and its contents weighing approximately 337 pounds.

The NS30 Waste Canister (Figure 2.5-7) is a removable-lid canister with a high-density polyethylene neutron-shielding insert with minimum pipe thickness of 1.412 inches. It is approximately 26 inches in diameter and approximately 120 inches tall, weighs approximately 1,660 pounds empty, and has a maximum gross weight of 3,100 pounds. It is designed to carry three 30-gallon steel payload drums with each drum and its contents weighing approximately 480 pounds.

2.5.3 Remote-Handled Waste Casks

There are two types of RH Waste Casks: the Facility Cask and the LWFC.

2.5.3.1 Shielded Insert

The shielded insert is specifically designed to be used in the Transfer Cell to hold and transport loaded facility canisters from the Upper Hot Cell until loaded into the RH Waste cask. The shielded insert, designed and constructed similar to the RH-TRU 72-B shipping package, has a 29-inch inside diameter and an inside length of 130.5 inches to accommodate the facility canister. The shielded insert is installed on and removed from the Transfer Cell Shuttle Car in the same manner as the RH-TRU 72-B shipping package.

2.5.3.2 Facility Cask

The Facility Cask (Figure 2.5-8) is a double end-loading shielded cask, weighing approximately 67,000 pounds empty and 75,000 pounds loaded (with a maximum weight Waste Canister of 8,000 pounds). The Facility Cask is approximately 165 inches long with an approximate height of 98 inches and consists of two concentric steel cylinders with the annulus between them filled with lead. The internal cylinder has a 30-inch diameter and a 0.50-inch wall thickness. The outer cylinder has an external diameter of 41.75 inches with a wall thickness of 0.625 inch. The lead annulus is 4.75 inches thick. The robustness of the Facility Cask serves to prevent any breach of the Waste Canister. The Facility Cask is designed such that it maintains its shielding integrity when dropped from a height of up to 102 inches The equivalent impact load is 1 g horizontal and 13 g vertical (SDD WH00, *Waste Handling System (WH00) System Design Description (SDD)*). The Facility Cask has two support trunnions located approximately mid-length at 180 degrees from each other. The trunnions are the support points of the FCTC. The Facility Cask has a motor-operated gate-type shield valve at each end used for loading and unloading RH Waste Canisters. Both shield valves are electrically operated with manual overrides and have spring-loaded pins that lock the valve gates closed. Compressed air is used to release the locking pins to permit the valves to be opened. The Facility Cask shield valves have approximately 9-inch-thick steel blocks and are designed to support the weight of a fully loaded RH Waste Canister when they are closed and the cask is vertical. The Facility Cask has two sets of forklift pockets; the lower set is used for transport and placement on the Horizontal Emplacement and Retrieval Equipment (HERE) or the Horizontal Emplacement Machine (HEM).

The Facility Cask is designed to provide shielding for an RH Waste Canister such that the cask surface dose rate is less than 200 mrem per hour when the Waste Canister surface dose rate is 7,000 rem per hour.

Both Facility Cask shield valves are equipped with limit switches to indicate locking pin position (retracted or inserted) and shield valve position (open or closed). Additional switches mounted in the face of each shield valve housing indicate when the shield bell is in contact with the top shield valve housing and when the telescoping port shield ring is in contact with the bottom shield valve housing.

2.5.3.3 Light-Weight Facility Cask

The LWFC (Figure 2.5-9) is a double end-loading shielded cask, weighing approximately 48,450 pounds empty and 56,450 pounds loaded (with a maximum weight RH Waste Canister of 8,000 pounds). The LWFC is approximately 165 inches long with an approximate height of 92 inches and consists of two concentric steel cylinders with the annulus between them filled with lead. The internal cylinder has a 30-inch diameter and a 0.50-inch wall thickness. The outer cylinder has an external diameter of 36.25 inches with a wall thickness of 0.625 inch. The lead annulus is 2.0 inches thick. The robustness of the LWFC serves to prevent any breach of the RH-TRU 72-B canister. The LWFC is designed such that it maintains its shielding integrity when dropped from a height of up to 102 inches. The equivalent impact load is 1 g horizontal and 13 g vertical (SDD WH00). The LWFC has two support trunnions located approximately mid-length at 180 degrees from each other. The trunnions are the support points of the

FCTC. The LWFC has a motor-operated gate-type shield valve at each end used for loading and unloading RH Waste Canisters. Both shield valves are electrically operated with manual overrides and have electrically actuated pins that lock the valve gates closed. The LWFC shield valves have approximately 8.5-inch-thick steel gates and are designed to support the weight of a fully loaded RH Waste Canister when they are closed and the cask is vertical. The LWFC has two sets of forklift pockets; the lower set is used for transport and placement on the HERE or the HEM, and the upper set is used for maintenance.

The LWFC is designed to provide shielding for an RH Waste Canister such that the LWFC surface dose rate is less than 200 mrem per hour when the Waste Canister surface dose rate is less than or equal to 100 rem per hour.

Both LWFC shield valves are equipped with limit switches to indicate locking pin position (retracted or inserted) and shield valve position (open or closed). Additional switches mounted in the face of each shield valve housing indicate when the shield bell is in contact with the top shield valve housing and when the telescoping port shield ring is in contact with the bottom shield valve housing.

2.5.4 Remote-Handled Waste Handling Equipment

2.5.4.1 Remote-Handled Bay Equipment

2.5.4.1.1 140/25-ton Overhead Bridge Crane

The 140-ton overhead bridge crane with a 25-ton auxiliary hoist is used for RH shipping container handling and maintenance operations. The overhead bridge crane is designed to stay on its rails, retaining control of the load, during a loss of power or DBE (SDD WH00). The crane is controlled from a radio-frequency handheld control box operated from the floor of the RH Bay. The 140-ton main hoist has a lifting height of 41 feet and the 25-ton auxiliary hoist has a lifting height of 42 feet.

2.5.4.1.2 Motorized Man Lifts

Motorized manlifts may be used to provide Waste Operations personnel elevated work platforms for access to the RH-TRU 72-B and 10-160B shipping packages while on the transport trailers. Waste Operations personnel may use the platforms to perform the initial Waste Handling activities of removing the impact limiters from the shipping packages and performing any work required for readying the shipping package for lifting from the trailer.

2.5.4.1.3 140/25-ton Crane Cask Lifting Yoke

The 140/25-ton crane cask lifting yoke is a lifting fixture that attaches to either hook of the 140/25-ton overhead bridge crane and is designed to lift and rotate the RH-TRU 72-B shipping package by engaging its handling trunnions. Figure 2.5-10 shows the 140/25-ton overhead bridge crane with the cask-lifting yoke lowering an RH-TRU 72-B shipping package onto the RH-TRU 72-B RCTC.

2.5.4.1.4 Remote-Handled Transuranic 72-B Road Cask Transfer Car

The RH-TRU 72-B RCTC is a rail-guided structural-steel car with two A-frame supports and a bottom-positioning fixture designed to hold the RH-TRU 72-B shipping container in the vertical position. The point of the A-frame is designed to cradle the transport trunnions of the shipping container (Figure 2.5-11), while the positioning fixture prevents the cask from moving.

The four-wheeled car, weighing approximately 3,500 pounds with a load capacity of 40,000 pounds, is designed to transport the RH-TRU 72-B shipping container from the transport trailer to the cask preparation station and then into the CUR. It also repeats the route in reverse for empty RH-TRU 72B shipping containers. Each of the two front wheels of the RH 72-B RCTC is powered by a variable speed drive electric motor via electrical cable. The RH-TRU 72-B RCTC rails are located in the east side of the RH Bay and start in the CUR and run south about 80 feet, ending near the fire water collection sump by the south wall of the RH Bay. Only one RCTC is operated on the rails at a time.

2.5.4.1.5 10-160B Road Cask Transfer Car

The 10-160B RCTC is a four-wheeled, self-propelled, rail-guided structural-steel car constructed similar to the RH-TRU 72-B RCTC without the A-frame structure. The 10-160B RCTC, weighing approximately 3,000 pounds with a load capacity of approximately 62,500 pounds, is designed to transport the 10-160B shipping package in the vertical position from the transport trailer to the cask preparation station and then to the CUR. Angled guides are bolted on top of the frame to center the beveled bottom of a 10-160B shipping package on the car and prevent any lateral cask movement. It also repeats the route in reverse for an empty 10-160B shipping package. Each of the two front wheels is powered by an electric motor.

2.5.4.1.6 Cask Preparation Station

The cask preparation station is a variable-height elevated work platform designed to provide accessibility to the RH-TRU 72-B shipping package lid area to allow workers to perform unloading preparations and shipment activities such as bolt detensioning/tensioning, package outer lid removal/installation, lid-lift fixture installation/removal, radiological surveys, inspections, and minor maintenance. The cask preparation station, which straddles the RCTC rails, has a work deck that is vertically adjustable from a height of approximately 72 inches to 168 inches above the RH Bay floor. The elevating deck is positioned by electrically operated screw jacks controlled from a pushbutton console.

2.5.4.1.7 10-160B Cask Lid-Lift Fixture

The 10-160B package lid-lift fixture has a pintle and three 1-inch ball locking pins (Figure 2.5-13). A ball locking pin is inserted into each of the lid-lifting lugs to attach the lift fixture to the 10-160B lid. When the 10-160B is in the CUR, the lid-lifting fixture pintle is engaged by a facility grapple connected to the Upper Hot Cell crane, and then the lid is lifted into the Upper Hot Cell. The 10-160B package lid-lift fixture is attached to the package lid.

2.5.4.1.8 Remote-Handled Transuranic 72-B Cask Outer Lid-Lift Fixture

The RH-TRU 72-B outer lid-lift fixture is typically used by the cask preparation station jib crane to remove the outer lid from the RH-TRU 72-B shipping package while it is in the vertical position. The bottom of the fixture is configured to engage the bayonet socket in the lid and rotate 60 degrees to engage the bayonet attachment. Two spring-loaded pins on the fixture are released to secure it in the outer cask lid. The pins prevent the inadvertent rotation of the fixture and disengagement of the bayonet attachment.

2.5.4.1.9 Remote-Handled Transuranic 72-B Cask Inner Lid-Lift Fixture

The pintle on the RH-TRU 72-B cask inner lid-lift tool interfaces with facility grapple lift fixtures. It allows remote removal of the inner lid while the cask is in the Transfer Cell. Operators place the fixture on the inner lid after the outer lid has been removed.

2.5.4.1.10 Remote-Handled Transuranic 72-B Cask Inner Lid Alignment Tool

The RH-TRU 72-B inner lid alignment tool consists of two parts that are installed at the cask preparation station. The arm is temporarily bolted in the inner lid. It fits in only one orientation and extends out to fit into the guide. The guide is temporarily bolted to the outer vessel after the arm is bolted to the lid. The location of the guide is determined by the location of the arm.

After the RH-TRU 72-B cask inner lid is removed in the Transfer Cell, it may rotate slightly before it is placed back on the cask. The two parts of the tool fit together to center and rotate the lid by the arm on the lid following the guide as the lid is lowered.

2.5.4.1.11 10-160B 55-Gallon Drum-Lift Device

A drum-lift device (Figure 2.5-13) is installed on each 55-gallon drum at the generator site. The drum-lift device is similar in construction to the drum lid bolt ring and is installed on the drum just below the first chine below the lid. The lift device has two diametrically opposed wire cable loops that are used to lift the drum from the carriage. When the wire cable loops are engaged by a lifting fixture, the symmetrical construction and placement of the drum-lift device allows the drum to be suspended, moved, and inserted into a Facility Canister.

2.5.4.2 Cask Unloading Room Equipment

2.5.4.2.1 25-ton Crane/Cask-lifting Yoke

The CUR 25-ton crane is fitted with a dedicated lifting yoke used to lift the RH-TRU 72-B from the RH-TRU 72-B RCTC, lower it through the open CUR floor shield valve, and set it in the shuttle car inside the Transfer Cell. The bridge rails of the CUR 25-ton crane are attached to the walls of the CUR. The crane is designed to stay on its rails, retaining control of its load, during a DBE. The cask-lifting yoke lifts the RH-TRU 72-B by engaging handling trunnions. The CUR 25-ton crane has a lifting height of 28 feet.

Load cells are located on each hoist cable to provide an indication of cable overload and/or load imbalance. In addition to protecting the crane and cask-lifting yoke from damage, the load cells are used to prevent the inadvertent decoupling of the cask-lifting yoke from the container-lifting trunnions.

The control console for the CUR crane is located in the CUR and contains a monitor for viewing Transfer Cell operations.

2.5.4.2.2 Cask Unloading Room Floor Shield Valve

The CUR floor shield valve has a valve body of carbon-steel plate approximately 6.5 inches thick, 68 inches wide, and 67.5 inches long. It is supported on four rollers that ride on two floor-mounted flat tracks. Four guide rollers mounted in the bottom of the shield keep the shield in line. The shield is positioned by a motor-driven ball screw actuator mounted such that the shield valve body rolls under the actuator as it moves from the closed to open position. The CUR shield valve is normally maintained in the closed position. The motor actuator includes a brake and limit switch for valve position indication and control. The CUR shield valve body weighs approximately 8,500 pounds. The CUR floor shield valve provides shielding and separates the CUR and the Transfer Cell. When lowering a RH-TRU 72-B shipping container into the Transfer Cell, air pressure in the CUR is maintained higher than in the Transfer Cell. The CUR floor shield valve is interlocked to other RH Waste Handling components as follows:

- The CUR floor shield valve cannot be closed unless the CUR 25-ton crane hook is in the high limit position.
- Access to the CUR shield valve control panel is prevented by the closed CUR shield door when the Upper Hot Cell shield plugs are removed. The Upper Hot Cell shield plugs cannot be removed while the CUR shield valve or the CUR shield door is open.
- The CUR floor shield valve cannot be opened unless the Upper Hot Cell shield valve and the Transfer Cell ceiling shield valve are closed.
- The CUR floor shield valve cannot be opened unless the Transfer Cell Shuttle Car is positioned under the shield valve and the CUR crane is positioned over the shield valve.

2.5.4.3 Upper Hot Cell Equipment

The Upper Hot Cell Equipment is required for 10-160B processing.

2.5.4.3.1 Upper Hot Cell Crane

The bridge of the remote-operated overhead Upper Hot Cell crane has a 32-foot span and can travel about 96 feet in an east–west direction at a speed of up to approximately 16 fpm. The bridge speed control is designed to slow its travel speed to a maximum of 8 fpm when the bridge is approximately 10 feet from the west wall. The Upper Hot Cell crane bridge carries a trolley, load rated at 15 tons, which can move in a north–south direction approximately 24 feet at a speed of up to approximately 15 fpm. The trolley speed control is designed to slow its travel speed to a maximum of 8 fpm when the trolley is approximately 10 feet from the north wall. (The north and west walls of the Upper Hot Cell contain the Upper Hot Cell Operating Gallery viewing windows, and the speed control is provided to minimize the consequences of a load being carried by the Upper Hot Cell crane impacting the windows.) The trolley carries a hoist that supports a grapple rotating block and the Upper Hot Cell facility grapple. A hook can be attached to the Upper Hot Cell facility grapple to handle loads including loaded or empty 10-160B drum pallet/carriage units, and 55-gallon drums of RH Waste. The hoist has a lifting height of 64 feet. The crane is designed to stay on its tracks, and to hold its load in place, in the event of a DBE or electrical failure (SDD WH00).

If the Upper Hot Cell crane requires maintenance, it can be moved into the Crane Maintenance Room. In the event the crane becomes inoperable while moving a load, an electric override system for the crane and grapple are used to safely lower and release the load and then raise the grapple to a position that will allow the crane bridge sweep winch to position the crane inside the Crane Maintenance Room.

The operator control console, located in the Operating Gallery, is hand held to allow the operator to select the optimum Upper Hot Cell viewing window location to visually observe the crane operation.

2.5.4.3.2 Upper Hot Cell Facility Grapple Rotating Block Assembly

The Upper Hot Cell facility grapple rotating block assembly is a fabricated steel housing consisting of four sheaves at the top and a gear drive connected to a clevis at the bottom. The grapple rotating block is suspended from the Upper Hot Cell crane by cables passing through the sheaves. The gear drive has a motor-driven pinion that rotates the clevis yoke that normally supports a facility grapple.

2.5.4.3.3 Upper Hot Cell Facility Grapple

The Upper Hot Cell facility grapple (Figure 2.5-12) is a special lift fixture designed to engage a standard WIPP pintle and has a lift capacity of 21,000 pounds. The facility grapple has an axially mounted, electrically operated actuator that rotates a drive gear that drives three lifting lugs into or out of engagement under the WIPP pintle. In the event of a power failure when the facility grapple is engaged on a lifting pintle, the lifting lugs will automatically lock in place. The grapple is equipped with a proximity switch interlocked with the drive motor that rotates the pivot dogs. The pivot dogs can only rotate when the switch is in contact with a pintle. During lifting, the space between the pintle and the proximity switch prevents the pivot dogs from rotating. The Upper Hot Cell facility grapple is identical to the FCLR facility grapple described in Section 2.5.4.5.6.

A crane hook, rated at 15 tons, can be used with the facility grapple. The hook is attached to a handling pintle with a flange.

2.5.4.3.4 Upper Hot Cell Shield Plug Lift Fixtures

There are two Upper Hot Cell shield plug lift fixtures, one for each size shield plug. Both fixtures can be used with the Upper Hot Cell crane to remove their respective Upper Hot Cell shield plug, or both shield plugs can be removed at the same time using only the large Upper Hot Cell shield plug lift fixture. The small Upper Hot Cell shield plug lift fixture resembles a tripod. It is 9 feet tall with a handling pintle at the top that is engaged by the Upper Hot Cell facility grapple. The legs are fabricated from 3-inch schedule 40 pipe. Each leg has an engagement pin that can engage lifting lugs, on a 13-inch radius, on the small shield plug removal adapter. A centering pin is provided near the bottom of the shield plug lift fixture to engage the shield plug removal adapter and align the fixture with the removal adapter. The fixture is lifted by the Upper Hot Cell crane with the facility grapple installed. The fixture is rotated by the rotating block to allow it to engage the shield plug removal adapter lifting lugs. The Upper Hot Cell small shield plug lift fixture weighs approximately 400 pounds and has a lift capacity of approximately 10,000 pounds.

The shield plug removal adapter is a fabricated steel fixture that is attached to the small shield plug with three bolts through holes in its base plate. It has three arms, each with a lifting lug that can be engaged by the small Upper Hot Cell shield plug lift fixture. The centerline of the lifting lugs is on a 13-inch radius. The adapter has a height of 12.375 inches and weighs approximately 160 pounds.

The large Upper Hot Cell shield plug lift fixture, similar in design to the small Upper Hot Cell shield plug lift fixture, is 11 feet tall and its engagement pins have a 39-inch radius. It is fabricated from 3-inch schedule 80 pipe to accommodate a greater lift weight. Its three engagement pins are designed to engage the three lifting lugs of the large shield plug removal adapter. The large Upper Hot Cell shield plug lift fixture weighs approximately 800 pounds and has a lift capacity of 20,000 pounds.

2.5.4.3.5 10-160B Drum Carriage Lift Fixture

The 10-160B drum carriage lift fixture is a pentagon with five legs and a centering guide post with a guide pin. Each leg has an engagement pin that engages a lift lug, mounted on a lifting post, on the drum carriage. The guide pin slides into the center of the drum carriage center stanchion. Figure 2.5-13 shows the 10-160B drum carriage lift fixture and a fully loaded (five 55-gallon drums) drum carriage. The 10-160B drum carriage lift fixture has a lift capacity of approximately 6,500 pounds.

2.5.4.3.6 Viewing Windows

Six Upper Hot Cell viewing windows are provided in the Operating Gallery. Four viewing windows are located in the north wall and two in the west wall. The window frames are cast in the 54-inch-thick concrete shield wall separating the Upper Hot Cell from the Operating Gallery. The frames are designed so that any radiation streaming paths parallel to the optical axis are prevented. The oil-filled shielding windows are composed of the frame, leaded shielding glass, cover glasses, and trim frames. The cover glasses and gaskets retain the oil in the window housing. The cold side (Operating Gallery) consists of a tempered cover glass and three 5-inch-thick lead-shielded glasses. The hot side (Upper Hot Cell) contains a 1.5-inch-thick non-browning cover glass. The oil fill provides radiation shielding and acts as a heat transfer medium. An oil expansion tank is provided as a means of keeping the window full of oil despite the temperature excursions caused primarily by exposure to radiation and the lighting in the Upper Hot Cell.

2.5.4.3.7 Wall-Mounted Manipulators

There are four wall-mounted heavy-duty manipulators in the Upper Hot Cell, located at two inspection stations, which allow operators in the Operating Gallery to reproduce the natural movements and forces of the human hand. The operator must exert the same force on the master arm that he wishes to exert with the slave arm; however, the tong squeezing motion does have a mechanical force multiplication. The manipulators are used for performing tool handling, radiological surveying, and identification of canisters in the Upper Hot Cell. The manipulators are mounted in the wall of the Upper Hot Cell using a through tube and are equipped with counterweights that limit the motion and speed of travel in the event that the operator releases the manipulator control.

2.5.4.3.8 Overhead-powered Manipulator

The overhead-powered manipulator is a crane-mounted remotely controlled arm with shoulder, elbow, and wrist pivots that can be independently driven. The wrist can support various adapter tools including a hook hand and parallel jaw hand. The manipulator is suspended from a rotation-drive assembly, which permits full rotation of the manipulator about its vertical axis. The manipulator is attached to the rotation drive by two locking pins, which allow for remote removal of the manipulator from the rotation-drive assembly. The overhead-powered manipulator is designed to hold its load in place in the event of a loss of electrical power or a DBE.

The rotation drive is attached to the bottom of a telescoping tube that provides manipulator vertical motion. There are five square-nested telescoping sections connected in such a way that movement of any one tube causes all tubes to move. The telescoping tubes have an up–down travel of approximately 15 feet and have a lifting capacity of 5,000 pounds. The telescoping tube assembly is supported by the trolley carriage that travels on a bridge assembly. The bridge can travel east–west for approximately 50 feet at a speed of up to 22 fpm, whereas the trolley can travel north–south for approximately 25 feet at a speed of up to 15 fpm.

The control panel for the overhead-powered manipulator includes controls for bridge and trolley, hoisting, speed, and manipulator operation, and is located in the Operating Gallery. To protect the viewing windows in the north and west walls of the Upper Hot Cell, the overhead-powered manipulator speed control is designed to slow the bridge travel speed when the bridge is approximately 10 feet from the west wall and to slow the trolley travel speed when the trolley is approximately 10 feet from the north wall. The operator controls and indicators are located on a console.

2.5.4.3.9 Closed-Circuit Television System

The high-resolution CCTV cameras located in the Upper Hot Cell, the CUR, and Transfer Cell provide direct viewing of specific operations. Transfer Cell and Upper Hot Cell operations can be monitored in the CUR, the Upper Hot Cell Operating Gallery, the Transfer Cell Service Room, or the FCLR. The Upper Hot Cell operations can only be monitored in the Upper Hot Cell Operating Gallery. Each CCTV camera includes a camera head, a control unit, and connecting cable.

2.5.4.3.10 Shielded Transfer Drawer

The shielded Upper Hot Cell transfer drawer is used to transfer materials, such as radiological smear samples and small tools, from the Upper Hot Cell to a transfer drawer enclosure in the Operating Gallery (Figure 2.5-15). A motor-driven shield plug blocks the approximately 20-inch opening in the shield wall of the Upper Hot Cell. The shield plug travels approximately 46 inches perpendicular to the opening on rollers that ride on tracks fastened to a steel frame.

The Upper Hot Cell transfer drawer enclosure in the Operating Gallery side of the shield wall has a viewing window, two glove ports, and a transfer port. A motor-driven shield plug in the floor of the transfer drawer enclosure blocks off the Upper Hot Cell transfer port in the same manner as is done inside the Upper Hot Cell. The transfer drawer enclosure shield plug has a travel range of approximately 38 inches. The motors of the shield plugs are electrically interlocked so that only one shield plug is in the open position at any time. The Upper Hot Cell transfer drawer is moved in and out of the shield wall opening as the Upper Hot Cell shield plug is moved. A light screen machine guard system is installed inside the transfer drawer enclosure to prevent movement of the Operating Gallery shield plug while hands, gloves, or other obstructions are protruding though the transfer drawer enclosure glove ports or transfer canister port.

A sample tray is used for transferring the assessment swipes between the Operating Gallery and the Upper Hot Cell. The sample tray is manually moved into the shield wall opening and must be completely inside the shield wall opening before the Operating Gallery shield plug is closed.

The transfer drawer is a flat tray, roller-mounted on the drawer carriage that rolls on rails on the bottom of the opening of the Upper Hot Cell shield wall. When the Upper Hot Cell shield plug is closed and the transfer drawer enclosure shield plug is retracted, the operator can pull the sample tray into the transfer drawer enclosure.

2.5.4.3.11 Upper Hot Cell Shield Valve

The Upper Hot Cell shield valve body is a carbon-steel plate 6.5 inches thick by 68 inches wide by 67.5 inches long and is supported on four rollers that ride on two floor-mounted flat tracks. Four guide rollers are mounted in the bottom of the shield and ride on the inside edges of the tracks to keep the shield in line. The shield is positioned by a motor-driven ball screw actuator that includes a brake and a rotary limit switch assembly. The shield valve assembly weighs approximately 10,000 pounds. The shield valve provides permanent shielding and separates the Upper Hot Cell and the Transfer Cell. When moving Waste Canisters between the Upper Hot Cell and the Transfer Cell, ventilation airflow is from the Transfer Cell into the Upper Hot Cell. Guide tubes are provided between the Upper Hot Cell and the Transfer Cell to ensure proper alignment of a canister being transferred between the two locations. The Upper Hot Cell shield valve is interlocked to other RH Waste Handling system components as follows:

- The Upper Hot Cell shield valve cannot be opened unless the CUR floor shield valve and the Transfer Cell ceiling shield valve are closed.
- The Upper Hot Cell shield valve cannot be closed unless the Upper Hot Cell facility grapple is in the preset high limit position.
- The Upper Hot Cell shield valve and the CUR floor shield valve must be closed before the Transfer Cell ceiling shield valve can be opened.
- The Upper Hot Cell shield valve and the Transfer Cell ceiling shield valve must be closed before the CUR floor shield valve can be opened.

- The Upper Hot Cell shield valve cannot be opened unless the Transfer Cell Shuttle Car is positioned below the Upper Hot Cell shield valve port and the detensioning robot is in the home position.

2.5.4.4 Transfer Cell Equipment

2.5.4.4.1 Transfer Cell Shuttle Car and Shielded Insert

The Transfer Cell Shuttle Car (Figure 2.5-16) is a steel-frame structure with a single cask basket designed to accommodate a loaded RH-TRU 72-B shipping container or a shielded insert. The car is used to place a cask in four positions:

1. Under the CUR floor shield valve (CUR port)
2. Under the Upper Hot Cell shield valve (Upper Hot Cell port)
3. Under the Transfer Cell ceiling shield valve (FCLR port)
4. In the RH-TRU 72-B cask lid storage position

A platform located on the car just west of the cask basket is used to store the inner vessel lid of the RH-TRU 72-B cask during canister transfer to the RH Waste Cask. The shuttle car, approximately 22 feet long by 10 feet deep by 6 feet wide, has four steel wheels that ride on rails mounted on support trestles, and is designed to support its load and remain on the rails in the event of a DBE (SDD WH00).

The shielded insert, described in Section 2.5.3.1, can also be loaded into the cask basket. The shielded insert allows for the shielded transport of Facility Canisters that have a larger diameter than the RH Waste Canister from under the Upper Hot Cell port to under the FCLR port.

Impact limiters are cylindrical containers filled with sand located under each cask/canister handling position. The impact limiters are designed to minimize damage to the casks, shielded insert, canisters, and the Transfer Cell floor in the event of an accidental drop of a cask or shielded insert by the CUR 25-ton crane or a drop of a canister by the FCLR grapple hoist. The impact limiters also help to ensure that the RH-TRU 72-B cask, shielded insert, or canister remain upright after being dropped.

The bottom support beams of the cask basket are connected to the Transfer Cell Shuttle Car with shear bolts designed to break away, allowing the cask or shielded insert to fall through the bottom of the basket into the impact limiters. This prevents serious damage to the Transfer Cell Shuttle Car structure and aids in accident recovery by maintaining the RH-TRU 72-B cask or shielded insert in an upright position.

The Transfer Cell Shuttle Car is driven east and west by a chain drive system at the west end of the Transfer Cell. A solid shaft that penetrates the Transfer Cell wall drives the double-chain sprockets. The gear reducer and drive motor are located in the Transfer Cell Service Room. The reducer and drive motor are connected by a triple V-belt. A turnbuckle linkage mounted on the gear reducer can adjust belt tension. Proper chain drive tension is maintained by two counterweights that hang from the chains near the west end of the Transfer Cell. A single chain can move the Transfer Cell Shuttle Car.

The Transfer Cell Shuttle Car position is sensed by an encoder on the chain drive shaft and controlled by the Programmable Logic Controller in the FCLR control panel.

The Programmable Logic Controller also controls the speed of the Transfer Cell Shuttle Car through the variable-speed drive to allow shifting from high speed to low speed as the programmed stop locations are approached. The Transfer Cell Shuttle Car has two over-travel stop limit switches.

The shuttle car is interlocked with the CUR floor shield valve, the Upper Hot Cell shield valve, and the Transfer Cell ceiling shield valve such that the shuttle car cannot move unless the three shield valves are closed.

2.5.4.4.2 Detension Robot

The detension robot, located in the Transfer Cell, is used to detension the inner lid bolts of the RH-TRU 72-B shipping container. The robot incorporates a torque wrench end-of-arm tool. The robot detensioning sequence is initiated and controlled from the operator console located in the FCLR. It can also be operated by a pendant located outside the Transfer Cell. Once the detensioning process has been initiated, it is controlled by a Programmable Logic Controller located in the FCLR console.

2.5.4.4.3 Swipe Robot

The swipe robot is used to take swipes of the RH-TRU 72-B inner lid and the Waste Canister to detect the presence of surface contamination before completing the canister transfer from the RH-TRU 72-B shipping package to the RH Waste Cask. The swipe robot interfaces with the swipe delivery system. The robot is equipped with a specially designed end-of-arm tool with pneumatically operated finger grippers. The grippers are designed to interface with the swipe holders. The swipe robot is controlled from the operator console located in the FCLR. It can also be operated by a pendant located outside the Transfer Cell.

2.5.4.4.4 Swipe Delivery System

The swipe delivery system is used to transport swipes from the Transfer Cell to the Service Room for counting and then to return clean swipes to the Transfer Cell. The swipe delivery system's send-and-receive station is located in the Service Room vent hood. The vent hood is kept at a slightly negative pressure with respect to the Service Room pressure. The swipe delivery system interfaces with the send-and-receive station in the Service Room with an acceptor tube that is mounted adjacent to the swipe robot in the Transfer Cell. The swipe delivery system operation is initiated by health physics personnel at the send station or automatically when a swipe is placed in a pneumatic swipe carrier at the acceptor tube in the Transfer Cell. A blower provides the motive force to send the pneumatic swipe carrier between the send-and-receive station and the acceptor tube. The blower exhausts to the Transfer Cell and the vent hood exhausts into the RH Bay ventilation system.

2.5.4.4.5 Transfer Cell Ceiling Shield Valve

The Transfer Cell ceiling shield valve is located under the port connecting the Transfer Cell to the FCLR. The shield valve has a 12-inch-deep steel frame supporting a 42-inch-square shield plate that is 1 inch thick. The approximately 8-foot-long frame is bolted to the Transfer Cell ceiling. The electric-motor-driven screw actuator is attached to the shield plate with a clevis pin. The Transfer Cell ceiling shield valve is closed, except during RH Waste Cask loading activities. The valve motor is equipped with torque switches that will automatically shut off power if the valve is closed against an object in its path. The Transfer Cell ceiling shield valve provides permanent shielding and is interlocked to other RH Waste Handling system components as follows:

- The Transfer Cell ceiling shield valve cannot be opened unless the CUR floor shield valve is closed.
- The Transfer Cell ceiling, CUR, and Upper Hot Cell shield valves are interlocked with the Transfer Cell Shuttle Car drive so that the Transfer Cell Shuttle Car cannot be moved unless all shield valves are closed. This interlock prevents damage to the canister from Transfer Cell Shuttle Car movement during canister transfer.
- The Transfer Cell ceiling shield valve cannot be closed with the RH Waste Cask bottom shield valve open.
- The Transfer Cell ceiling shield valve cannot be opened if the telescoping port shield is not in contact with RH Waste Cask bottom shield valve.

2.5.4.4.6 Canister Alignment Fixture

The canister alignment fixture is installed on the Transfer Cell ceiling, adjacent to the Transfer Cell ceiling shield valve, in a location that will not interfere with normal Transfer Cell operations. The fixture will be used only if an off-normal event occurs that would require an RH Waste Canister to be transferred from the RH Waste Cask back into the Transfer Cell. The alignment fixture consists of a tapered conical guide welded to a flat alignment plate. Slide rails interface with the alignment plate and are attached and aligned to the east side of the Transfer Cell ceiling shield valve steel fame. The installation allows the alignment fixture to be positioned by the swipe robot and only when the Transfer Cell ceiling shield valve is open.

2.5.4.4.7 Transfer Cell Cameras

CCTV cameras and vision cameras are located in the Transfer Cell and are used to provide operators direct viewing of Transfer Cell operations. Visuals provided by the cameras can be monitored in the CUR, the Upper Hot Cell Operating Gallery, the operator console located in the FCLR, and the Transfer Cell Service Room.

2.5.4.5 Facility Cask Loading Room Equipment

2.5.4.5.1 Facility Cask Transfer Car

The FCTC (Figure 2.5-17) is a rail-mounted car weighing approximately 7,900 pounds that is electrically powered via cable with a variable-speed electric motor that drives two wheels at speeds up to 30 fpm. The FCTC has two A-frame structures, each with a trunnion saddle to support the RH Waste Cask weight and transport the RH Waste Cask in the stable horizontal position on four 18-inch-diameter wheels. It also allows rotating the Facility Cask on its trunnions to the vertical position by the FCRD. The FCTC has brackets that engage locking pins on the rotating device to prevent movement of the car while the Facility Cask is being rotated. The FCTC car is designed to perform the following functions:

- Serve as the platform for the Facility Cask in the FCLR.
- Transport the Facility Cask from the FCLR to the Waste Shaft Conveyance.
- Serve as the platform for the RH Waste Cask while the RH Waste Cask is on the Waste Shaft Conveyance.
- Transport the RH Waste Cask from the Waste Shaft Conveyance to the E-140/S-400 intersection.

An FCTC position limit switch is provided to stop the car in its load position over the telescoping port shield.

2.5.4.5.2 Facility Cask Turntable

The Facility Cask Turntable is a circular platform containing tracks to guide the FCTC to the RH Bay or to the Waste Hoist Collar from the FCLR. The turntable is supported by air bearings recessed into the FCLR floor. Compressed air is manually supplied by a hand valve to assist the rotation of the turntable. The turntable can be rotated 360 degrees to change the direction of FCTC travel.

2.5.4.5.3 Facility Cask Rotating Device

The FCRD (Figure 2.5-14), a floor-mounted hydraulically operated structure, is designed to rotate the RH Waste Cask from the horizontal position to the vertical position for RH Waste Canister loading and then back to the horizontal position after the RH Waste Canister has been loaded into the RH Waste Cask. The FCRD is equipped with a 40-gallon hydraulic tank and uses hydraulic fluid that has a flash point of 302°F. Hydraulic rams are attached to the center of the connecting beams of two rotating arms. One end of each rotating arm is attached to a pivot point on the floor-mounted structure, while the other end latches to a pivot pin on the RH Waste Cask top shield valve enclosure. Hydraulic rams extend to rotate the RH Waste Cask to the vertical position and retract to rotate the RH Waste Cask to the horizontal position.

2.5.4.5.4 6.25-ton FCLR Grapple Hoist

The 6.25-ton FCLR grapple hoist, mounted to the ceiling of the FCLR, is designed to maintain control of its load during a DBE. The hoist is gear driven by a two-speed induction motor. The hoist has a position transmitter that sends a position signal to the control console Programmable Logic Controller. A load cell monitors the weight being applied to the grapple hoist and provides a signal to the Programmable Logic Controller to shut down the hoist if the load is excessive. In the event of a power failure, the 6.25-ton FCLR grapple hoist brakes are automatically set (SDD WH00). Figure 2.5-18 shows the 6.25-ton FCLR grapple hoist, the shield bell, and the stationary alignment sheave.

2.5.4.5.5 Stationary Alignment Sheave

The stationary alignment sheave (a single cable pulley) is anchored to the FCLR ceiling above the cask loading station. The stationary alignment sheave is used to convert the horizontal travel of the hoist cable to the vertical travel of the facility grapple. The load cell is a pin type on which the sheave rotates. The cable passes over the pulley and down to the block in the top of the shield bell. The cable then extends back to the ceiling, where it is attached to the ceiling. This arrangement provides an accurately positioned vertical lift for the facility grapple even though there is a lateral shift of the cable on the hoist drum. A limit switch, also part of the stationary alignment sheave, is mounted on a bracket attached to the pulley housing and is used to sense the upper travel limit of the shield bell and prevent the facility grapple from being raised too high.

2.5.4.5.6 FCLR Facility Grapple

The FCLR facility grapple (Figure 2.5-12) is a lifting fixture designed to engage a standard WIPP pintle. The facility grapple has an axially mounted, electrically operated actuator that rotates a drive gear that drives three lifting lugs into or out of engagement under the WIPP pintle. In the event of a power failure when the facility grapple is engaged on a lifting pintle, the lifting lugs will automatically lock in place. The grapple is equipped with a proximity switch interlocked with the drive motor that rotates the pivot dogs. The pivot dogs can only rotate when the switch is in contact with a pintle. During lifting, the space between the pintle and the proximity switch prevents the pivot dogs from rotating.

2.5.4.5.7 Telescoping Port Shield

The telescoping port shield (Figure 2.5-19) is mounted in the floor of the FCLR, centered directly over the Transfer Cell ceiling shield valve opening. An electric-motor-driven jacking system is used to raise the telescoping port shield to mate with the RH Waste Cask lower shield valve housing during RH Waste Canister transfer. Two switches mounted in the face of the RH Waste Cask’s bottom shield valve housing are actuated when the telescoping port shield is in contact with the shield valve housing. The telescoping port shield must be in contact with the RH Waste Cask before the bottom shield valve can be opened.

Limit switches mounted above and under the FCLR floor are actuated by the shield ring and indicate when the telescoping port shield is fully up and fully down. The telescoping port shield provides radiation shielding when the Transfer Cell ceiling shield valve and the RH Waste Cask bottom shield valve are open during transfer of an RH Waste Canister into the RH Waste Cask.

2.5.4.5.8 Shield Bell and Block

The shield bell (Figure 2.5-20) is a heavy-walled steel casting that provides radiation shielding from the RH Waste Canister when the RH Waste Cask top shield valve is open. The shield bell has an approximately 18-inch internal cavity to house the facility grapple and the grapple support block. The grapple support-block cavity contains the single pulley block and provides a path for the facility grapple electrical cable to pass through to the grapple. When not in use, the shield bell rests on the top of the facility grapple support block, which is suspended from the grapple hoist. The shield bell is supported by the RH Waste Cask when the facility grapple is in use.

Two switches mounted in the face of the RH Waste Cask’s top shield valve housing are actuated when the shield bell is resting on the RH Waste Cask. The shield bell must be in contact with the RH Waste Cask before the top shield valve can be opened.

2.5.4.5.9 Control Console

The FCLR control console is in a 19-inch-thick concrete wall shadow shield area with a dry shield window in the north side of the FCLR. The floor-mounted control console has a Programmable Logic Controller, control switches, indicators, and a television monitor that displays the Transfer Cell operations. The operator can control Transfer Cell and FCLR operations using the FCLR control console.

2.5.4.6 Underground RH Waste Handling Equipment

The UG RH Waste Handling and emplacement equipment consists of diesel-powered forklifts, the HERE, and the HEM. RH Waste Handling equipment is the largest equipment transporting waste in the waste disposal area.

2.5.4.6.1 Horizontal Emplacement and Retrieval Equipment

The HERE is used to transfer an RH Waste Canister from the RH Waste Cask into a horizontal disposal borehole. The HERE includes the items listed in Table 2.5-1 with a total hydraulic fluid capacity of 110 gallons.

The Waste Transfer Machine Assembly (WTMA) consists of the Alignment Fixture, Leveling Platform, Staging Platform, and Carriage (Figures 2.5-21, 2.5-27, and 2.5-28). When assembled with the Facility Cask and Shield Plug Carriage, they are used to push a RH Canister into the borehole.

Table 2.5-1. Horizontal Emplacement and Retrieval Equipment

Waste Transfer Equipment		Borehole-Related Components
Alignment fixture	RH Waste Cask	Shield plug
Shield collar	Portable power cable	Shield plug carriage
Leveling platform	Control console	Shield plug rings
Staging platform	Transfer carriage	

2.5.4.6.2 Alignment Fixture

The alignment fixture (Figure 2.5-21) provides a reference plane for aligning the waste transfer mechanism (WTM) with respect to the borehole to allow Waste Canister and shield plug installation. It is a welded carbon-steel structure consisting of a base plate with three hydraulic jacks and a vertical faceplate with holes for attaching and bolting the shield collar. It has two forklift pockets to facilitate its moving. The horizontal base supports the front end of the WTM. It has two alignment pins located to ensure that the WTM and shield collar line up.

The three hydraulic jacks are used to align the alignment fixture with the borehole. The hydraulic system is powered by a hydraulic pump with a 30-gallon hydraulic tank located on the alignment fixture. The alignment fixture has three tilt sensors and three proximity switches. The tilt sensors provide tilt information to permit the operator to level the alignment fixture. The proximity switches sense the gap between the shield collar and the RH Waste Cask.

The alignment fixture has four hydraulic locking clamps used to rotate and lock the shield collar to the RH Waste Cask. The locking clamps are controlled by a selector switch located on the control console. The alignment fixture also has a passive FSS with four discharge nozzles aimed at the hydraulic power unit and the leveling jacks. The interlocks between the HERE transfer mechanism, RH Waste Cask, and alignment fixture provide the following automatic actions:

- The RH Waste Cask front and rear shield valves cannot be opened unless the tilt sensors on the HERE indicate that the WTM is aligned with the alignment fixture, the proximity switches on the alignment fixture detect the RH Waste Cask, and the proximity switches on the transfer mechanism detect the RH Waste Cask.
- The RH Waste Cask shield valves cannot be closed if the HERE transfer mechanism is extended beyond the respective shield valve.

2.5.4.6.3 Alignment Fixture Assembly

The Alignment Fixture Assembly (AFA), Figure 2.5-21, used for the HERE has been redesigned to include a Shield Valve Assembly in place of the shield collar with proximity detection sensors and hydraulic actuated cam locking clamps. The proximity sensors are mounted on the Shield Valve Assembly so that they will detect the close proximity of an RH Waste Cask (either the Facility Cask or LWFC) and are used as one of the interlock control signals to allow the RH casks front shield valve to be opened. The hydraulic cam locks mounted on the shield collar are used to clamp the RH cask to the

Shield Valve Assembly. The cam locks clamp into matched slots in the RH cask. The fixture has not yet been installed. The HERE has not yet been modified to incorporate the Shield Valve Assembly.

2.5.4.6.4 Leveling Platform

The leveling platform is a steel frame on which the components that interface with the alignment fixture and staging platform are located (Figure 2.5-21).

The front end of the leveling platform has two holes that sit on the alignment fixture alignment pins. A motor-driven hydraulic pump operates a hydraulic jack located at the rear of the leveling platform. The jack is used to align the WTM (consisting of the leveling platform, staging platform, and transfer carriage) axis with the axis of the alignment fixture shield collar.

Three sets of rails are mounted on each side of the leveling platform. The rails support the staging platform and interface with roller bearings on the staging platform that allows the staging platform to travel on the rails. A staging-platform drive system is mounted on the leveling platform. The drive system moves the staging platform in the forward and reverse direction to position the front face of the RH Waste Cask against the shield collar.

2.5.4.6.5 Staging Platform

The staging platform is a steel frame that rests on roller bearings that engage and ride on the rails of the leveling platform. The staging platform supports the RH Waste Cask and transfer carriage, and has a hydraulic ram providing linear motion to the transfer carriage. The transfer carriage rides on two rails bolted to the top of both sides of staging platform. The staging platform requires a regulated compressed air supply to operate the RH Waste Cask locking pins.

The following control devices are mounted on the staging platform:

- A tilt sensor used to monitor the longitudinal tilt of the WTM for alignment with the alignment fixture.
- A rotary limit switch used to stop the transfer carriage forward and reverse travel motion before the travel limits have been reached.
- A two-position detection limit switch, which is activated when the shield plug carriage is seated on the staging platform rails.

2.5.4.6.6 Transfer Carriage

The transfer carriage (Figure 2.5.21) is a large steel cylinder with its own hydraulic system that is used to push the RH Waste Canister from the RH Waste Cask into the borehole or the shield plug from the shield plug carriage into the borehole.

The rear end of the transfer carriage houses the transfer mechanism and includes heavy wall shielding to prevent exceeding radiation dose rate limits when the RH Waste Cask top shield valve is opened. The hydraulic drive system that operates the transfer mechanism is mounted to the transfer carriage housing.

The transfer carriage has roller bearings that ride on the staging platform rails. The staging platform-based drive system moves the transfer carriage forward and in reverse to emplace a Waste Canister. The transfer carriage is positioned with the front of the housing against the RH Waste Cask during Waste Canister emplacement. During shield plug emplacement, the transfer carriage is retracted to provide room for installing the shield plug carriage on the staging platform.

The transfer mechanism consists of a double-acting five-stage telescopic hydraulic cylinder attached at the plunger end of the transfer carriage housing end plate. The front end of the cylinder is supported by two rollers attached to a steel plate, which provides shielding and supports the transfer mechanism grapple. The transfer mechanism grapple, similar to the facility grapples used with the Upper Hot Cell crane and in the FCLR, is not closed when emplacing either the RH Waste Canister or the shield plug into the borehole. Proximity switches, mounted on the grapple, detect grapple contact with the pintle of the RH Waste Canister or shield plug. Position switches indicate when the grapple jaws are open or closed. The drive motor stops when the transfer mechanism reaches a preset travel distance. If necessary, the transfer mechanism can be manually retracted.

The transfer carriage is equipped with four locking clamps to secure the carriage to the RH Waste Cask and shield plug carriage. Multi-turn rotary potentiometers monitor the linear travel distance of the transfer mechanism. Three proximity metal-detecting position switches stop the carriage drive when the transfer carriage is within 0.5 inch of the RH Waste Cask.

2.5.4.6.7 Shield Plug Carriage

The shield plug carriage maintains the shield plug in a horizontal position during emplacement and aligns the bottom of the shield plug with the bottom of the RH Waste Cask cavity. The shield plug carriage is placed on and supported by the rails of the staging platform, which also supports the transfer carriage. The shield plug carriage has two forklift pads to facilitate handling by a forklift and has four roller-bearing supports that ride on the staging platform rails.

2.5.4.6.8 Control Console

The control console for the HERE provides all the controls and information displays necessary to operate the waste transfer equipment. The console is mounted on a movable platform to facilitate relocation. The console can be located at a sufficient distance from the HERE to ensure radiation doses to the console operator are kept as low as reasonably achievable (ALARA).

Each step in the operational sequence is controlled by the operator through an electronic process controller mounted in the control console. The process controller incorporates interlock functions to ensure the proper sequence of operations.

2.5.4.6.9 Air Compressor

An air compressor for the HERE provides the air supply to drive the locking pins on the RH Waste Cask shield valves to the retracted position so that the valves can be opened. A switch on the control console energizes a solenoid that allows air pressure to the locking pins. The air compressor is not used for the LWFC because its locking pins are electrically actuated.

2.5.4.6.10 Portable Power Cable

The portable power cable is used to electrically connect the HERE to a 480-volt, three-phase, 60-hertz power source.

2.5.4.6.11 Transport Equipment

The transport equipment consists of wheel assemblies that convert the leveling platform to a trailer-like configuration used to move the WTM assembly from one location to another. The assembly can be towed by a forklift or tractor.

2.5.4.6.12 Borehole Shield Plugs

A shield plug is inserted into the borehole after emplacement of the RH Waste Canister. It provides shielding from the emplaced RH Waste Canister. The shield plug is a cylinder approximately 61 inches long and 29 inches in diameter and is made of concrete shielding material inside a steel shell with a removable pintle placed on a pintle pipe extending from one end of the plug. The shield plug is inserted so that the pintle end is facing outward from the borehole after emplacement. Each shield plug has integral forklift pockets and weighs approximately 3,900 pounds.

Steel shielding rings can be used to prevent radiation streaming from the gap between the shield plug and the borehole. When used, shielding rings are installed after the shield plug. The rings are made from carbon-steel plate, configured with an opening in the center that fits over the center assembly of a shield plug. Areas of the shielding rings that do not contribute to the shielding function have cutouts to minimize weight to allow operators to install them quickly.

Shield plugs are transported by a forklift using either the shield plug carriage or the forklift pockets provided in the shield plugs. Figure 2.5-22 shows the Waste Canister and shield plug.

2.5.4.6.13 41-ton Diesel Forklift

The 41-ton diesel forklift has a lifting capacity of 82,000 pounds and a maximum lifting height of approximately 99 inches. It is used to lift the RH Waste Cask (either the Facility Cask or LWFC) from the FCTC and transport it at a speed of approximately 3 to 4 mph to the active RH Waste emplacement room, where it places the loaded RH Waste Cask on the waste emplacement equipment (Figure 2.5-23). It is also used to transport the WTM assembly. The forklift has a 50-gallon diesel fuel tank and a 125-gallon hydraulic fluid tank. The forklift is equipped with an automatic FSS and a portable fire extinguisher. The hydraulic fluid is a water/glycol-based fluid that will not flash or support combustion.

2.5.4.6.14 20-ton Diesel Forklift

The 20-ton diesel forklift has a lifting capacity of 40,000 pounds and a maximum lifting height of approximately 84 inches. The forklift has a 50-gallon diesel fuel tank and a 64-gallon hydraulic fluid tank. It is used to lift and handle the alignment fixture assembly, consisting of the alignment fixture and the shield valve assembly. The forklift is equipped with an automatic FSS and a portable fire extinguisher.

2.5.4.6.15 6-ton Diesel Forklift

The 6-ton diesel forklift has a lifting capacity of 12,000 pounds and a maximum lifting height of approximately 72 inches. The forklift has a 37-gallon diesel fuel tank and a 24-gallon hydraulic fluid tank. It is used to lift and handle the shield plug carriage and the shield plug. The forklift is equipped with an automatic FSS and a portable fire extinguisher.

2.5.4.6.16 Horizontal Emplacement Machine

The HEM (Figure 2.5-24) is used to transfer an RH Waste Canister from the LWFC into a horizontal disposal borehole. The HEM will be modified later to accommodate the Facility Cask. The HEM includes the items listed in Table 2.5-2 with a total hydraulic fluid capacity of 200 gallons.

- The cask carriage is the support carriage that moves the RH Waste Cask or the shield plug carriage into contact with the shield valve assembly.
- The carriage extends the shield valve assembly into the borehole.
- The HEM frame assembly includes the machine support frame, drive mechanism, and leveling jacks, as well as the HEM control panel and portable drive control box that will be used to operate the Waste Handling equipment and guide the HEM into position, respectively.
- The HEM control panel is situated away from the HEM during waste emplacement.

Table 2.5-2. Horizontal Emplacement Machine

Waste Transfer Equipment		Ancillary Equipment
Alignment fixture with shield valve assembly	Waste transfer mechanism	Shield plug carriage
Frame assembly	Control console	Portable drive control
Cask carriage	Portable power cable	

2.5.4.6.17 Shield Valve Assembly

The shield valve assembly is a welded carbon-steel structure that is an integrated component of the HEM. The shield valve assembly consists of a shield collar, shielded valve, and various sensors, motors, and actuators needed to perform its function.

The shield valve assembly provides a reference plane for aligning the frame assembly of the HEM with respect to the borehole. If needed, laser alignment tools mounted on the shield valve assembly may also be used to assist with HEM alignment to the borehole. Once aligned, the shield valve assembly has an integral electric motor to move it along an associated rail system so that the shield collar can be inserted into the borehole.

The shield valve gate uses a gear-reduction electric motor drive to raise and lower it. The open and closed positions are determined by associated limit switches that are connected to the HEM control panel. The gate is locked in the open position by a pin driven by an electrically powered actuator.

Mounted on the shield valve assembly are three proximity switches to sense the gap between the shield valve and the LWFC. The output of all three proximity switches is required to determine whether the RH Waste Cask is in close enough proximity to verify proper mating of shielding components between the shield valve assembly and the LWFC.

The shield valve assembly has four hydraulic locking clamps used to rotate and lock the shield valve to the LWFC and ensure that the shielding surfaces remain connected between the two. The locking clamps are controlled by a selector switch on the control console. The interlocks between the HEM WTM, RH Waste Cask, and the shield valve assembly provide the following automatic actions:

- The LWFC front shield valves cannot be opened unless the proximity switches on the shield valve assembly detect the RH Waste Cask and the proximity switches on the WTM detect the LWFC.
- The LWFC rear shield valve and the shield valve gate cannot be opened unless the proximity switches on the shield valve assembly detect the LWFC and the proximity switches on the WTM detect the LWFC.
- The LWFC shield valves and the shield valve gates cannot be closed if the HEM WTM is extended beyond the respective shield valve gate.

2.5.4.6.18 Frame Assembly

The frame assembly is a steel frame on which the components operate and interface with the shield valve assembly, cask carriage, WTM, and the shield plug carriage.

The frame assembly has two motor-driven hydraulic pumps that operate the four hydraulic jacks and the four wheel assemblies. The jacks are used to align the HEM axis with the axis of the shield valve assembly. The four-wheel assemblies are used to maneuver the HEM. The wheel assemblies consist of hydraulic drive motors and slow drive motors associated with 44-inch tires.

Two sets of rails are mounted on each side of the frame assembly. The rails support the WTM, cask carriage, and shield valve assembly and interface with roller bearings on the WTM, cask carriage, and shield valve assembly that allow them to travel on the rails.

2.5.4.6.19 Cask Carriage

The cask carriage is a steel frame that rests on roller bearings that engage and ride on the rails of the frame assembly. The cask carriage supports the RH Waste Cask when emplacing the RH Waste Canister or the shield plug carriage when inserting the shield plug. The cask carriage has a hydraulic ram that provides linear motion to extend and retract the cask carriage to the shield valve assembly.

2.5.4.6.20 Waste Transfer Mechanism

The description of the WTM for the HEM is the same as the transfer carriage for the HERE, as described in Section 2.5.4.6.16.

2.5.4.6.21 Shield Plug Carriage

The shield plug carriage (Figure 2.5-25) holds the shield plug in a horizontal position during emplacement and aligns the bottom of the shield plug with the bottom of the shield valve assembly. The shield plug carriage is placed on the cask carriage after the LWFC is removed from the HEM, which rides on the rails of the frame assembly. The shield plug carriage has two forklift pads to facilitate handling by a forklift.

2.5.4.6.22 Control Console

The description of the control console for the HEM is the same as the control console for the HERE as described in Section 2.5.4.6.8.

2.5.5 Remote-Handled Waste Handling Process

2.5.5.1 Remote-Handled Waste Receiving

On arrival at the gate of the WIPP facility, each incoming RH shipment is inspected to verify the shipment documentation and a security check is performed. A radiological survey of the shipping package is performed either at the gate or in the WHB Parking Area Unit. If radiation or contamination levels exceed the criteria in the *Waste Isolation Pilot Plant Radiation Safety Manual* (WP 12-5), subsequent activities include posting, decontamination, or both. If the shipping package has visible external damage, the Waste Handling process will likely proceed and the shipping package will be subsequently repaired.

Following turnover of the shipping documentation, the driver parks the trailer in the WHB Parking Area Unit for RH shipping package trailers near the RH entrance to the WHB. The driver unhooks the tractor and is subsequently released. The number of loaded RH shipping packages on trailers in the WHB Parking Area Unit is coordinated with CH Waste Handling such that the WHB Parking Area Unit limits established in the HWFP are not exceeded.

2.5.5.2 Remote-Handled Transuranic 72-B Remote-Handled Waste Handling Process

2.5.5.2.1 Cask Preparation

When space becomes available, a trailer with a loaded RH-TRU 72-B shipping package is brought into the RH Bay. Because of space limitations, only two loaded shipping packages are administratively allowed in the RH Bay at a time. After the trailer is spotted inside the RH Bay, operators either use a motorized manlift work platform or stand on removable platforms on the trailer to unbolt the two impact limiters from the shipping package while it is still on the trailer. The 140/25-ton overhead bridge crane is used to lift the impact limiters and place them on support stands. The RH-TRU 72-B lifting yoke is connected to the 140/25-ton overhead bridge crane. The cask-lifting yoke engages the handling trunnions of the RH-TRU 72-B shipping package, rotates the package to the vertical position, and then lifts it clear of the trailer and sets it on the RH-TRU 72-B RCTC. If the RH-TRU 72-B shipping package arrives on a trailer with hydraulics to rotate the shipping package, the shipping package is rotated after the impact limiters are removed. The shipping package is removed from the trailer using the cask-lifting yoke. The A-frame of the RH-TRU 72-B RCTC supports the shipping package at the transporter trunnions. The RH-TRU 72-B shipping container is moved to the cask preparation station. The RH-TRU 72-B Waste Handling process from the cask preparation stand through the FCLR is controlled by the RH-TRU RH Processing procedure. RH canister downloading and emplacement is controlled by the RH Waste Downloading and Emplacement or RH Waste Downloading/Emplacement Using Distributed Controls procedures. The cask preparation station, which straddles the RCTC rails, allows personnel to have access to the top area of the shipping package for conducting radiological surveys, performing physical inspections or minor maintenance, performing cask unloading preparation activities, and performing decontamination, if necessary.

After surveys for surface contamination and radiation levels are performed, the test port tool and vent adapter are installed on the outer lid sampling port. The outer lid sampling port is opened, using the test port tool, venting the atmosphere between the inner lid and outer lid. The test port tool and vent adapter are removed from outer lid sampling port and the outer lid is unbolted. The RH-TRU 72-B cask outer lid-lifting fixture is attached to the outer lid using the 2.5-ton jib crane. The outer lid is lifted to allow the underside of the outer lid and top of the inner lid to be surveyed for contamination. The outer lid is placed on a storage stand. The test port tool and vent adapter are installed on the inner lid sampling port. The inner lid sampling port is opened, venting the shipping package cavity atmosphere through an assessment filter and the HEPA roughing filters. The radiological assessment filter is checked for radioactive contamination. The test port tool and vent adapter are removed from the inner lid sampling port. The inner lid vent is opened to equalize the pressure between the shipping package cavity and atmosphere. Then the inner lid pintle is attached to the inner lid. The pintle is used as a lifting fixture for the inner lid and interfaces with the facility grapple used to transfer a RH Waste Canister into the RH Waste Cask (Facility Cask or LWFC).

2.5.5.2.2 Cask Unloading Room

The RH-TRU 72-B shipping package is moved from the cask preparation station into the CUR. The CUR 25-ton crane with the RH-TRU 72-B cask-lifting fixture engages the two opposing lifting trunnions of the shipping package. The 25-ton crane lifts the shipping package from the RH-TRU 72-B RCTC and positions it over the CUR shield valve. Before the CUR shield valve can be opened, the CUR 25-ton crane has to be positioned over the floor shield valve, the Transfer Cell Shuttle Car cask receiver has to be positioned under the floor shield valve, the Transfer Cell ceiling shield valve has to be closed, the Upper Hot Cell shield valve has to be closed, and the Upper Hot Cell floor shield plugs must be installed. The process is reversed when an RH-TRU 72-B shipping package is removed from the Transfer Cell.

Ventilation flow is from the CUR to the Transfer Cell to protect the workers in the case of an off-normal event.

2.5.5.2.3 Transfer Cell

The RH-TRU 72-B shipping package is lowered through the open CUR floor shield valve port into the Transfer Cell and into the shuttle car road cask receiver. The design of the Transfer Cell Shuttle Car road cask receiver prevents lateral movement. Vertical movement is prevented by the weight of the cask. The RH-TRU 72-B cask lifting fixture is disengaged from the lifting trunnions. CCTVs and load cells on the lifting fixture are used to verify lifting fixture disengagement. The CUR 25-ton crane lifting fixture is lifted into the CUR and the floor shield valve is closed.

The Transfer Cell Shuttle Car is positioned at the robotic inner lid bolt detensioner, where the inner lid retaining bolts are detensioned. The bolts are spring loaded so that they remain in the lid. The Transfer Cell Shuttle Car then positions the RH-TRU 72-B shipping package directly below the Transfer Cell ceiling shield valve.

2.5.5.2.4 Facility Cask Loading Room

In the FCLR, the empty RH Waste Cask on the FCTC is positioned over the port to the Transfer Cell. The FCLR doors are closed. The RH Waste Cask is rotated to the vertical position by the FCRD to align it with the port to the Transfer Cell, the Transfer Cell ceiling shield valve, and the telescoping port shield.

When the RH Waste Cask has been rotated to the vertical position, the telescoping port shield, mounted in the floor of the FCLR, is raised to mate with the RH Waste Cask bottom shield valve body. The 6.25-ton FCLR grapple hoist is lowered so that the shield bell is in contact with the RH Waste Cask top shield valve body. With the shield bell and the telescoping port shield in contact with the RH Waste Cask, a totally shielded volume is formed to allow the safe transfer of an RH Waste Canister from the RH-TRU 72-B shipping container into the RH Waste Cask.

The RH Waste Cask top shield valve is opened, the Transfer Cell ceiling shield valve is opened, then the RH Waste Cask bottom shield valve is opened and the facility grapple is lowered through the RH Waste Cask into the Transfer Cell. The facility grapple engages the inner lid pintle and lifts the inner lid clear of the RH-TRU 72-B shipping package. The Transfer Cell will be maintained at a negative pressure when an RH-TRU 72-B canister is being processed. When the lid is clear of the shipping package, radiological contamination swipes are taken robotically and transferred through the swipe delivery system to the Service Room for analysis. The lid is lifted above the Transfer Cell ceiling shield valve, the shield valve is closed, and the Transfer Cell Shuttle Car is repositioned so that the inner lid storage platform is aligned under the Transfer Cell ceiling shield valve. The Transfer Cell ceiling shield valve is opened and the facility grapple positions the inner lid on its storage platform and releases the pintle. The facility grapple is lifted so that the Transfer Cell ceiling shield valve can be closed. The Transfer Cell Shuttle Car is positioned so that the RH-TRU 72-B shipping package is in alignment with the Transfer Cell ceiling shield valve and a radiological smear is taken of the canister pintle. After the contamination check, the facility grapple is lowered until it engages the pintle of the RH Waste Canister.

As the RH Waste Canister is lifted from the RH-TRU 72-B shipping package and before it passes through the Transfer Cell Ceiling Shield Valve, radiological contamination swipes on the RH Waste Canister are taken robotically and transferred through the swipe delivery system to the Service Room for analysis. The RH Waste Canister identification is observed by CCTV cameras and verified against the hazardous waste manifest and the WIPP Waste Data System (WDS). During the lift, the CCTV cameras provide a visual inspection to verify the mechanical integrity of the RH Waste Canister. If any discrepancy in a RH Waste Canister's identity, integrity, or radiological contamination is detected, the RH Waste Canister is reinserted inside the RH-TRU 72-B, using the canister alignment fixture, if necessary, and the inner lid placed on the shipping container. Notifications of the discrepant RH Waste Canister will be made and a path forward determined.

2.5.5.3 10-160B RH Waste Handling Process

The facility was originally designed to process 10-160B in the Hot Cell Complex. This process is no longer part of the mission at WIPP but the 10-160B SSCs are present and therefore described in this chapter.

2.5.5.3.1 Cask Preparation

A loaded 10-160B shipping package is brought into the RH Bay. After the trailer is spotted inside the RH Bay, the top impact limiter is removed from the shipping package while it is still on the trailer. The 140/25-ton overhead bridge crane is used to lift the impact limiter and place it at a designated location. Operators install the lifting lugs on the sides of the shipping package. The 140/25-ton overhead bridge crane is used to lift the 10-160B shipping package from the trailer by engaging the lifting lugs and place it on the 10-160B RCTC. From this point in the process through the FCLR, the 10-160B Waste Handling process is controlled by the 10-160B RH Processing procedure. The vent port cap located on the shipping package lid is removed and the vent fixture with an integral radiological assessment filter and HEPA filter is placed over the vent port plug secured in place using electromagnets. The vent port plug is removed with the vent port tool and a sample of the shipping package atmosphere is pulled through the assessment filter using a vacuum pump integral to the vent tool controls. The assessment filter is analyzed for any contamination. A contamination smear of the following areas is performed:

- The vent port plug.
- The vent port plug tools.
- The surface area inside the vent fixture.

The filter is surveyed for contamination after the pressure is equalized and before the 10-160B Waste Handling process starts. Operations removes the cask lid bolts and installs a lid guide tool in the bolt holes to aid in placement of the lid back on the cask after the waste drums have been removed. The guide tool has a neoprene spindle on the tip of the tool to avoid damaging the seal area on the underside of the lid. The 10-160B cask lid-lifting fixture with an integral pintle is attached to the cask lid. The lid-lifting fixture is installed by using either the 140/25-ton overhead bridge crane or the cask preparation station jib crane.

2.5.5.3.2 Cask Unloading Room

Two activities occur in the CUR related to the 10-160B process. The activities are independent of one another and cannot occur at the same time. One activity positions the 10-160B cask in the CUR so that its contents can be transferred to the Upper Hot Cell. The other activity involves placing the shielded insert in the Transfer Cell Shuttle Car to receive a loaded facility canister from the Upper Hot Cell. The shielded insert can only be placed in an empty Transfer Cell Shuttle Car. The shielded insert is placed into the Transfer Cell Shuttle Car using the same process as the RH-TRU 72-B road cask.

The RCTC transports the 10-160B cask to the CUR and positions it under the Upper Hot Cell floor shield plugs. Waste Handling personnel leave the CUR and close the shield door. The CUR shield door and floor shield valve and the Upper Hot Cell shield valve have to be closed before the Upper Hot Cell shield plugs can be removed.

2.5.5.3.3 Upper Hot Cell

Repackaging of the RH Waste drums shipped in the 10-160B shipping package occurs in the Upper Hot Cell. Access is restricted to the Upper Hot Cell when RH Waste is present. Any reentry after RH Waste Handling requires a radiological survey of the Upper Hot Cell area. The Upper Hot Cell equipment, including the Upper Hot Cell crane and its attachments, the overhead-powered manipulator and attachments, master-slave manipulators, and CCTV system, are used for Waste Handling operations inside the Upper Hot Cell.

Operators in the operating gallery use the Upper Hot Cell crane and the Upper Hot Cell shield plug lifting fixtures, while monitoring the CCTVs, to remove the Upper Hot Cell shield plugs and set them aside in the Upper Hot Cell. The crane with a facility grapple is lowered into the CUR and engages the lid-lifting-fixture pintle on the 10-160B lid. The lid is raised into the Upper Hot Cell where radiological contamination surveys are performed on its inside surfaces before it is set aside. The facility grapple on the Upper Hot Cell crane engages the pintle on the 10-160B drum carriage-lifting fixture and lowers it into the CUR where it engages the lifting elements of the upper drum carriage unit. The crane lifts the drum carriage unit into the Upper Hot Cell and moves it to the inspection station. At the inspection station, radiological contamination swipes are taken on the drums and carriage. The swipes are placed in the Upper Hot Cell transfer drawer and transferred into the transfer drawer enclosure in the Operating Gallery for radiological counting. While waiting for radiological counting results, the identification of each drum is verified and compared against the hazardous waste manifest and the WDS. Once the identification of each of the five drums is verified and all are determined to be free of contamination, the carriage is placed at the designated storage location on the Upper Hot Cell floor. The process is repeated for the second drum carriage unit. If any discrepancy in a waste drum’s identity or radiological contamination is detected, both loaded carriages will be reinserted into the 10-160B and the 10-160B unloading process is reversed. If any empty drum carriage units are in the Upper Hot Cell, a maximum of two are placed into the empty 10-160B. The crane picks up the 10-160B container lid and lowers it into the CUR and places it on the empty 10-160B. The Upper Hot Cell shield plugs are reinstalled.

Facility canister(s) have been previously staged in the inspection station of the Upper Hot Cell. The inspection station accommodates two canisters. Typically, the location closest to the Upper Hot Cell viewing window is used. A facility grapple installed on the Upper Hot Cell crane is used to remove the lid of the canister in the inspection station. The bridge-mounted overhead-powered manipulator or the Upper Hot Cell crane is used to lift a drum from the carriage and place it into an empty RH Waste Canister. This process is repeated two more times until three drums are in a RH Waste Canister. The overhead-powered manipulator or the Upper Hot Cell crane is used to install and secure the lid to the filled RH Waste Canister. The canister is ready to be moved either to the Transfer Cell or to a storage location until the Transfer Cell is available to receive a facility canister. This canister loading process is repeated until all drums have been removed from the two carriages.

2.5.5.3.4 Transfer Cell

The Transfer Cell Shuttle Car with a shielded insert, which is similar to an RH-TRU 72-B cask but has a larger inside diameter, is positioned so that the shielded insert is directly below the Upper Hot Cell Shield Valve. A filled facility canister is positioned over the Upper Hot Cell shield valve. With the shield valve open, the facility canister is lowered through the shield valve port into the shielded insert. The guide tubes ensure that the facility canister is properly positioned during the lowering process. The Upper Hot Cell crane facility grapple is disengaged from the facility canister pintle and lifted back inside the Upper Hot Cell. CCTV cameras and load cells on the crane are used to verify disengagement. When the open port of the Upper Hot Cell shield valve is clear and the hoist is at its preset high limit, the shield valve is closed. The Transfer Cell Shuttle Car moves one facility canister in a shielded insert from below the Upper Hot Cell shield valve to below the Transfer Cell ceiling shield valve.

2.5.5.3.5 Facility Cask Loading Room

The processing of a facility canister is the same as processing an RH Waste Canister, with the following exceptions:

- The shielded insert does not have an inner lid to remove.
- Identity verification is not performed on a facility canister because verification will have already been performed in the Upper Hot Cell.
- A facility canister does not have to undergo radiological surveying because it will have been previously completed in the Upper Hot Cell.

2.5.5.4 Waste Shaft Collar Room

RH Operations verifies that the Waste Shaft Conveyance is at the Waste Shaft Collar before moving the RH Waste Cask into the Waste Shaft Collar Room.

With the Waste Shaft Conveyance properly positioned, the gates are opened, the pivot rails are positioned, the FCLR shield doors are opened, and the FCTC transports the RH Waste Cask onto the Waste Shaft Conveyance. The FCLR shield doors are closed. The Waste Shaft Conveyance is lowered to the Waste Shaft Station at the disposal horizon.

2.5.5.5 Waste Shaft Station

When the Waste Shaft Conveyance has stopped at the disposal horizon, the Waste Shaft Station gates are opened, the pivot rails are positioned, a power cable is connected, and the FCTC moves from the conveyance (Figure 2.5-26) into the S-400/E-140 intersection. The 41-ton diesel forklift positions its tines so that they are inserted into the lower set of forklift pockets of the RH Waste Cask and then lifts the RH Waste Cask from the FCTC. The 41-ton forklift transports the RH Waste Cask to the disposal location at a speed of approximately 3 to 4 mph. In the event of UG contamination a contaminated zone boundary and a radiation buffer area will be established. The waste will be transferred to a different vehicle across the contaminated zone / radiation buffer area boundary. Empty Facility Casks/LWFC destined for the surface will be surveyed and decontaminated if necessary.

2.5.5.6 Underground Remote-Handled Waste Disposal Area

There are two types of RH emplacement machines, the HERE and the HEM. Both the HERE and the HEM are capable of aligning the RH Waste Cask with the borehole and emplacing RH Waste Canisters. The HERE may also be used to retrieve RH Waste Canisters.

2.5.5.6.1 Horizontal Emplacement Retrieval Equipment Process

At the RH Waste borehole disposal location, the 41-ton diesel forklift places the RH Waste Cask on the WTM, which will have been previously aligned with the borehole. The cask is moved forward to mate with the shield collar and the transfer carriage is advanced to mate with the RH Waste Cask rear shield valve. The rear shield valve is opened, and after the transfer mechanism makes contact with the pintle on the RH Waste Canister, the front shield valve is opened, and the transfer mechanism extends to push the canister into the borehole (Figure 2.5-27). After retracting the transfer mechanism into the RH Waste Cask, the front shield valve is closed. The transfer carriage is retracted and a diesel forklift places a shield plug on the shield plug carriage on the staging platform. The transfer mechanism pushes the shield plug into the RH Waste Cask. The front shield valve is opened and the shield plug is pushed into the borehole (Figure 2.5-28).

The transfer mechanism is retracted into its housing and the RH Waste Cask shield valves are closed. The shield plug carriage and the RH Waste Cask are removed from the emplacement machine. The emplacement machine is now available for transfer to another location.

During combined CH and RH disposal operations, boreholes are drilled into the ribs in such a manner as to not affect CH disposal operations. Because of the length of the HERE, CH Waste cannot be transported around the HERE when the HERE is set up for emplacement in a borehole. CH Waste disposal and RH Waste Canister emplacement do not occur in the same room at the same time.

2.5.5.6.2 HEM Process

The HEM is driven to an RH Waste emplacement borehole, where the HEM is connected to its control panel. The HEM is lifted off its transport wheels and aligned with the borehole using its four integral leveling jacks. The laser alignment operator tool may be used if needed to assist with alignment of the HEM to the borehole.

Once the HEM is aligned, lasers located on the outriggers near the shield valve assembly paint dots on the rib on either side of the borehole. Marks may be made on the dots as needed to help evaluate whether realignment is needed after the loaded LWFC is placed onto the cask carriage. Once aligned, the shield valve assembly is extended into the borehole countersink.

The LWFC is placed on the HEM cask carriage and moved to contact the shield collar using the cask carriage rails' linear roller bearings and cask carriage hydraulic cylinder. Proximity sensors mounted on the shield valve assembly are used to detect the LWFC front valve when it is mated to the shield collar.

After the cask is in place, the shield valve assembly uses four rotating hydraulic locking clamps to secure the shield valve collar to the LWFC.

The WTM is moved into contact with the LWFC rear shield valve using the carriage rails, linear roller bearings, and hydraulic cylinder. Proximity sensors mounted on the WTM cylindrical housing are used to detect the LWFC when it is mated to the rear shield valve. After the WTM is in contact with the LWFC four rotating hydraulic locking clamps are used to secure the WTM to the LWFC.

With all shielding in place, the WTM is controlled in conjunction with LWFC and shield valve assembly gate configurations to emplace an RH Waste Canister into the borehole. The WTM uses a five-stage hydraulic ram system enclosed in its housing to push the Waste Canister from the LWFC into the borehole. Upon completion of the emplacement, the shield valve assembly gate is closed and the LWFC is removed from the HEM.

After removal of the LWFC, the shield plug carriage with a shield plug is placed on the cask carriage. The cask carriage is then extended toward the shield valve assembly and the locking clamps rotated to secure the shield valve to the shield plug carriage. The WTM is then extended to contact the shield plug carriage and the bottom locking clamps rotate to secure the WTM to the shield plug carriage. An optional securing bracket is installed as needed for reinforcement on the WTM. The WTM hydraulic cylinder is then extended to engage the shield plug and push it toward the shield valve. When the shield plug is moved to within approximately 6 inches of the shield valve surface, the shield valve is opened and the shield plug is emplaced in the borehole.

Upon completion of the shield plug emplacement, the shield plug carriage is removed and the shield valve assembly is retracted from the borehole. The leveling jacks are fully retracted until the HEM is supported on its four drive tires. The HEM can be driven using its portable drive-control box to the next emplacement borehole to be reconfigured for waste emplacement.

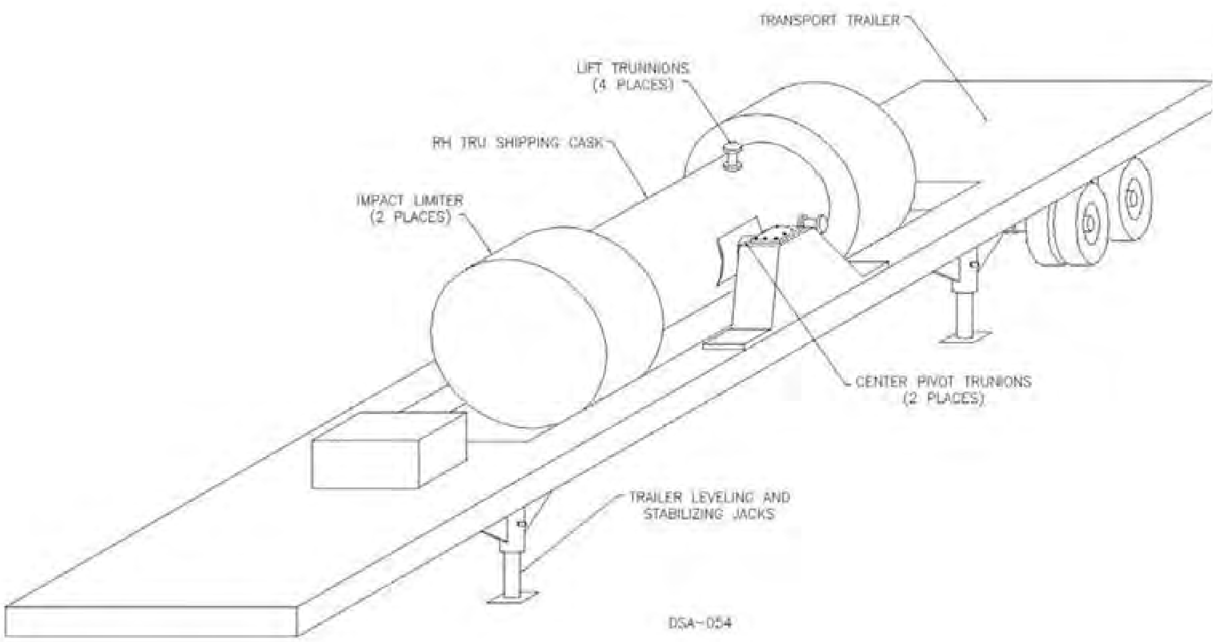


Figure 2.5-1. Remote-Handled Transuranic 72-B Shipping Package on Trailer

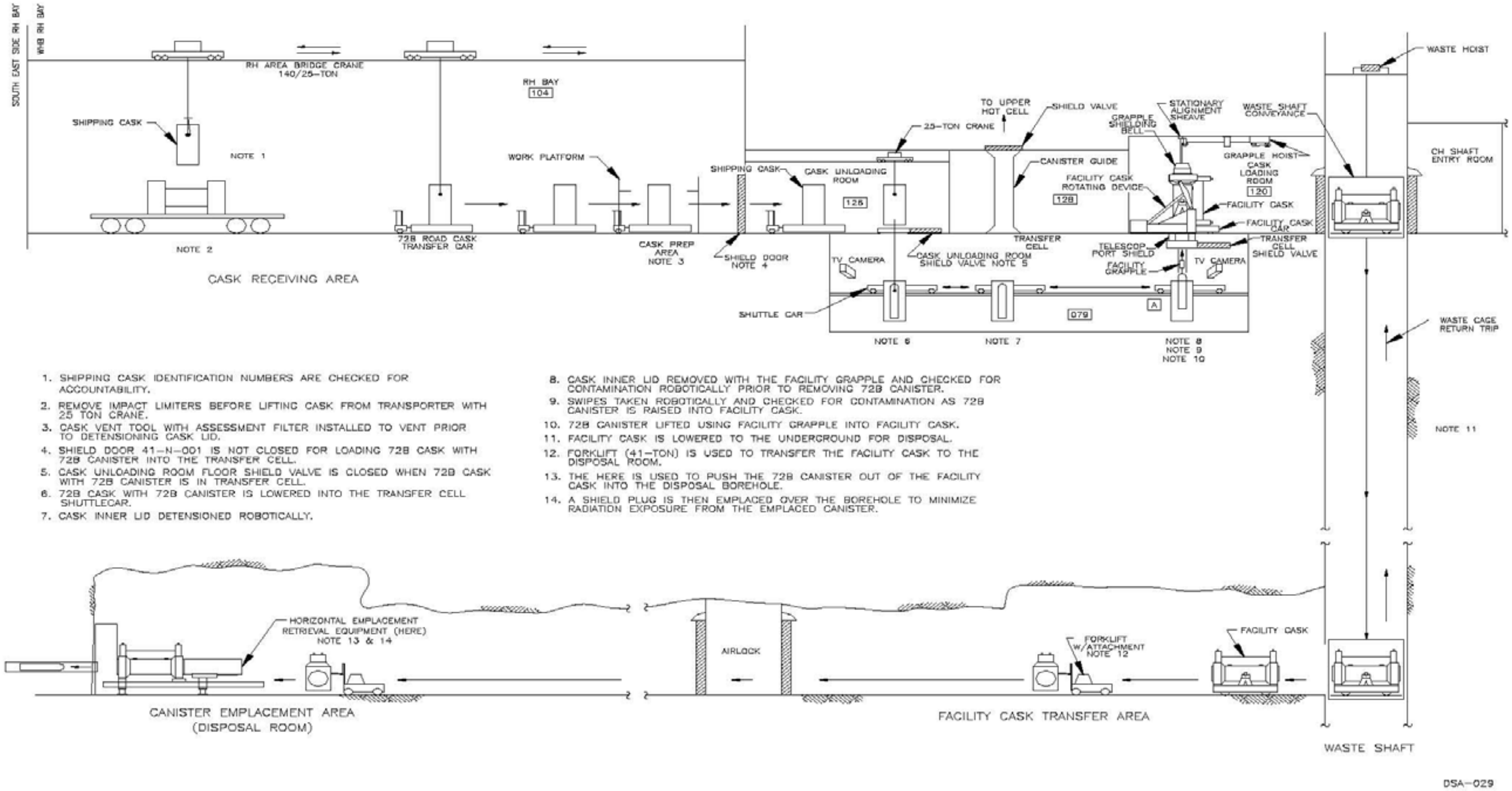


Figure 2.5-2. Remote-Handled Transuranic 72-B Remote-Handled Waste Handling Process

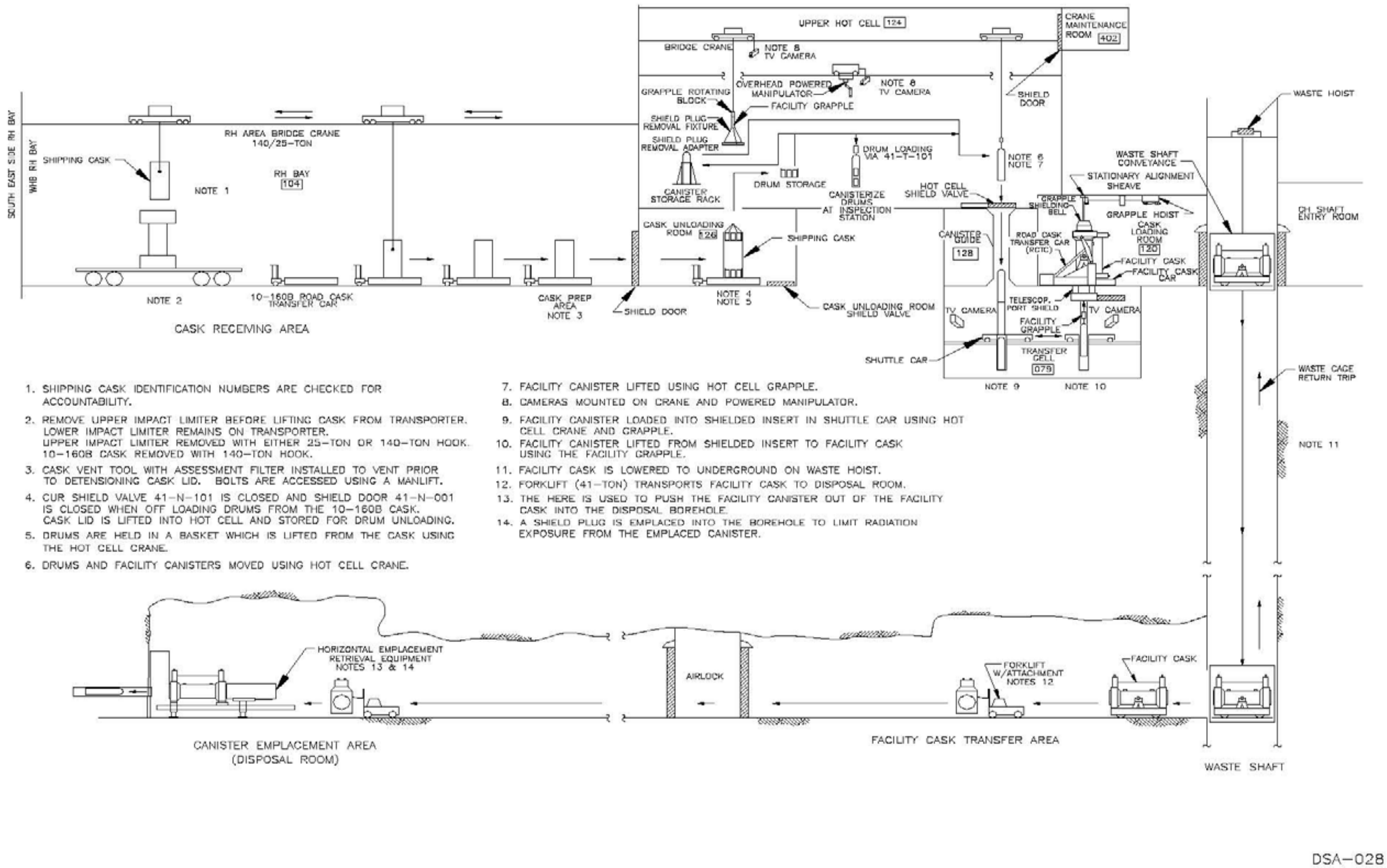


Figure 2.5-3. 10-160B Remote-Handled Waste Handling Process

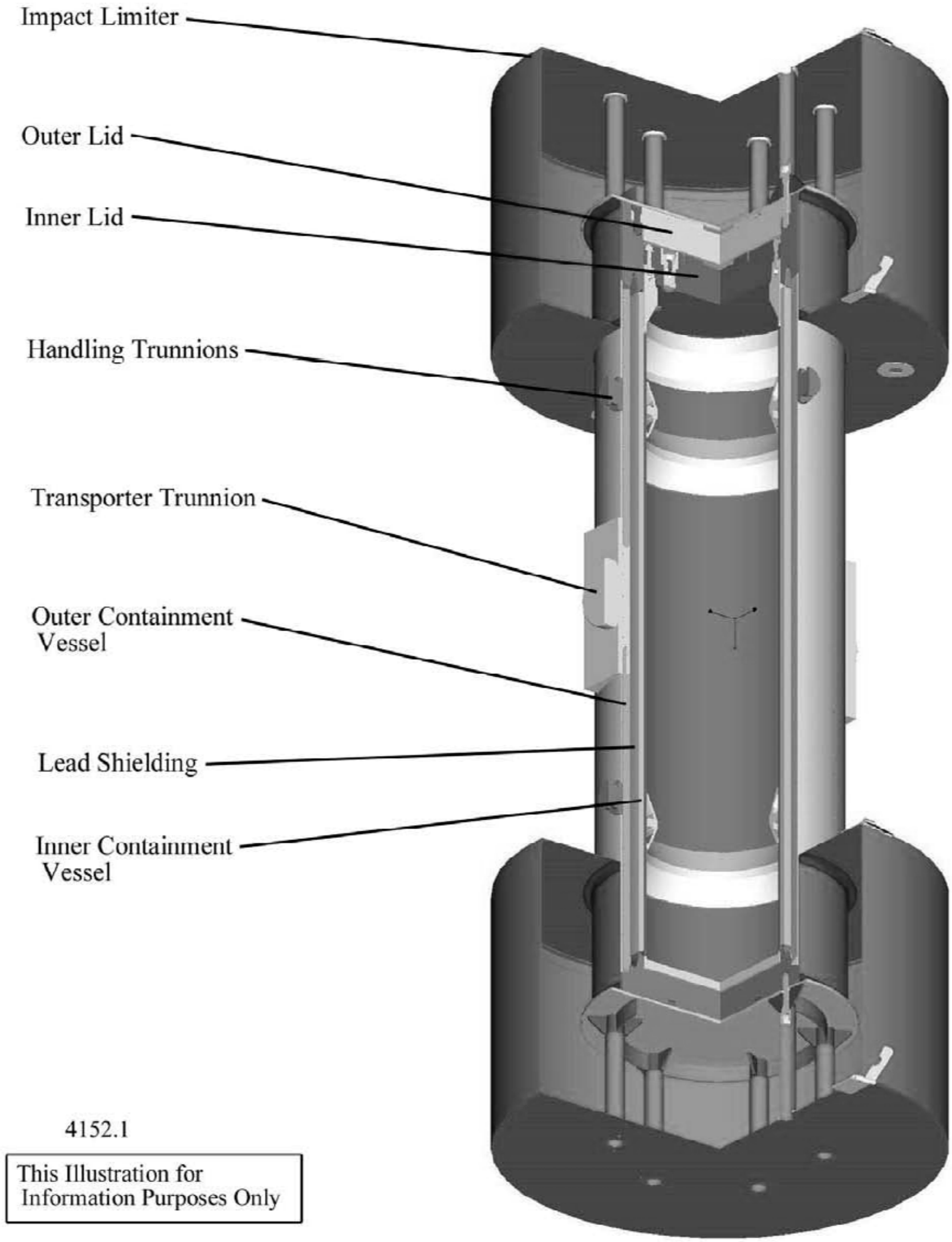


Figure 2.5-4. Remote-Handled Transuranic 72-B Shipping Container

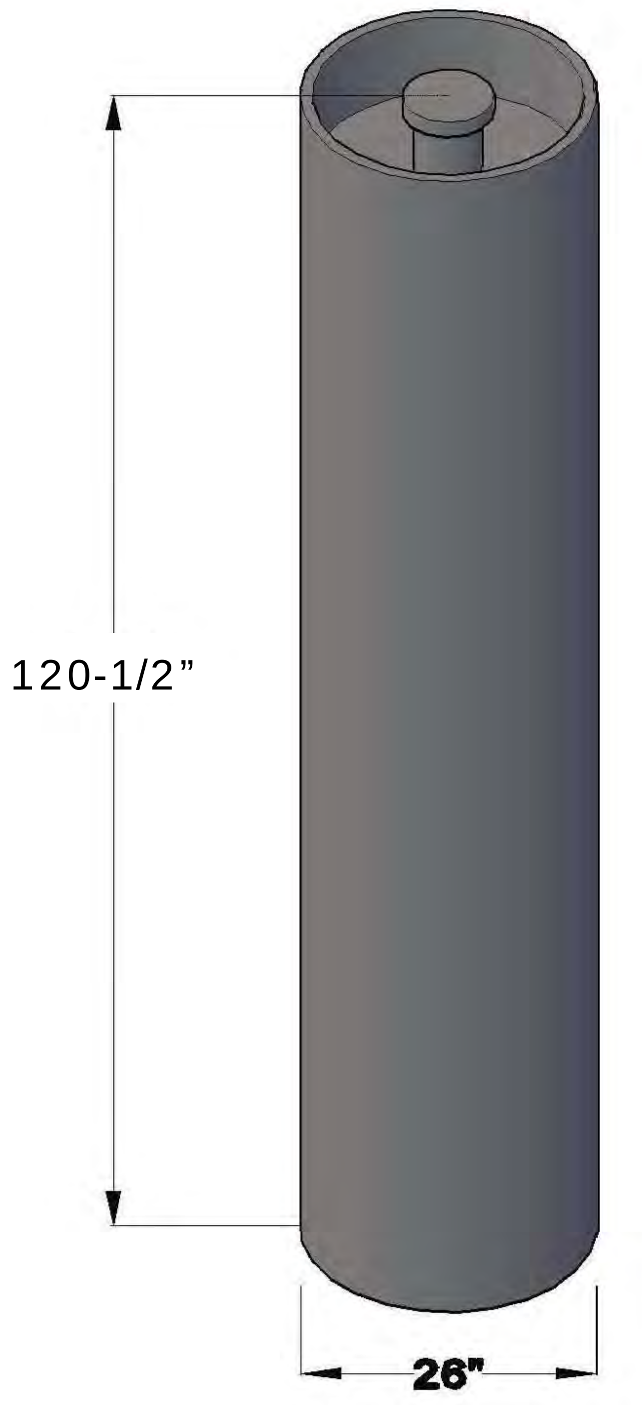


Figure 2.5-5. Remote-Handled Waste Canister

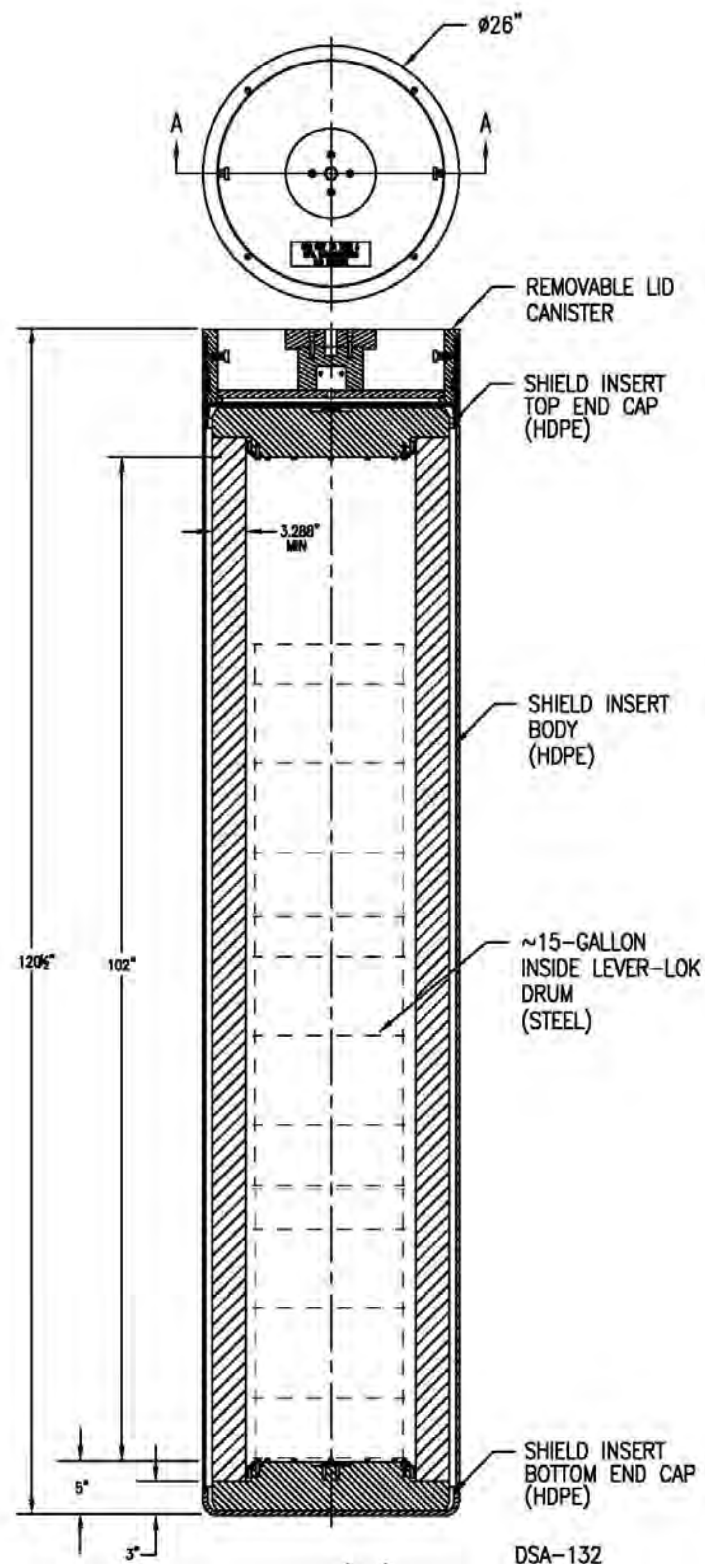


Figure 2.5-6. Neutron-shielded Canister NS15

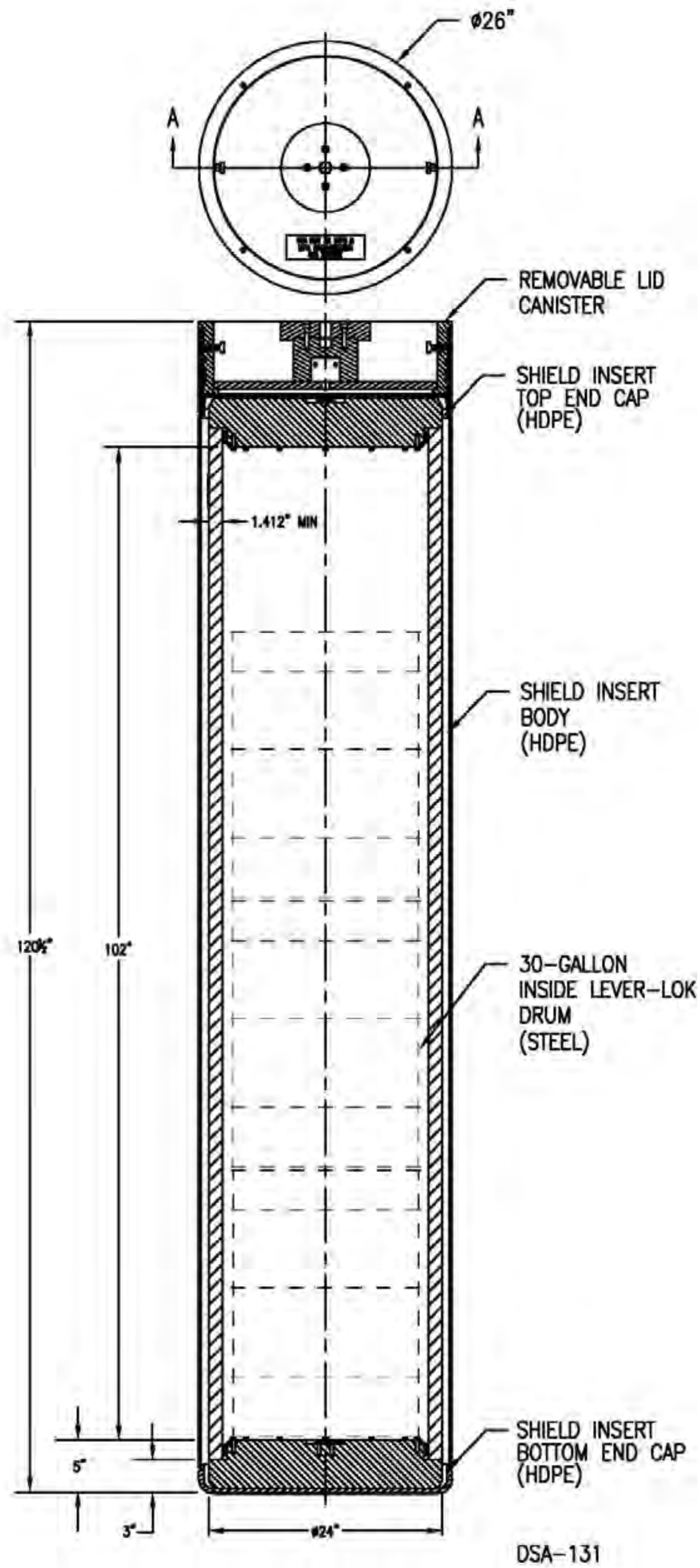


Figure 2.5-7. Neutron-shielded Canister NS30

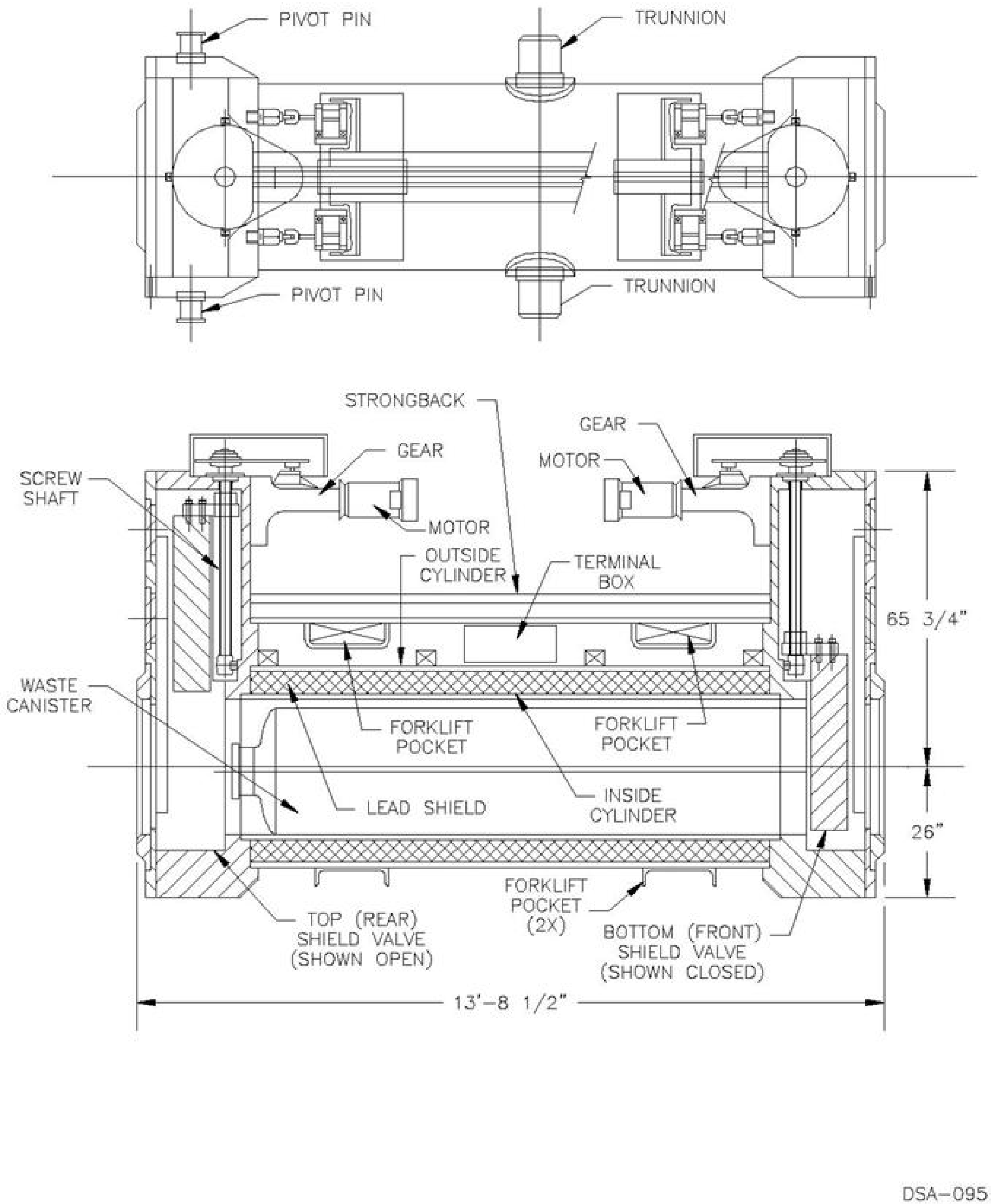


Figure 2.5-8. Facility Cask (a Remote-Handled Waste Cask)

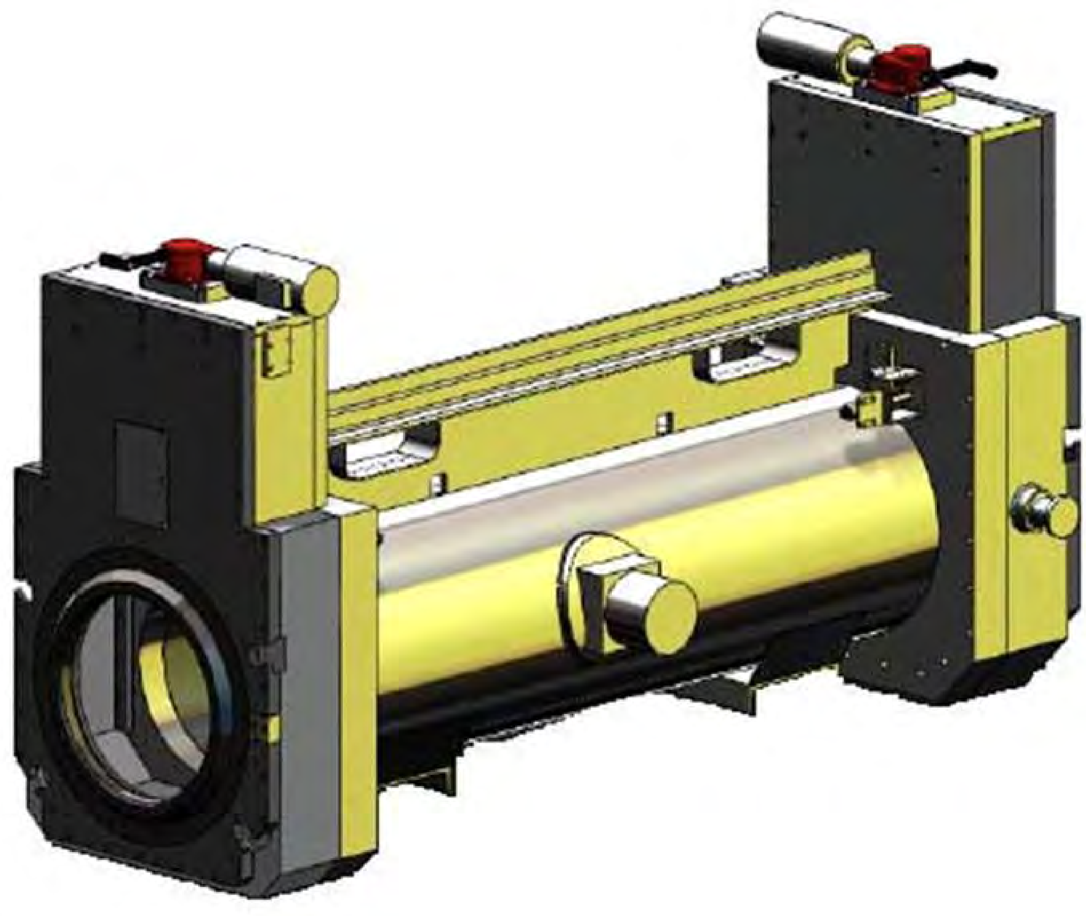


Figure 2.5-9. Light Weight Facility Cask (a Remote-Handled Waste Cask)

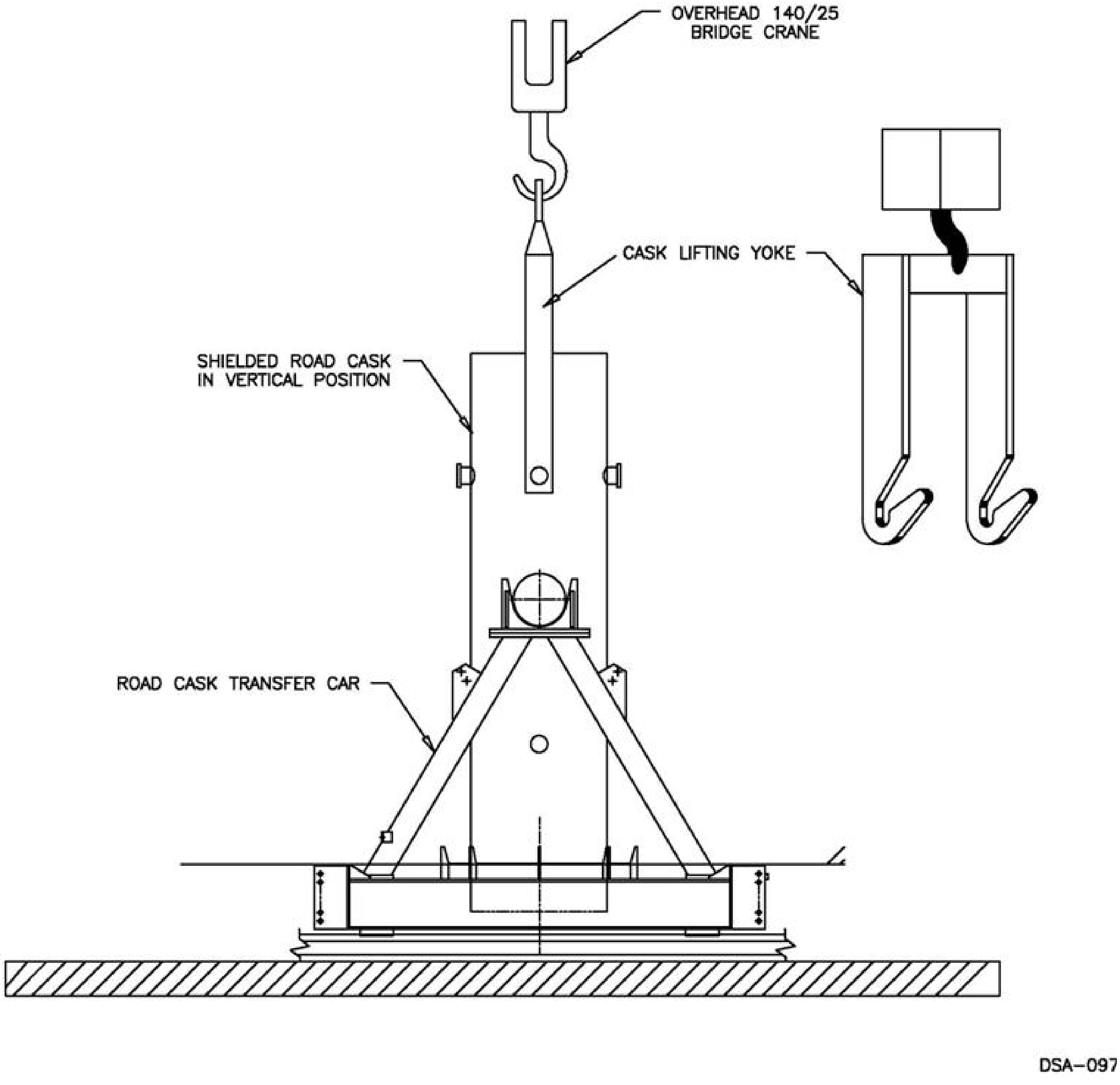


Figure 2.5-10. 140/25-ton Crane Cask-lifting Yoke

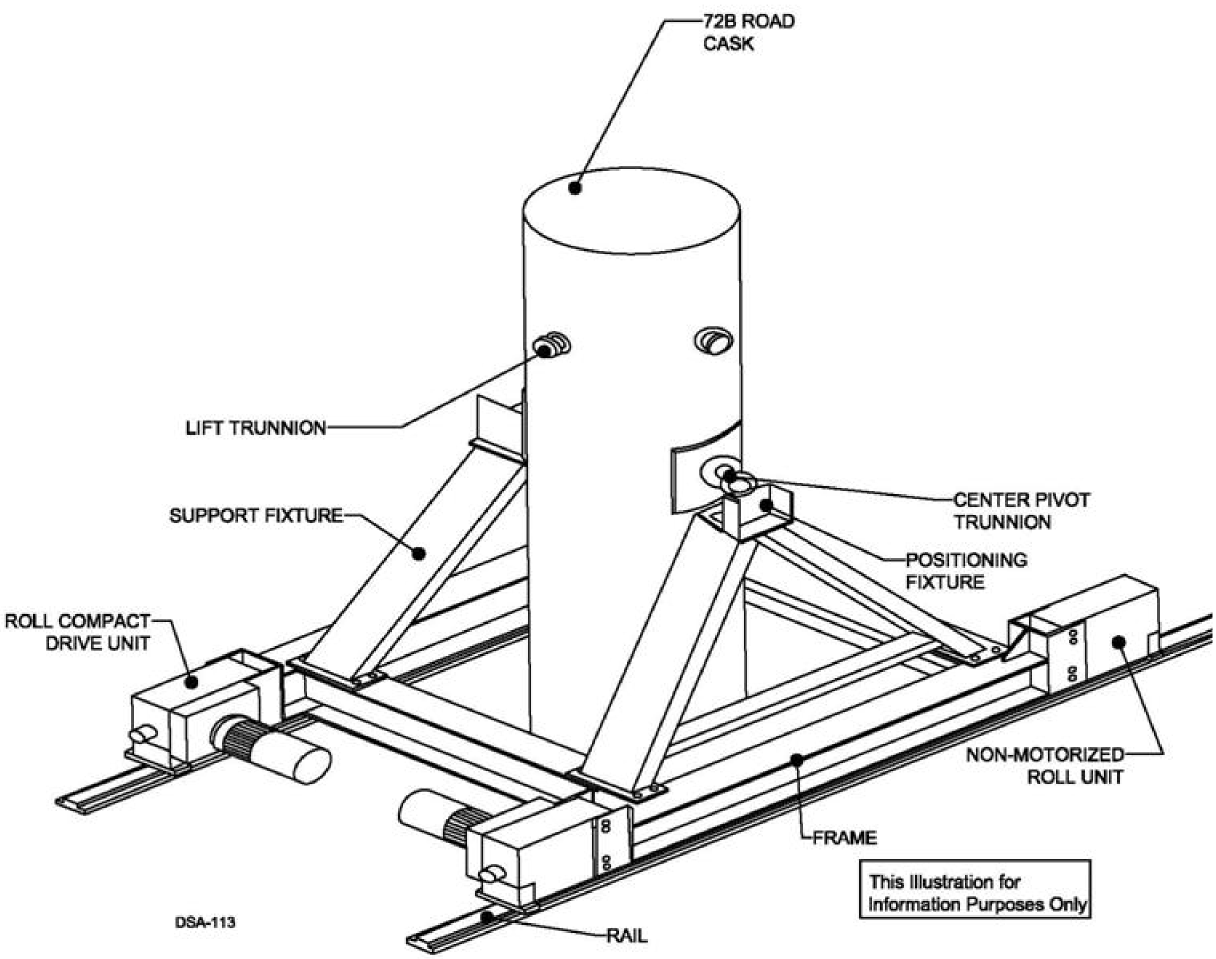


Figure 2.5-11. Remote-Handled Transuranic 72-B Shipping Package on Transfer Car

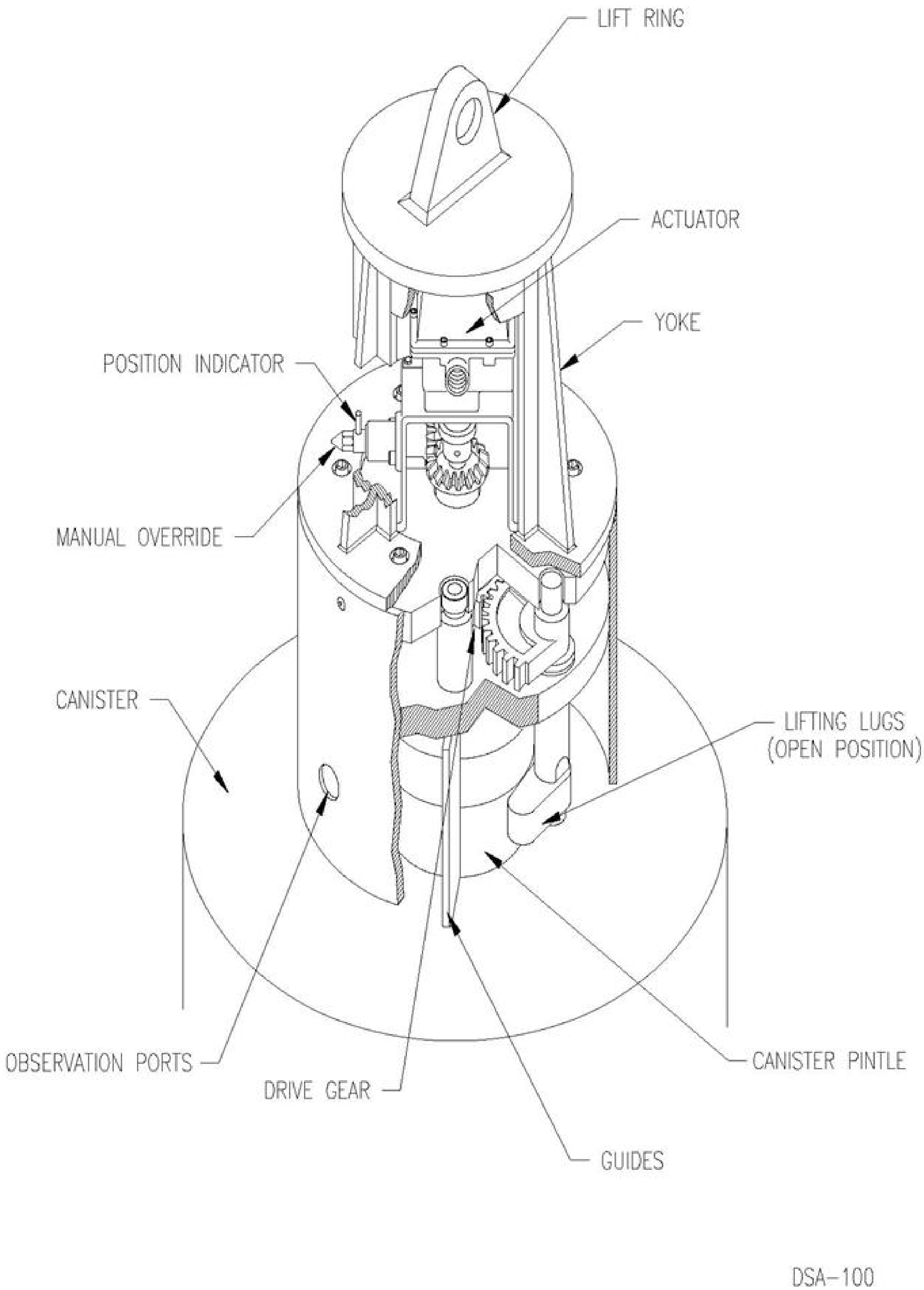


Figure 2.5-12. Facility Grapple

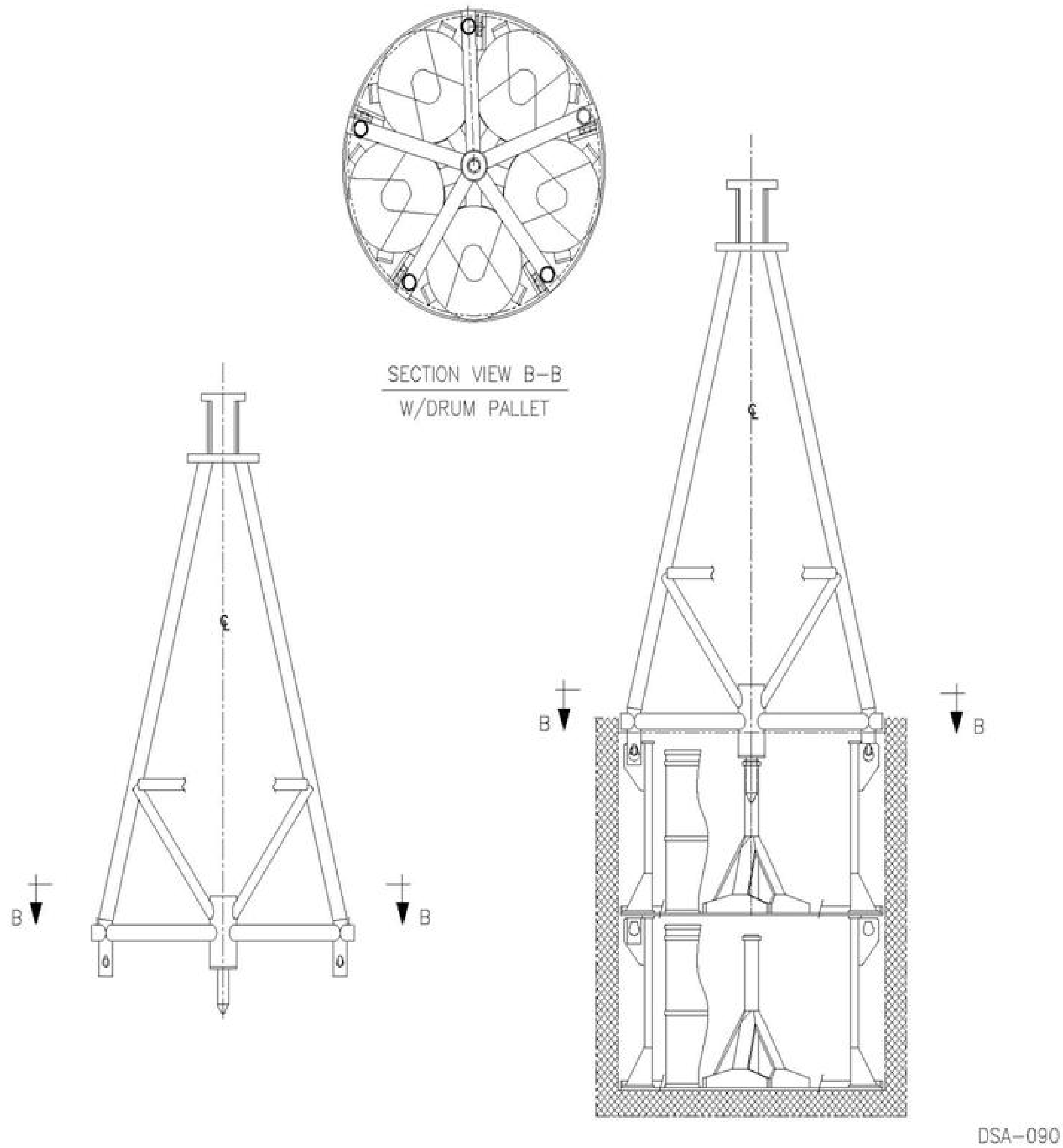


Figure 2.5-13. 10-160B Drum Carriage Lifting Fixture

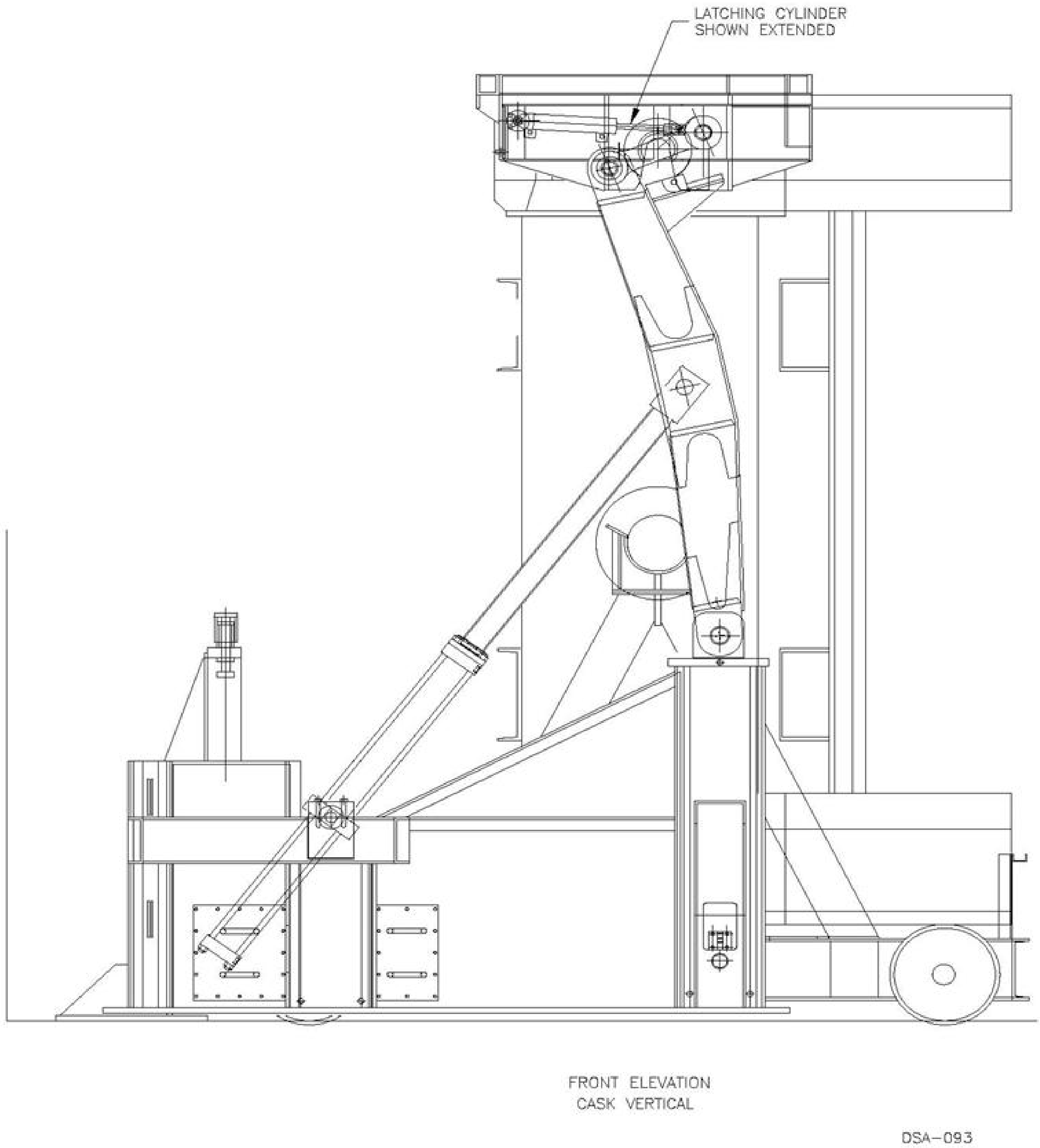


Figure 2.5-14. Facility Cask Rotating Device

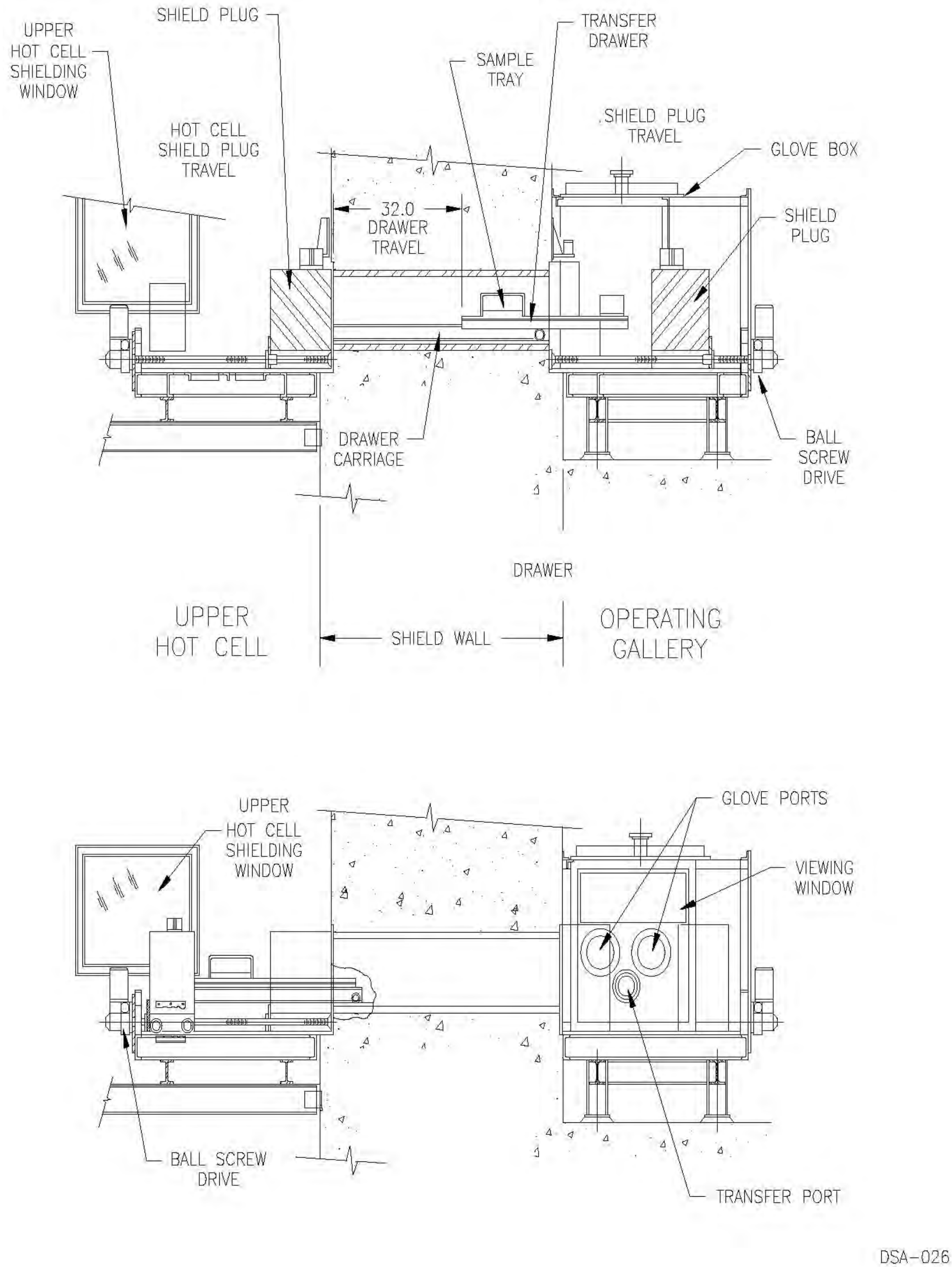


Figure 2.5-15. Upper Hot Cell Transfer Drawer

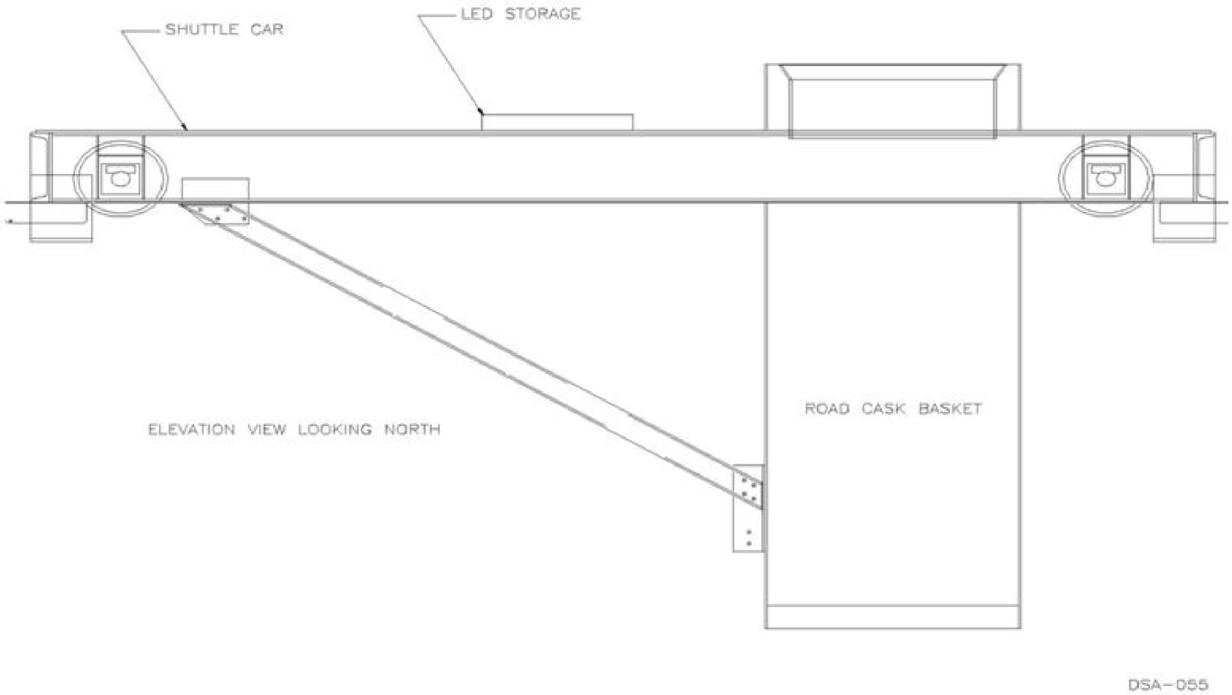


Figure 2.5-16. Transfer Cell Shuttle Car

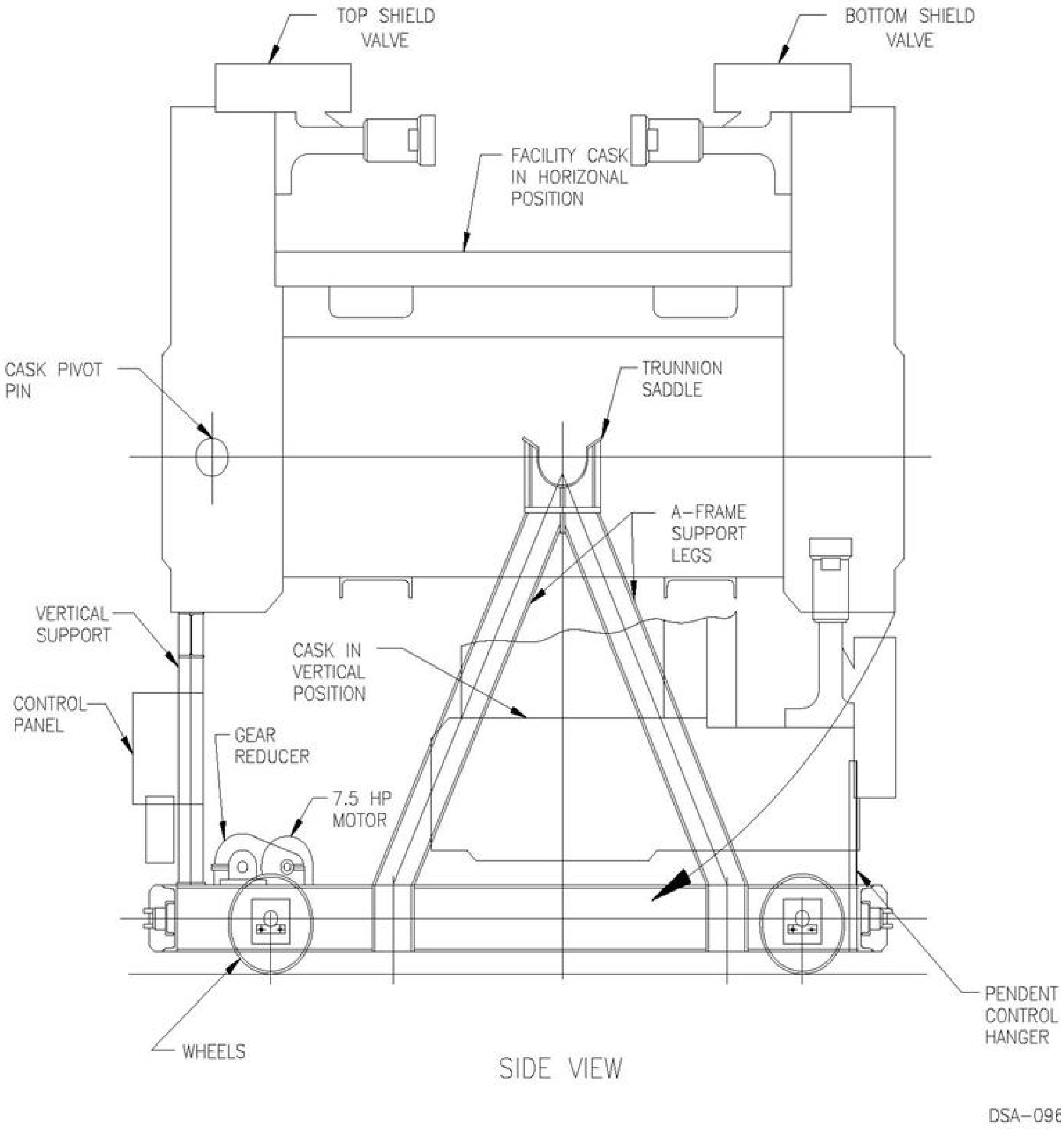


Figure 2.5-17. Facility Cask Transfer Car

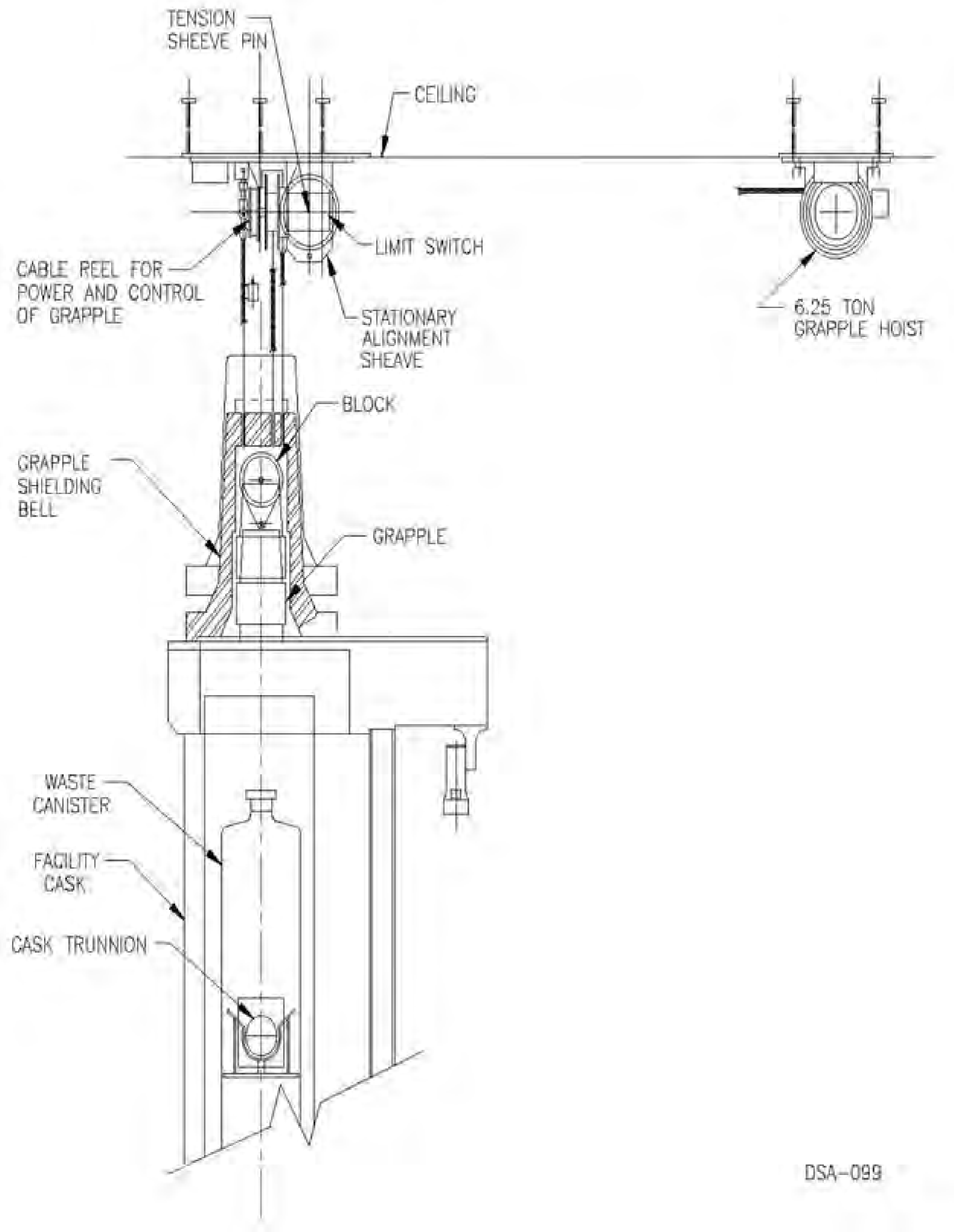


Figure 2.5-18. 6.25-ton Facility Cask Loading Room Grapple Hoist

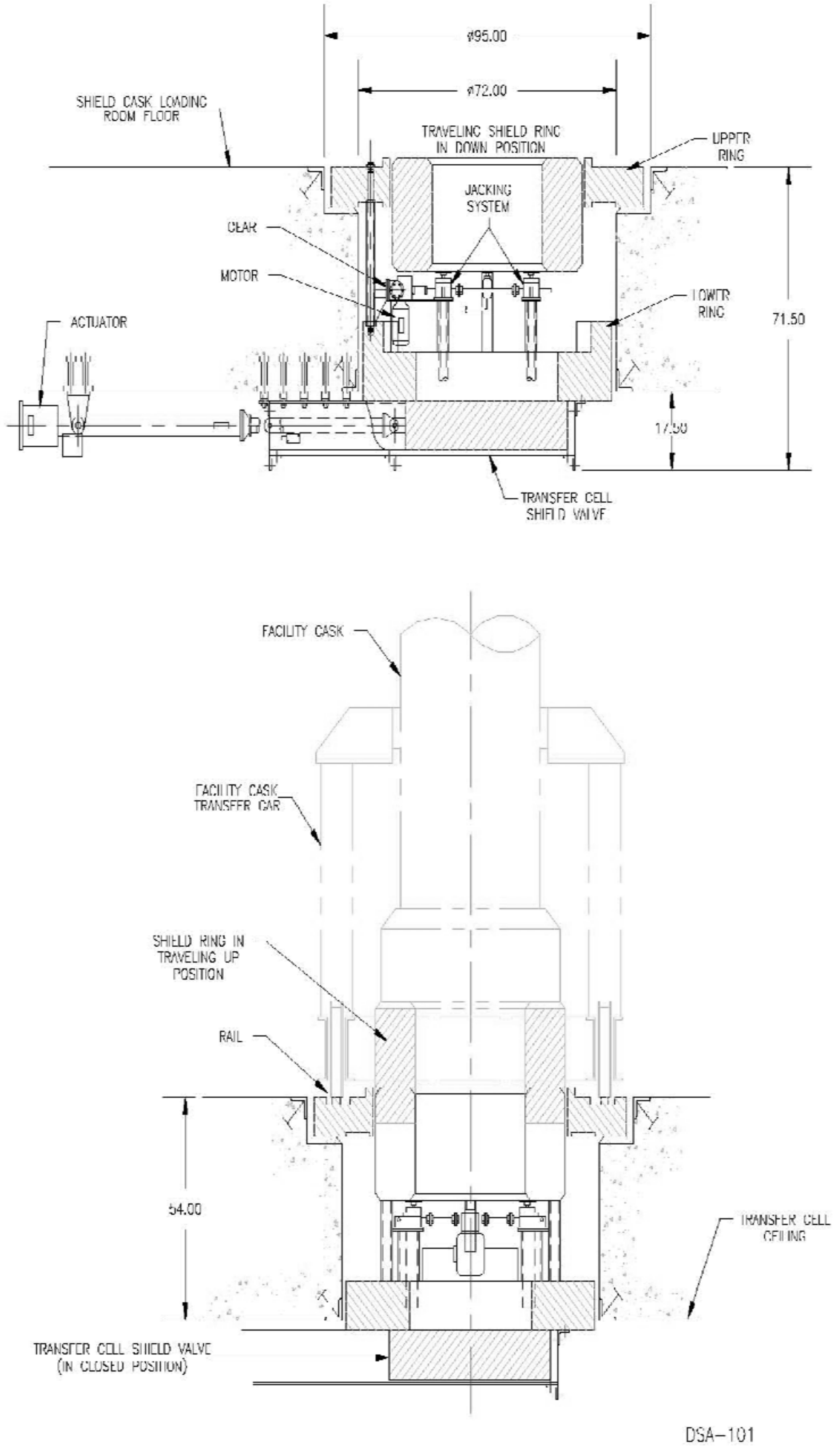


Figure 2.5-19. Telescoping Port Shield

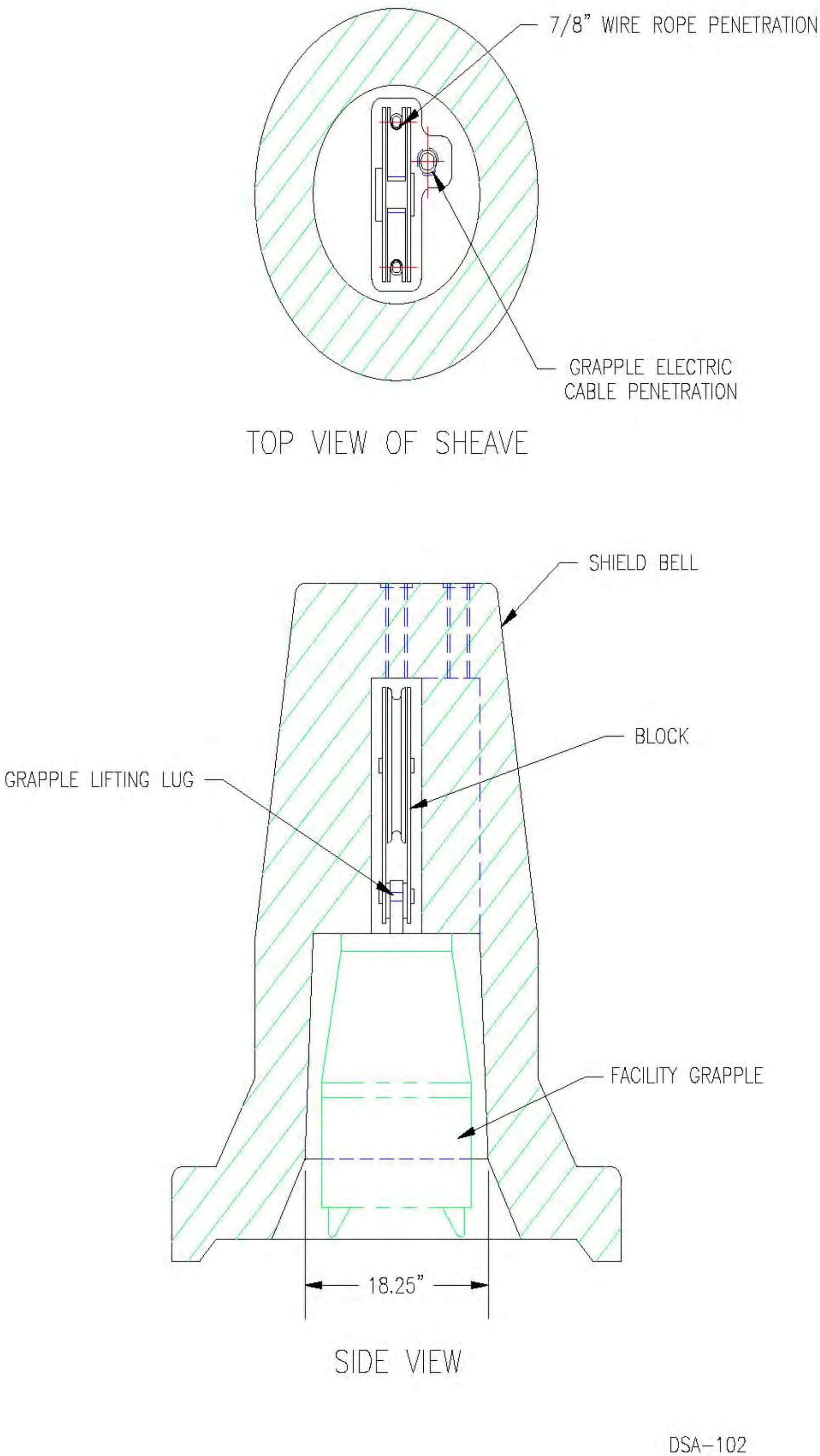


Figure 2.5-20. Bell Shield and Block

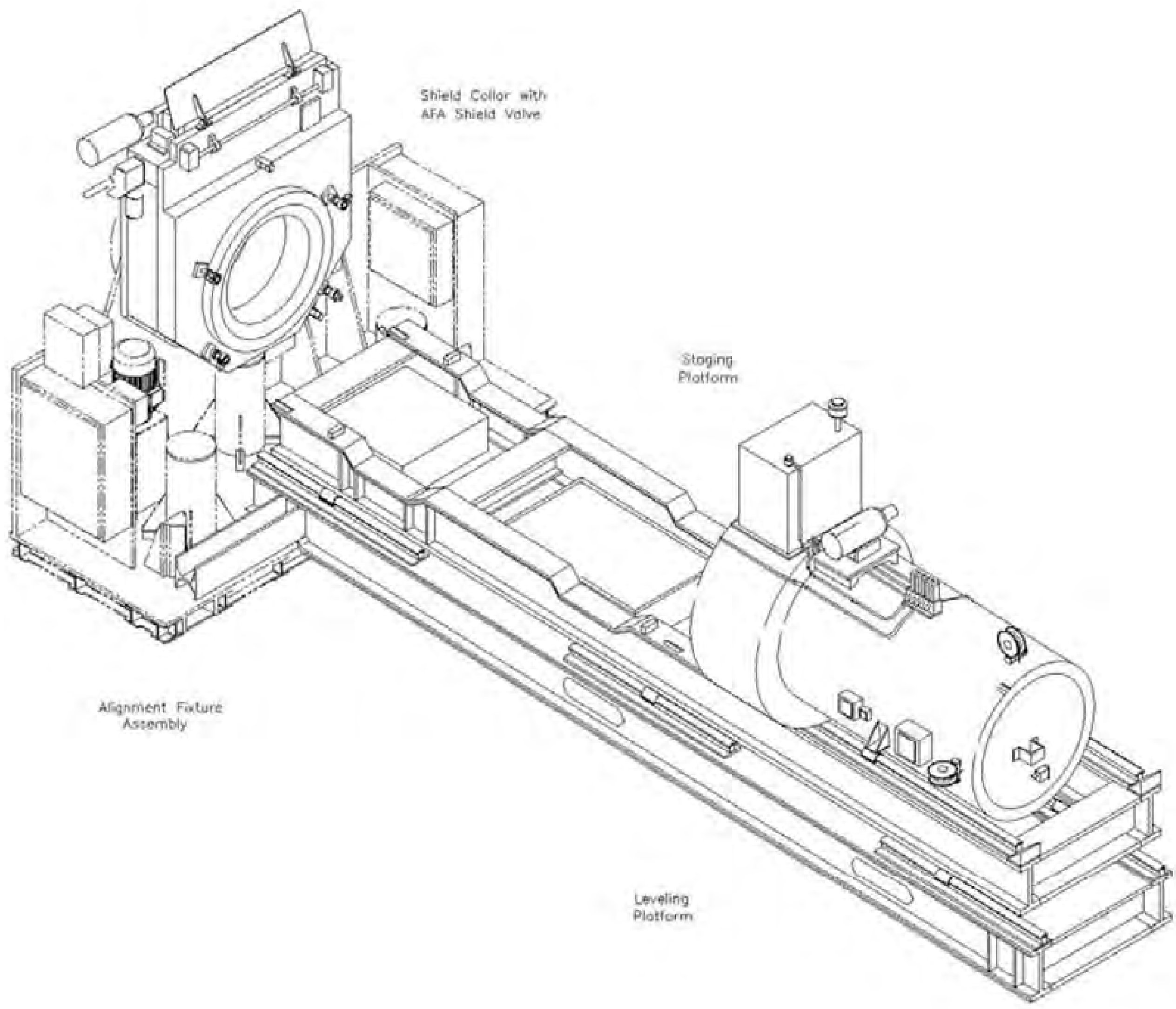


Figure 2.5-21. Waste Transfer Machine Assembly Installed on the Alignment Fixture

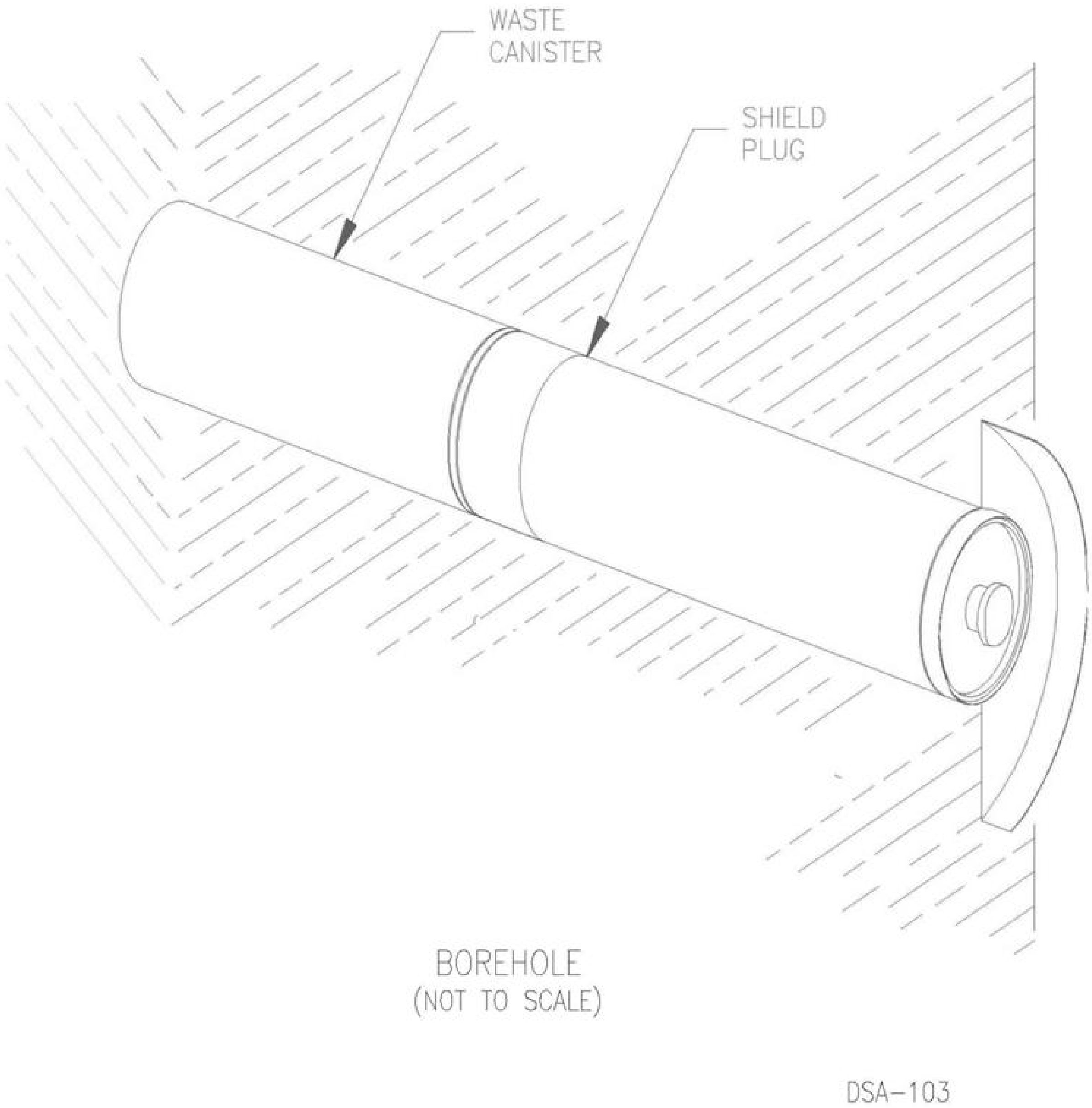
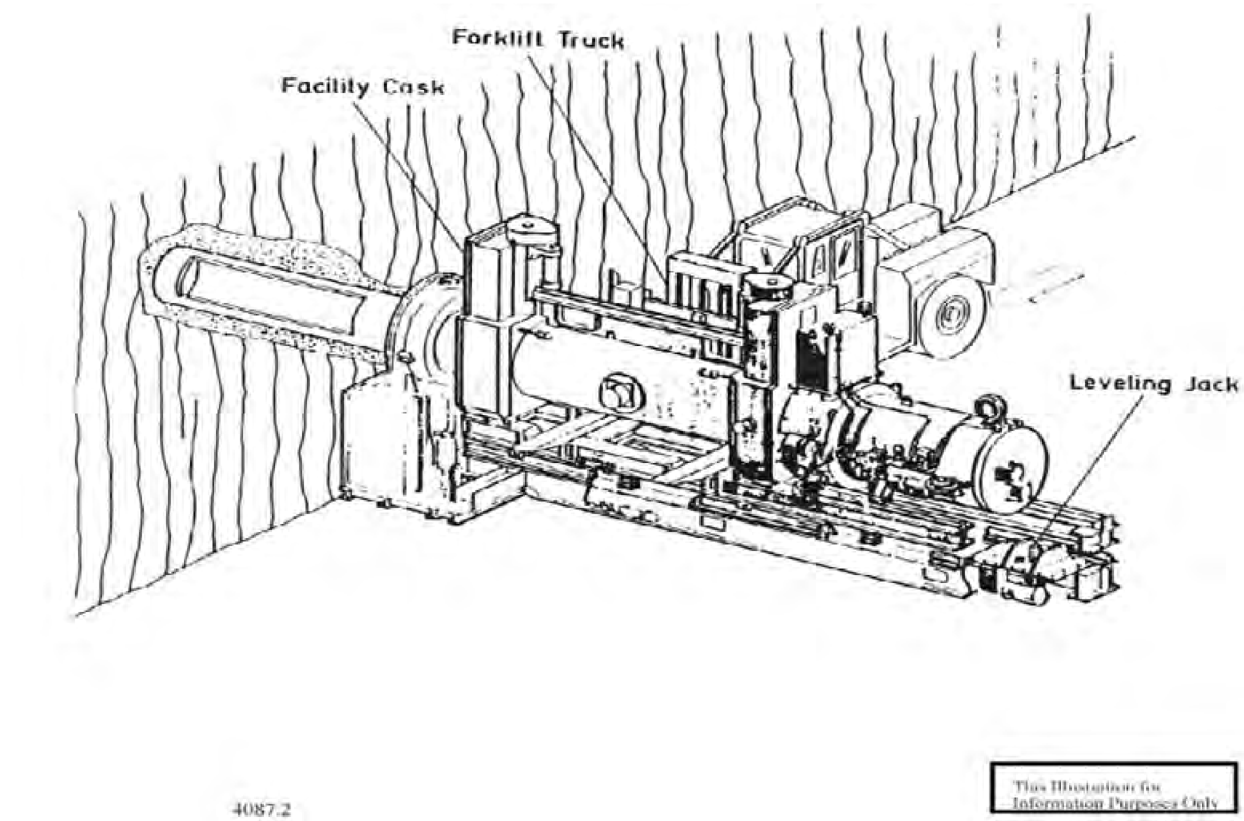


Figure 2.5-22. Remote-Handled Waste Emplacement Configuration



DSA-118

Figure 2.5-23. Facility Cask Installed on the Waste Transfer Machine Assembly

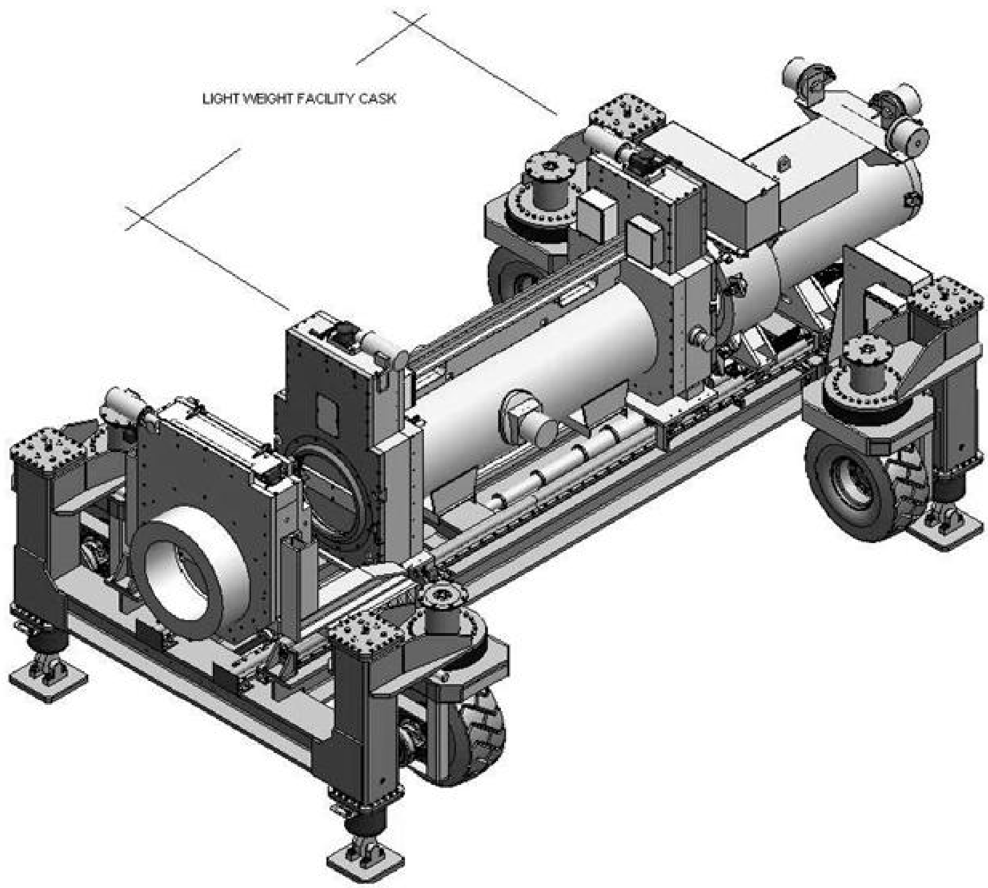


Figure 2.5-24. Horizontal Emplacement Machine with Light Weight Facility Cask

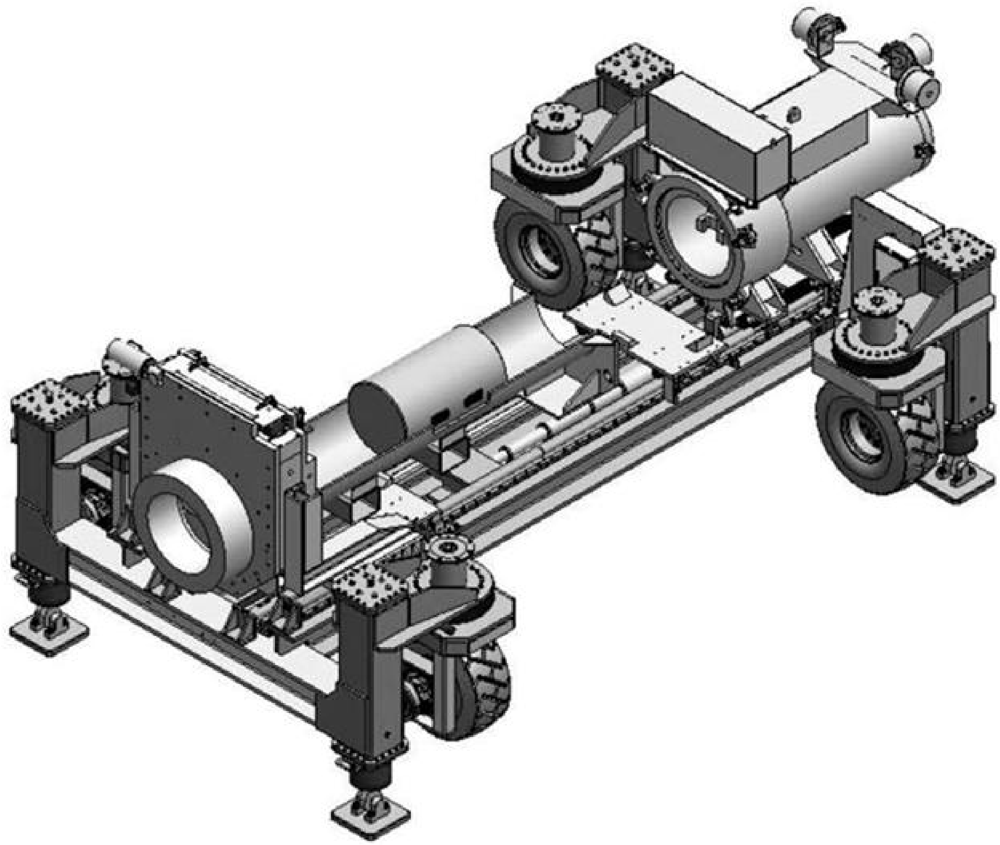


Figure 2.5-25. Horizontal Emplacement Machine with Shield Plug

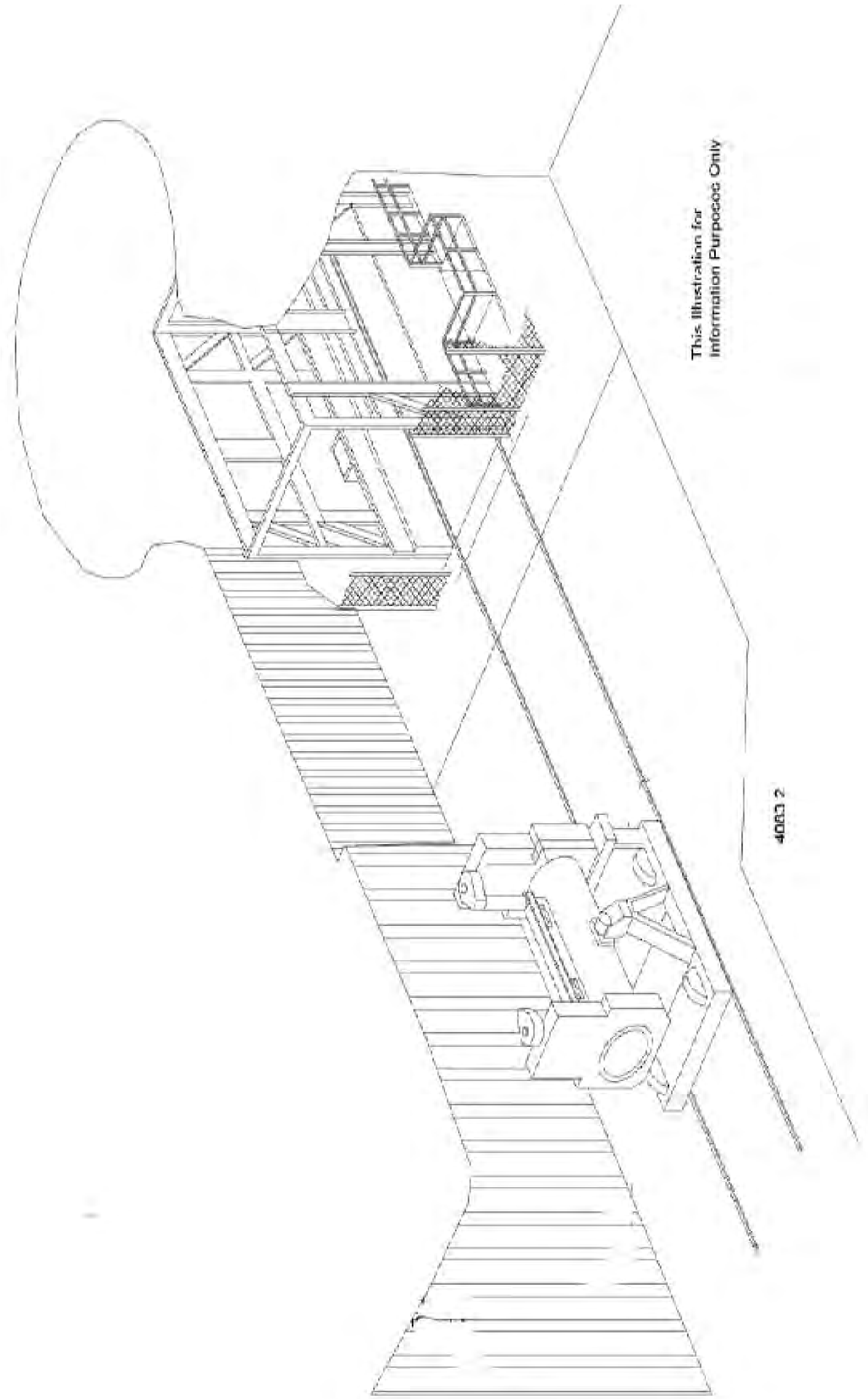


Figure 2.5-26. Remote-Handled Waste Handling Facility Cask Unloading from Conveyance

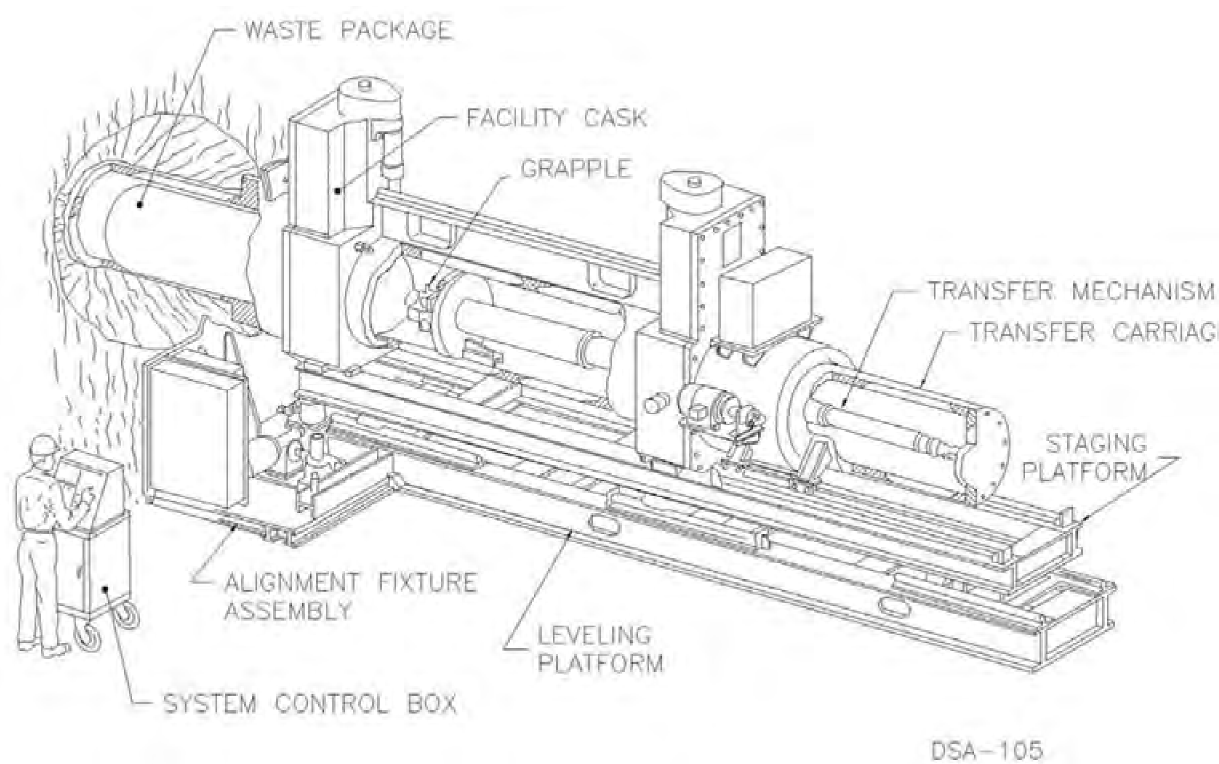


Figure 2.5-27. Remote-Handled Waste Canister Emplacement

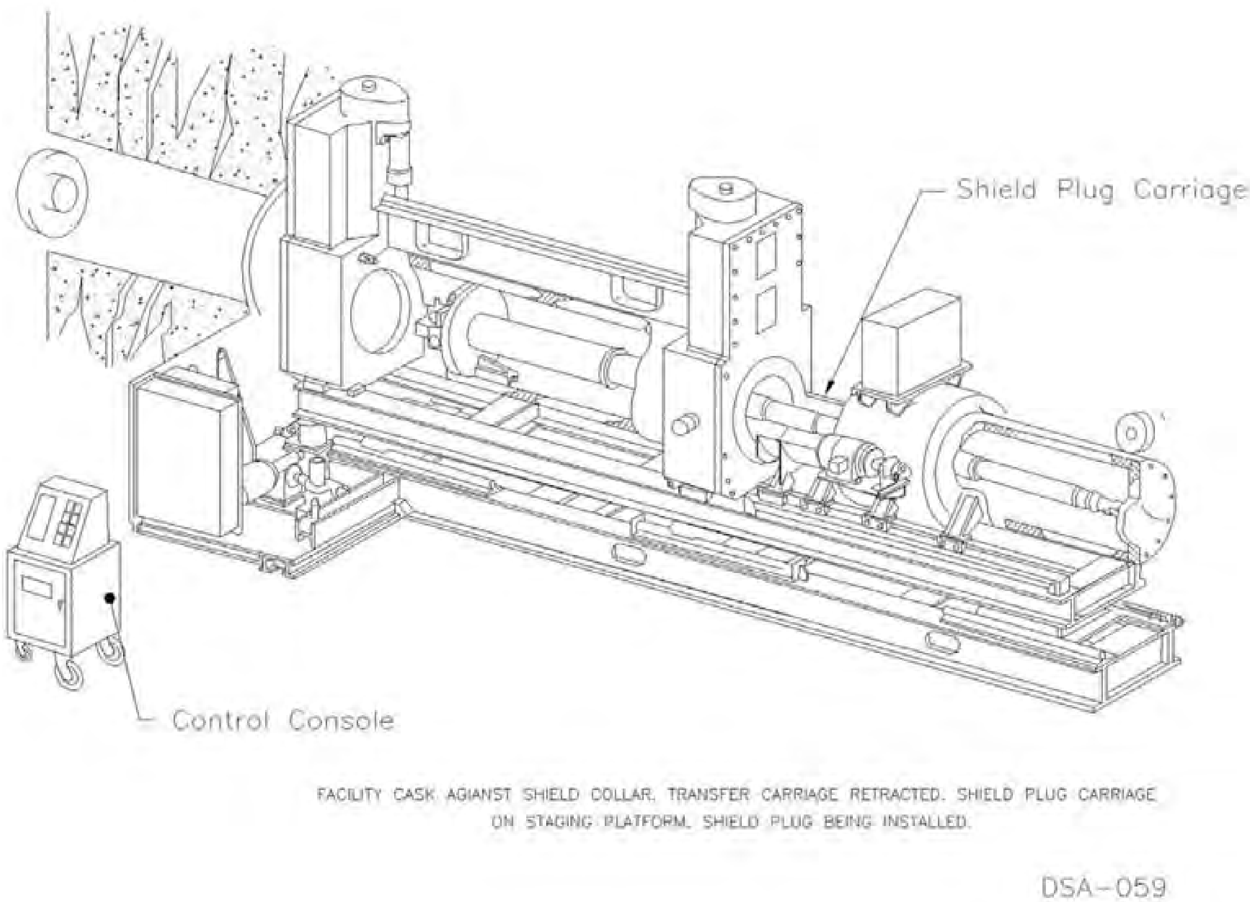


Figure 2.5-28. Installing Shield Plug

2.6 CONTACT-HANDLED WASTE HANDLING EQUIPMENT AND PROCESS DESCRIPTION

This section describes the CH Waste Handling equipment and process. The CH Waste Handling process begins at the security gate where CH Waste in shipping packages (TRUPACT-IIs, HalfPACTs, or TRUPACT-IIIs) arrives by truck (Figure 2.6-1 shows TRUPACT-IIs). Specific details of acceptable quantities and forms are provided in the WIPP WAC and the HWFP. A diagram of the CH Waste Handling process is shown in Figure 2.6-2.

2.6.1 Contact-Handled Waste Shipping Packages

2.6.1.1 TRUPACT-II

The TRUPACT-II is a stainless-steel, polyurethane foam-insulated Type-B shipping package designed to provide single containment for a shipment of CH Waste Containers (Figure 2.6-3). The packaging consists of an unvented stainless-steel Inner Containment Vessel (ICV) positioned within an Outer Confinement Assembly (OCA), which consists of an unvented stainless-steel Outer Confinement Vessel (OCV), a layer of polyurethane foam, and an outer stainless-steel shell. The container is a right circular cylinder with an outside diameter of approximately 94 inches and a height of approximately 122 inches.

The OCA has a domed lid that is secured to the OCA body with a locking ring. The OCV is equipped with a seal test port and a vent port. The ICV is a right circular cylinder with domed ends.

The TRUPACT-II is a certified Type B shipping package, by the NRC per "General License: NRC-Approved Package" (10 CFR 71.17), and is designed to safely transport TRU- and tritium-contaminated materials and wastes packaged in one of the following payload containers:

- 55-gallon drum.
- 85-gallon drum.
- 100-gallon drum.
- SWB.
- Standard pipe overpack.
- S100 pipe overpack.
- S200 pipe overpack.
- S300 pipe overpack.
- Criticality Control Overpack.
- TDOP.

The maximum weight of a TRUPACT-II is 19,250 pounds when loaded with the maximum allowable content weight of 7,265 pounds. The maximum gross weight of a payload container and the maximum number of payload containers per package are shown in Table 2.6-1.

Table 2.6-1. Payload Containers Maximums

Type	Maximum Number of Containers	Maximum Weight per Container
55-gallon drum	14 (2 seven-packs)	1,000 pounds
85-gallon drum (short)	8 (2 four-packs)	1,000 pounds
100-gallon drum	6 (2 three-packs)	1,000 pounds
SWB	2	4,000 pounds
Standard pipe overpack	14 (2 seven-packs)	328 pounds per 6-inch container 547 pounds per 12-inch container
S100 pipe overpack	14 (2 seven-packs)	550 pounds
S200 pipe overpack	14 (2 seven-packs)	547 pounds
S300 pipe overpack	14 (2 seven-packs)	547 pounds
Shielded containers (HalfPACT)	3 (1 three-pack)	2,260 pounds
Criticality Control Overpack	14 (2 seven-packs)	350 pounds
TDOP (TRUPACT-II)	1	6,700 pounds

Through analysis, the TRUPACT-II and HalfPACT are sufficiently robust to withstand the effects of a tornado-borne missile should a tornado occur at the WIPP facility (NS-05-001, *WIPP Contact Handled (CH) Documented Safety Analysis (DSA) Revision 10 Source Term, Dose Consequence and Supporting Information*).

2.6.1.2 HalfPACT

The HalfPACT, shown in Figure 2.6-4, is an NRC-certified Type B shipping package with a stainless-steel and polyurethane foam-insulated shipping container similar to, but shorter than, the TRUPACT-II. The package consists of an unvented stainless-steel ICV positioned within an OCV. The package is a right circular cylinder with an outside diameter of approximately 94 inches and a height of 92 inches.

The OCA has a domed lid that is secured to the OCA body with a locking ring. The OCV is equipped with a seal test port and a vent port. The ICV is a right circular cylinder with domed ends.

The HalfPACT is certified by the NRC per 10 CFR 71.17 and is designed to safely transport TRU- and tritium-contaminated materials and wastes packaged in the containers identified in Table 2.6-1 except for the TDOP. The TDOP is too large to be transported in a HalfPACT. The maximum weight of a HalfPACT is 18,100 pounds when loaded with the maximum allowable content weight of 7,600 pounds. Shielded containers will only be shipped in a HalfPACT.

2.6.1.3 TRUPACT-III

The TRUPACT-III (Figure 2.6-5) is an NRC-certified Type B shipping package designed to retain the integrity of containment and shielding required for its radioactive contents when subjected to normal conditions of transportation and hypothetical accident conditions set forth in “Packaging and Transportation of Radioactive Material” (10 CFR 71). The TRUPACT-III is certified by the NRC per 10 CFR 71.17 and is designed to safely transport CH TRU in the SLB2 waste payload container.

The containment boundary and all primary structural members of the body are constructed of stainless steel. The containment boundary structure consists of an inner shell that is backed by a corrugated sheet of Unified Numbering System (UNS) S31803 stainless steel and an outer structural shell. Completely surrounding the containment boundary structure is a unique combination of energy-absorbing and insulating materials that provide both structural and thermal protection.

The TRUPACT-III has a bolted closure lid, equipped with vent and test ports, and is further secured by an overpack cover that is bolted to the TRUPACT-III to protect the lid.

The maximum weight of the TRUPACT-III is 55,116 pounds when loaded with the maximum allowable content weight of 11,486 pounds.

Through analysis, the TRUPACT-III is sufficiently robust to withstand the effects of a tornado-borne missile should a tornado occur at the WIPP (NS-05-001).

2.6.2 Contact-Handled Waste Containers

2.6.2.1 55-gallon Drums

The standard 55-gallon metal drum (Figure 2.6-6) is a DOT Type 7A steel drum with a maximum gross weight of 1,000 pounds. A 55-gallon drum is approximately 0.05 inch thick and is constructed with a lap-welded bottom and numerous lid configurations. A standard 55-gallon drum has a gross internal volume of approximately 7 ft^3.

2.6.2.2 85-gallon Drums

The 85-gallon drum (Figure 2.6-7) is a DOT Type 7A steel drum, approximately 0.06 inch thick and constructed similar to the 55-gallon drum. The 85-gallon drum is used primarily for overpacking 55-gallon drums. The 85-gallon drum has a gross internal volume of approximately 11 ft^3. There are two sizes of 85-gallon drums (*Contact-Handled Transuranic Waste Authorized Methods for Payload Control* (CH-TRAMPAC)). The short 85-gallon drum is approximately 35 inches tall and has a diameter of approximately 30 inches. The tall 85-gallon drum has a height of approximately 40 inches and a diameter of approximately 29 inches. Only the short 85-gallon drums can be transported in a TRUPACT-II, while the HalfPACT can transport both types of 85-gallon drums.

2.6.2.3 100-gallon Drums

The 100-gallon metal drum (Figure 2.6-8) is a DOT Type 7A steel drum with a maximum gross weight of 1,000 pounds. The 100-gallon drum may be either direct loaded or loaded with compacted 55-gallon drums. The 100-gallon drum has a gross internal volume of approximately 13 ft^3.

2.6.2.4 Standard Waste Box

The SWB (Figure 2.6-9) is a DOT Type 7A steel-fabricated box with a lap-welded bottom and an internally flanged, bolted closure lid. The weight of an empty SWB is approximately 680 pounds and the maximum gross weight of a loaded SWB is 4,000 pounds. Four threaded couplings, two on each side of the SWB with the lifting clips, are installed in the flange for inserting a filter to provide protection from particulate leakage during shipment or from buildup of internal pressure. The SWB has an internal volume of approximately 66 ft^3.

2.6.2.5 10-Drum Overpack

The TDOP (Figure 2.6-10) is a DOT Type 7A welded-steel right circular cylinder, approximately 74 inches tall and 71 inches in diameter. An empty TDOP weighs approximately 1,600 pounds and has a maximum loaded weight of 6,700 pounds. A bolted lid on one end is removable and sealing is accomplished by clamping a gasket between the lid and the body. Filter ports are located near the top of the TDOP. A TDOP may contain up to 10 standard 55-gallon drums or one SWB. The TDOP has an internal volume of approximately 155 ft^3.

2.6.2.6 Standard Pipe Overpack

The standard pipe overpack (Figure 2.6-11) consists of a stainless-steel pipe component surrounded by fiberboard and plywood dunnage in a DOT Type 7A 55-gallon drum with a rigid polyethylene liner and lid. The pipe container provides three significant control functions with regard to waste materials: criticality control, shielding, and containment of waste material.

The pipe component (Figure 2.6-12) is a stainless-steel cylindrical pipe with a closed-bottom cap and a bolted stainless-steel lid sealed with an O-ring. The pipe component is approximately 2 feet long, and is available with either a 6-inch or a 12-inch diameter. The pipe component is vented through a filter. The pipe component is centered in the standard 55-gallon vented steel drum with fiberboard and plywood packing material.

The pipe component and pipe overpack weights are shown in Table 2.6-2.

Table 2.6-2. Pipe Component and Pipe Overpack Weights

Size of Pipe Component	Pipe Component Maximum Content Weight (lb)	Pipe Component Maximum Gross Weight (lb)	Pipe Overpack Maximum Gross Weight (lb)
6-inch diameter	66	153	328
12-inch diameter	225	407	547

2.6.2.7 S100 Pipe Overpack

The S100 pipe overpack (Figure 2.6-13) is a neutron-shielded container. It differs from the standard pipe overpack in that most of the fiberboard dunnage is replaced with neutron-shielding material. In addition, neutron-shielding material is placed inside the pipe component above, below, and around the payload.

The S100 pipe overpack consists of a 6-inch pipe component surrounded by neutron-shielding material on the sides and by fiberboard and plywood dunnage on the top and bottom, in a 55-gallon drum with a rigid polyethylene liner and lid. It is placed in the drum, using the same type of fiberboard and plywood dunnage below the lower surface and above the upper surface of the pipe component. The space around the sides of the pipe component is filled with neutron shielding material. To provide shielding for the top and bottom of the pipe component, rigid high-density polyethylene plugs are placed above and below the payload inside the pipe component. A rigid high-density polyethylene shield sleeve is placed between the two end plugs. The S100 pipe overpack is intended for the shipment of sealed neutron sources.

2.6.2.8 S200 Pipe Overpack

The S200 pipe overpack is a gamma-shielded container. It differs from the standard pipe overpack through the addition of a gamma shield insert located by dunnage inside the pipe component. It is intended for the shipment of TRU Waste forms with high gamma energies. The gamma shield insert is a two-component lead assembly consisting of a cylindrical body with an integral bottom cap and a detachable lid. The shield insert is available in two sizes. The overall dimension of the S200-A shield insert is approximately 10 inches in diameter and 11 inches tall. The overall dimension of the S200-B shield insert is approximately 9 inches in diameter and 18 inches tall. The pipe component is positioned using fiberboard and plywood dunnage in a 55-gallon drum with a rigid polyethylene liner and lid.

2.6.2.9 S300 Pipe Overpack

The S300 pipe overpack (Figure 2.6-14) is a neutron-shielded container. It differs from the standard pipe overpack through the addition of neutron shielding inside the pipe component. It is intended for the shipment of sealed neutron sources. The neutron shield insert is a two-part assembly consisting of a cylindrical body and stepped lid. The insert fits inside and fills the 12-inch pipe component and is held in place by the lid of the pipe component. The shield insert is made from solid high-density polyethylene and has a wall thickness of approximately 4 inches.

2.6.2.10 Standard Large Box 2

The SLB2 is a DOT Type 7A steel-fabricated box (Figure 2.6-15) with a lap-welded bottom and an internally flanged, bolted closure lid. The weight of an empty SLB2 is approximately 2,700 pounds and the maximum gross weight loaded is 10,500 pounds. The SLB2 is approximately 108 inches long, 69 inches wide, and 73 inches high. Threaded couplings installed on each side of the SBL2 are for inserting a filter to provide protection from particulate leakage during shipment or from buildup of internal pressure. There are also two lifting clips on each side of the SLB2. The SLB2 has an internal volume of approximately 246 ft^3.

2.6.2.11 Shielded Containers

The shielded container (Figure 2.6-15a) is a vented carbon-steel and lead cylindrical structure with a removable lid designed to hold an inner 30-gallon container of RH Waste. The shielded container meets DOT 7A Type A requirements of 49 CFR 178.350, “Specification 7A; General Packaging, Type A,” and will be shipped to WIPP in HalfPACT Type B packaging. The cylindrical sidewall of the shielded container has approximately 1-inch-thick lead shielding sandwiched between two carbon-steel shells. The external wall is approximately 1/8 inch thick, and the internal wall has a thickness of approximately 3/16 inch. The lid and the bottom of the shielded container are made of carbon steel and are approximately 3 inches thick. An empty container weighs about 1,726 pounds. The shielded container and the inner 30-gallon container will be vented, assembled in a three-pack configuration on a triangular pallet, and surrounded by radial and axial dunnage components.

Upon arrival at WIPP in a HalfPACT, the containers will be processed like CH TRU Mixed Waste using CH Waste Handling equipment and operating procedures. The waste will be designated as RH Waste from the generator’s inventory in the WDS WIPP Waste Information System.

Based on the waste definitions, the designation of CH and RH Waste is based solely on the dose rate at the surface of the payload container as determined at a generator site during characterization.

2.6.2.12 Criticality Control Overpack

The Criticality Control Overpack is a 55-gallon drum (Figure 2.6-15b), containing a stainless steel criticality control container held in place by plywood dunnage plates in the top and bottom of a 55-gallon drum. The criticality control container provides two significant control functions: criticality geometry control by limiting the most reactive configuration to a cylinder and confinement of waste material.

The criticality control container is a stainless steel cylindrical pipe with a blind flange welded bottom cap and a blind flange bolted to a slip-on flange with a gasket providing a sealed lid. The criticality control container is approximately 2 feet long and has a 6-inch diameter. Both the Criticality Control Overpack and criticality control container are vented through a filter. The criticality control container is centered in the Criticality Control Overpack (55-gallon drum) by plywood dunnage plates. The Criticality Control Overpack has a maximum gross weight of 350 pounds.

2.6.3 Contact-Handled Waste Handling Equipment

This section describes the CH Waste Handling equipment located in the CH Bay and Room 108 (Section 2.6.3.1), as well as the conveyance loading car (Section 2.6.3.1.20) and the CH Waste Handling equipment located in the UG (Section 2.6.3.2).

2.6.3.1 Contact-Handled Bay/Room 108

2.6.3.1.1 TRUDOCK 6-ton Cranes

Each TRUDOCK is serviced by two 6-ton overhead cranes that are used to transfer the shipping package OCV and ICV lids to their individual support stands and the payload Waste Containers to the facility pallet. The cranes are nearly identical, having a single girder, under-hung bridge, trolley, and wire rope hoist as shown in Figure 2.6-16. The two cranes at each TRUDOCK share the rails where the bridges travel. The north cranes can service either end of the TRUDOCK; however, the south cranes can only service the south positions. The cranes are prevented from colliding with each other by limit switches. If a limit switch is actuated on either crane. The crane will then stop motion in the direction of travel; however, the crane can move in the opposite direction to disengage the limit switch.

Each crane is controlled by its individual radio-frequency transmitter or pendant control. The TRUDOCK 6-ton cranes are designed to hold their load in the event of a DBE or loss of power (SDD WH00). Overhead cranes used in Waste Handling operations are certified to lift their rated capacity and load tested to 125 percent of maximum rated lift. The crane control system allows the operator to lift and transfer the load to the location of the facility pallet. The cranes use specially designed lifting and load-balancing fixtures, including the adjustable center-of-gravity lifting fixture (ACGLF) (Figure 2.6-17), the SWB lifting assembly, the TDOP lifting assembly, the four-pack lifting fixture, and short and long lifting leg sets.

2.6.3.1.2 TRUDOCK Exhaust System

Each TRUDOCK has an exhaust system with two working stations and each station consists of two subsystems: the TRUDOCK vent hood system and the TRUDOCK vacuum system. Both subsystems are routed through HEPA filters before entering the CH Bay Battery Charging Area exhaust system, which is also HEPA filtered, before discharging to the atmosphere (Figure 2.6-18 and Figure 2.6-19).

The TRUDOCK vent hood system consists of an enclosure that is installed over the ICV lid and the Shipping Package body before the lid is removed. The enclosure is connected to the exhaust system before the lid is removed, thus ensuring that any potential radioactive contamination is passed through a HEPA filter system. After the filter, there is a small fan at each dock that provides air flow for the docks that feeds the Battery Exhaust System.

The TRUDOCK vacuum system is used to evacuate the Shipping Package OCV or ICV to pull the outer or inner lid down to assist in lid removal. The vacuum system inlet is connected by flexible tubing, using quick-disconnect fittings, to the appropriate ICV or OCV vent port tool. A radiological assessment filter in the inlet line is used when evacuating the ICV. The radiological assessment filter is checked for radioactive contamination from the inside of the Shipping Package.

2.6.3.1.3 Space-frame Pallet Assemblies

Two types of space-frame pallet assemblies, more commonly called payload or drum pallets, are used in CH Waste shipments. A payload pallet supports the drum payloads contained in a TRUPACT-II or HalfPACT and interface with the ACGLF during payload removal from the transportation package. Space-frame pallets, constructed of aluminum, resemble a spoke wagon wheel that has a thin aluminum sheet welded to one side. Space-frame pallets have a diameter of approximately 63 inches, are approximately 3 inches thick, have a working load limit of 7,600 pounds, and have multiple lifting pockets that interface with the lifting legs of the ACGLF.

The payload pallet used under drum payloads has three lifting pockets of the same design and spacing as the OCA and ICV lids. Three guide tubes pass through the drums and align with the lifting pockets to guide the (long) lifting legs of the ACGLF when removing the waste assemblies. The weight of the pallet is approximately 136 pounds.

A second type of payload pallet, used for HalfPACT payloads of 85-gallon drums, has four lifting pockets of the same design as the OCA and ICV lids. This type of payload pallet interfaces with the HalfPACT four-drum pallet-lifting device discussed below and weighs approximately 147 pounds.

2.6.3.1.4 Adjustable Center-of-Gravity Lifting Fixture

The ACGLF (Figure 2.6-17) is used with a TRUDOCK 6-ton crane to lift the OCV and ICV lids or the payload Waste Containers out of the TRUPACT-II and HalfPACT. The ACGLF has a lifting capacity of 10,000 pounds and weighs approximately 2,500 pounds. The ACGLF is designed as follows:

- The lower strong-back assembly, a carbon-steel lifting beam structure, has three revolving joints, 120 degrees apart, to which the lifting legs are attached.
- Three linear actuators mounted on the underside of the lower strong-back assembly provide the linear motion for each of the lifting-leg revolving mechanisms, which connect the lifting legs to the load.
- Two rotating balance weights are mounted on a circular upper plate assembly. The rotating balanced weights are attached to two counter-rotating ring gears that are independently driven.
- Two 1/4-horsepower, 115-volt, single-phase motors drive the counter-rotating ring gears that position the rotating balance weights around the circumference of the upper plate assembly.
- Three short lifting legs raise the OCV and ICV lids or SWBs when raised with an SWB lifting-fixture adapter and three long lifting legs raise a payload pallet. The bottom of the lifting legs are designed to engage a horizontal lifting bar in the lifting pockets of the OCV and ICV lids, SWB lifting fixture adapter, and drum shipping pallet when the lifting leg is rotated into position. The

ACGLF also includes three electrical motors and arms to rotate the lifting legs into their locking lift positions. The control system has limit switches with lights to indicate that each lifting leg has rotated to attach to the lifting pins.

- Two tilt sensors provide X- and Y-axis tilt indication of the ACGLF.
- Two balance-weight-position sensors continuously provide the position of each of the two rotating balance weights.
- A single-point lifting shackle is mounted in the center of the ACGLF for attachment to the crane.
- One portable control console provides operator controls and indicators to monitor the balance condition of the load and to compensate, if necessary, for load imbalance by repositioning the two counterweights.

2.6.3.1.5 Nonadjustable Center-of-Gravity Lifting Fixture

This fixture is similar to the ACGLF in function except that it has no capability for balancing the load. It can be used as a backup for the ACGLF to lift the OCV and ICV lids, the entire ICV, and the payload Waste Containers (pallet with 14 drums, or two SWBs strapped together). The fixture has a lifting capacity of 10,000 pounds and weighs approximately 600 pounds.

2.6.3.1.6 HalfPACT Four-Drum Pallet Lifting Device

The HalfPACT four-drum pallet-lifting device is designed to lift four 85-gallon drums on a single pallet. Four legs connect the lifting device to the pallet. The ACGLF interfaces at three points with lifting sockets at the top of the lifting device. Four linkages connect the three ACGLF connector legs to the lifting-device legs. The linkages allow the lifting-device legs to be controlled by the ACGLF. Each lifting-device leg may be actuated by either the linear actuator on the ACGLF or the handle located on each ACGLF leg-turning sleeve. The HalfPACT four-drum pallet-lifting device has a rated load of 10,000 pounds. It may be lifted by an ACGLF at the three attachment points or by the clevis located in the center of the device.

2.6.3.1.7 SWB Lifting-fixture Adapter

The SWB lifting-fixture adapter (Figure 2.6-20) is designed to interface between the ACGLF and the SWB. Its frame is made from square steel tubing. The three lifting pockets on the top of the fixture are located on a circle 56 inches in diameter to match the positioning of the three legs of the ACGLF. The SWB lifting-fixture adapter has a rated lifting capacity of 7,500 pounds and weighs approximately 334 pounds.

2.6.3.1.8 SWB Forklift Fixture

The SWB forklift fixture (Figure 2.6-22) is used in the CH Bay to move SWBs with a 6-ton electric forklift. The SWB forklift fixture is a welded-steel frame mounted to and supported on the front side of a 6-ton forklift carriage from which the lifting forks have been removed. The fixture has a rated load of 4,000 pounds, is designed specifically for lifting SWBs, and weighs approximately 360 pounds.

2.6.3.1.9 TDOP Lifting-fixture Adapter

The TDOP lifting fixture adapter (Figure 2.6-21) is made from square steel tubing with sections of schedule 80 pipe welded to the assembly tubing. Holes are drilled into the pipe and cold-rolled steel pins are welded in place. The lifting pockets are located on a 56-inch diameter circle to match the positioning of the three legs of the ACGLF. The latch assemblies, which mate with the three lifting clips on the TDOP, are engaged with the latch handles and are locked in place with ball locking pins. The TDOP lifting fixture adapter has a rated lifting capacity of 7,000 pounds and weighs approximately 300 pounds.

2.6.3.1.10 TDOP Upender

The TDOP upender is used to overpack an SWB in a TDOP. The TDOP must be positioned horizontally to allow a forklift to insert the SWB. Once the SWB is loaded, the TDOP is returned to the vertical position for installation of the TDOP lid. The TDOP upender provides cradle rotation of 90 degrees by using a mechanical chain and double-reduction gear driven by an electric motor. The upender has a rated maximum capacity of 8,000 pounds and a gross weight of 5,920 pounds. The upender has a table sized to accommodate the TDOP. The table is equipped with a urethane-coated Vee block with tie-down straps to prevent a TDOP from rolling while being transported on the upender. The upender is bolted to a facility pallet before use to provide stability and to allow transport by CH Waste Handling equipment (13-ton battery-powered forklift in the WHB, the transporter, or a 20-ton forklift in the UG).

A warning beacon and horn mounted on the control enclosure activates a few seconds before movement of the cradle. End-of-travel limit switches automatically stop the cradle in either the full-up or full-down positions. Over-travel limit switches and hard mechanical stops prevent the cradle from rotating beyond the full-up or full-down positions.

2.6.3.1.11 Facility Pallets

Facility pallets (Figure 2.6-23) are fabricated-steel units approximately 13 feet long and 9 feet wide that weight approximately 4,200 lbs. Facility pallets are designed to accommodate two stacks of two-high assemblies of drums, two stacks of two-high SWBs, two stacks of one-high shielded containers, two TDOPs, one SLB2, or combinations of assemblies of drums, SWBs, and TDOPs. Facility pallets have a rated load of 25,000 pounds. TRUPACT-II payload is 7,265 pounds, two TRUPACT-II payloads can be placed on a facility pallet. Load management of the facility pallet is required when placing a HalfPACT payload (maximum weight 7,600 pounds) on a pallet to prevent exceeding the facility pallet load capacity. After removal from the Type B shipping package, waste assemblies are required to be on facility pallets until emplacement in the UG, in accordance with the HWFP.

Forklift pockets in the long side of the facility pallet allow lifting the facility pallet with a 13-ton battery-powered forklift. Using the forklift pockets reduces the potential for puncture accidents. Holding bars are built into the pallet and are used to tiedown waste assemblies.

2.6.3.1.12 Surface Waste Handling Forklifts

Battery-powered forklifts are used to handle CH Waste in the CH portion of the WHB. Battery-powered 13-ton forklifts are used to unload TRUPACT-IIs and HalfPACTs from the transportation trailers and move them through the WHB airlocks to support stands located in the pockets of the TRUDOCKS in the CH Bay. They are also used to move facility pallets between the CH Bay, the storage areas, and the CLR. Each 13-ton forklift has a maximum lifting height of 96 inches. The 13-ton forklifts are equipped with blunt tines to minimize Waste Container puncture, and can operate for eight hours before the batteries have to be recharged. Each forklift has a high-volume hydraulic pump unit that supplies the power for lifting, tilting, and side shifting of the forks. A separate hydraulic unit supplies power for braking and steering. The capacity of the hydraulic fluid reservoir is approximately 37 gallons.

The 13-ton battery-powered forklifts are designed and constructed such that the combustible materials, including electrical components, batteries, and hydraulic reservoir and lines, are segregated from each other by metal barriers sufficient to minimize fire that may originate on the forklift from propagating to other parts of the forklift.

The external structure of the 13-ton forklift is constructed with thick metal walls that provide protection for the hydraulics, motor, motor controls, and the batteries from collision damage that could initiate a fire involving the combustible material. Similarly, the internal design of the 13-ton battery-powered forklifts incorporates metal partitions that separate the batteries from the motor, motor controls, hydraulics, seat cushions, and solid rubber tires. The hydraulic cylinders that allow the forklift to pick up a load are mounted behind the forklift carriage such that the cylinders are not damaged during use. The 13-ton forklift hydraulic system operates at low operating temperatures (i.e., less than 150°F). The hydraulic fluid used in the 13-ton forklifts has a flashpoint per the *13-ton CH Forklift Fire Evaluation* (ECO 11676).

A 6-ton battery-powered forklift is also used in the CH Bay. It has a hydraulically operated side shift positioner for shifting the load to the right or left. The capacity of the hydraulic fluid reservoir is approximately 21 gallons. Either standard type forks or specially designed fixtures can be attached to the positioner for lifting different loads. The 6-ton battery-powered forklift has a maximum lifting height of 118 inches, and can operate for eight hours before the batteries have to be recharged. It can be operated with different attachments as listed below:

- A push/pull device to lift and move waste assemblies.
- A single- or double-drum handling device.
- An SWB forklift fixture to lift and move individual SWBs.
- Two forks for lifting loads.

A 35-ton diesel-powered forklift equipped with an International Standards Organization (ISO) container handler is used to lift a TRUPACT-III shipping container from the transport trailer and transfer it onto a YTV. The forklift has a 110-gallon diesel fuel tank and a 136-gallon hydraulic fluid tank.

2.6.3.1.13 Automated Guided Vehicles

The types of Automated Guided Vehicles used at the WIPP are the FTV and the YTV.

FTVs are used to handle CH Waste in the CH portion of the WHB. The FTV is designed to transport a facility pallet loaded with CH Waste. Its cross-sectional dimensions are slightly larger than a facility pallet and it is about three times as high. The FTV is certified to carry a load of 30,000 pounds while traveling in either forward or reverse at speeds of up to 240 fpm. Each FTV can perform up to seven lifts per hour and operate 16 hours a day, seven days a week. All components are electrical and no hydraulic systems are used.

The FTV is equipped with three polyurethane wheels for use in the WHB and three rail wheels for use in the CLR. Drive and steering units are located on each of the polyurethane wheel assemblies. The FTV lowers the rail wheels in the CLR when transporting a loaded facility pallet onto the Waste Shaft Conveyance.

The FTV is guided on a predetermined path that is programmed into the computer system. Movements are controlled through wireless transmission. The computer system is programmed to control Automated Guided Vehicle traffic to prevent collisions should two Automated Guided Vehicles approach the same travel segment. An operator continuously activates the FTV by constantly pressing a dead-man trigger switch while following the movements of the FTVs.

The position of the FTV is calculated by a laser navigation system. A laser scanner on the FTV emits a rotating laser beam that is reflected back by strategically positioned reflectors. The laser scanner continuously triangulates its position as the FTV moves along the path. The FTV maintains its position within 1 inch of the programmed parameters.

The FTV can function in a Manual or Automated Mode with an operator using a dead-man trigger. In Automated Mode, the FTV is computer controlled. A manual control can be attached directly to the FTV for movement outside the programmed path. The FTV is used in Automated Mode with an operator until all operations in the WHB are accustomed to keep clear of the FTV path.

The FTV is normally at rest in the recharge station until a command is initiated. The FTV will follow its course to the facility pallet stand, pick up the facility pallet, transport it to the CLR, lower the rail wheels, transport the pallet to the facility pallet chairs in the Waste Shaft Conveyance, and return to the charging station in the CH Bay. Other pickup and delivery functions are performed as programmed.

Construction of the FTV includes several safety features. Stop buttons are located around the units. A laser scanner prevents collision accidents. Warning mechanisms prevent personnel from approaching the moving vehicle. The platform is equipped with two pintles spaced to match openings in the bottom of the facility pallets. The pintles prevent the facility pallets from sliding or moving off the FTV.

There are four types of stop buttons. A dead-man trigger switch, which stops the vehicle if either in the no-squeeze or maximum squeeze position. A master battery-disconnect button stops all electrical functions, disabling the unit completely. Two controlled stop buttons, located one on each side, bring the unit to a slow stop. Four emergency stop buttons interrupt power to all moving devices to an immediate stop.

A laser scanner on each side of the FTV senses obstructions in its path. The system is programmed to respond to obstructions depending on the position of the obstacle along its path. The FTV may slow down or stop depending on the distance from the obstruction.

The YTV is designed to transport one TRUPACT-III shipping container from the WHB Parking Area Unit (PAU) through the WHB into Room 108. Its cross-sectional dimensions are slightly larger than a TRUPACT-III and it is approximately 31 inches in height. The YTV is certified to carry a load of 60,000 pounds. It can travel both forward and in reverse at speeds of up to 120 fpm. The YTV has no hydraulic systems.

The YTV is equipped with three polyurethane wheels for use in the yard and WHB. Two-wheel assemblies house drive units and a one-wheel assembly houses a steering unit. The YTV is not equipped with rail wheels.

The YTV travel path, collision avoidance system, and Operational Mode are the same as discussed for the FTV.

The YTV normally rests in its charging station, located in Building 412, until a command is initiated. The YTV follows its pre-programmed path to the yard transfer station or other pre-programmed tasks as assigned in the process. Once the tasks are complete, the YTV returns to its charging station. Other pickup and delivery functions are performed as programmed.

The YTV construction includes several safety features. Stop buttons are located around the units. Laser and mechanical bumpers prevent collisions with obstacles in its path. Warning mechanisms alert personnel to the proximity of the YTV. The YTV platform is equipped with two pintles spaced to match openings in the bottom of the TRUPACT-III shipping containers. The pintles prevent the shipping containers from sliding or moving off the YTV.

There are four types of stop buttons. A dead-man trigger switch stops the vehicle if either in the no-squeeze or maximum squeeze position. A master battery-disconnect button stops all electrical functions, disabling the unit completely. One controlled stop button, located on the side, brings the unit to a controlled stop. Four emergency stop buttons interrupt power to all moving devices, and pressing one of these buttons results in an immediate stop.

There is a laser scanner on both the front and rear of the YTV. The scanners sense obstructions in the YTV's path. The YTV will slow down or stop depending on the distance from the obstruction.

Other safety features include an alarm horn and warning lights that activate prior to movement and during movement. The exposed charging plates at the charging station and the YTV are not energized until the YTV is docked at the charging station and the charger determines the battery's condition warrants a charge.

2.6.3.1.14 TRUPACT-III International Standards Organization Container Handler

An ISO container handler, rated for 56,000 pounds and weighing approximately 6,000 pounds, is attached to the top of the TRUPACT-III using the 35-ton forklift. The ISO container handler is positioned on the TRUPACT-III and each latching pin inserted into its respective ISO pickup point and locked into position to secure the handler to the TRUPACT-III. The four latching mechanisms, one at each corner, are hydraulically controlled using the 35-ton forklift's hydraulic system.

2.6.3.1.15 TRUPACT-III Bolting Station

The bolting station (Figure 2.6-24) is located in the southeast corner of Room 108 and consists of the bolting robot, safety fence, control panel, overpack cover and closure lid stands, bolt rack, exhaust hood, and monorail hoist. The safety fence, control panel, overpack cover and closure lid stand, and bolt rack are installed to support operations at the bolting station. This equipment is used for overpack cover and closure lid removal and installation.

2.6.3.1.15.1 TRUPACT-III Monorail Hoist

The bolting station is serviced by a 7.5-ton monorail hoist that is used to remove the overpack cover and closure lid from the TRUPACT-III shipping container and place them in their stands. The monorail hoist is an under-hung, trolley and wire rope hoist. The monorail hoist travels between storage stands and is controlled by a radio-frequency transmitter or pendant control. The monorail hoist is designed to hold its load in the event of a DBE or loss of power. The monorail hoist is certified to lift its rated capacity and is load tested to 125 percent of maximum rated lift.

2.6.3.1.15.2 TRUPACT-III Bolting Robot

The bolting robot is an electromechanical system with an end-of-arm tool used to detension, remove, install, and retension the TRUPACT-III overpack cover and closure lid bolts. The end-of-arm tool is a direct current motor-driven nut runner with a capacity to torque the bolts to approximately

1,200 foot-pounds. The robot uses a two-dimensional vision system to locate the bolts and bolt holes. Hand tools, such as pneumatic hand wrenches, can be used in lieu of the bolting robot.

A safety perimeter is established around the bolting robot using an approximately 8-foot-high wire mesh fence and a light curtain. During robot operation, if the light curtain is broken the robot power is interrupted, stopping robot operations.

2.6.3.1.15.3 TRUPACT-III Exhaust Hood System

The bolting station has an exhaust hood system that consists of exhaust hood, dampers, roughing filter, and ductwork. The exhaust hood system consists of an enclosure, which is installed over the closure lid / TRUPACT-III container body interface before the closure lid is removed. The exhaust hood fan is interlocked with the two CH Bay Battery Charging Area exhaust fans. One of two fans must be operating for the exhaust hood fan to operate. Exhaust hood operation ensures that any potential airborne radioactivity released when removing the TRUPACT-III closure lid is passed through a roughing filter prior to entering the Battery Exhaust System, which is also HEPA filtered, before discharging to the atmosphere.

2.6.3.1.16 Payload Transfer Station

The Payload Transfer Station (Figure 2.6-25) is designed to remove an SLB2 from a TRUPACT-III and place it on a facility pallet. A FTV is pre-positioned at the Payload Transfer Station between the support columns of the SLB2 support stand. Following removal of the TRUPACT-III overpack cover and closure lid, the YTV with its TRUPACT-III payload moves to the Payload Transfer Station. During the approach, the YTV and TRUPACT-III are aligned with the FTV and transfer table. Hoist rings or other threaded connectors are manually fastened to the TRUPACT-III shipping pallet and then are attached to the connection tools of the pulling/pushing chain of the transfer table. Two connection tools are supplied, but the loaded pallet may be removed with just one connection tool. The TRUPACT-III's roller air bed is then manually inflated with plant air. The TRUPACT-III pallet with its SLB2 payload is extracted by activating the electric drive of the pulling/pushing chain. Once fully positioned on the transfer table, the FTV raises the transfer table along with the TRUPACT-III pallet and SLB2 payload to a height slightly above the retractable arms of the SLB2 support stand. The retractable arms of the support stand are positioned underneath the SLB2. The FTV lowers the TRUPACT-III pallet and transfer table, leaving the SLB2 suspended from the retractable arms of the SLB2 support stand. The TRUPACT-III pallet is then reinserted into the TRUPACT-III using the pulling/pushing chain, the D-clips are removed, the roller bed is depressurized, and the YTV is directed to return the TRUPACT-III to the bolting station. Once the YTV is clear of the Payload Transfer Station, the FTV with the transfer table is moved outside the footprint of the Payload Transfer Station and a second FTV with a facility pallet is positioned underneath the suspended SLB2. The FTV raises the facility pallet to the SLB2. The retractable arms of the support stands are disengaged from the SLB2 and the FTV with its facility pallet and SLB2 are lowered. The SLB2 is then secured to the facility pallet and the FTV is directed either to place the loaded facility pallet on a pallet stand in the CH Bay or to proceed to the CLR.

2.6.3.1.16.1 Transfer Table

The transfer table is an attachment to the FTV that shares the facility pallet interface. In addition to a roller bed, it has an electrically driven rigid chain system that can push and pull a fully loaded TRUPACT-III pallet. Similar to a facility pallet, the transfer table may be removed from the FTV. The electric drive of the transfer table is powered from local outlets at the SLB2 support stand. The transfer table control system is in a panel located outside of the support stands. The controls are limited to controlling the movement of the TRUPACT-III pallet.

2.6.3.1.16.2 SLB2 Support Stand

The SLB2 support stand is a stationary structure with locking retractable arms. The support stands are seismically qualified to hold a fully loaded SLB2 during a DBE. The support stand is sufficiently high to permit a FTV with a facility pallet to move underneath a suspended SLB2.

2.6.3.1.17 Facility Pallet Stands

Facility pallet stands are located in the CH Bay. These stands are used to support loaded or empty facility pallets. The stands are seismically qualified to hold a fully loaded facility pallet during a DBE. The facility pallet stands are sufficiently high to permit a FTV to move underneath the facility pallet. The FTV is then raised to lift the loaded facility pallet and remove it from the facility pallet stand (Figure 2.6-26).

2.6.3.1.18 Facility Pallet Dispenser

A facility pallet dispenser is located in the southwest area of Room 108. The dispenser is a powered device to store and dispense facility pallets. Empty facility pallets are loaded into the dispenser and FTVs can remove a facility pallet.

2.6.3.1.19 Miscellaneous Equipment

Other equipment used in the CH Bay and Room 108 to support Waste Handling or maintenance activities include battery-powered floor sweepers, a battery-powered manlift, and a battery-powered scissor lift.

2.6.3.1.20 Conveyance Loading Car

The conveyance loading car, which is approximately 13 feet long and 7.5 feet wide, is an electric-cable powered vehicle driven by electrical motors through variable speed drives that operates on rails. The car is designed with a flat bed that has adjustable height capability and is used to transfer facility pallets onto or off the pallet support stands in the Waste Shaft Conveyance by raising and lowering its bed (Figure 2.6-27). The conveyance loading car platform is equipped with two pintles spaced to match corresponding openings in the bottom of the facility pallet. The pintles prevent the pallet from sliding or moving off the conveyance loading car. The lifting height of the jackscrews that lift the conveyance loading car platform is approximately 8 inches. The jackscrews are designed to move together because they are driven by a single motor. Should any of the jackscrews fail such that the conveyance loading car lifting platform is tilted, the angle would not be enough to cause the Waste Containers to dislodge from the facility pallet.

2.6.3.2 Underground

The UG Waste Handling and emplacement equipment consists of diesel-powered transporters, forklifts, and forklift attachments.

2.6.3.2.1 Underground Transporter

The UG Transporter is a diesel-powered tractor-trailer with an articulating-frame steering system. The transporter has two sections: a front section consisting of the tractor cab and diesel engine and a rear section consisting of a flatbed trailer with a ball screw or chain-driven pallet transfer mechanism mounted in the middle of the bed. The pallet transfer mechanism is designed to handle a load of 28,000 pounds. The tractor has a hydraulic power-steering system with a direct-drive hydraulic pump, an orbital valve operated by the steering wheel, and two steering cylinders located at the articulated joint. The hydraulic fluid reservoir capacity is 20 gallons. The UG Transporter has a 35-gallon fuel tank and an automatic dry chemical FSS.

The automatic FSS on the UG Transporter consists of a detection system that causes a compressed gas cartridge to actuate and fluidize the fire suppressant powder and forces the powder to the distribution network. The system is equipped with a control module that includes system status lights to indicate normal and trouble conditions.

The axle brakes are air-over-hydraulic disc brakes with a dual master cylinder and separate circuits for the front and rear brakes. There is also a driveline disc brake, which is used as a parking brake. The brake automatically sets on low air pressure. The brake can also be set manually from the tractor cab. The UG Transporter attaches the pallet transfer mechanism hook to the facility pallet and pulls the facility pallet onto the transporter trailer. During transport to the UG Disposal Room, the facility pallet is secured to the transporter trailer with the pallet mover hook, and side rails prevent side-to-side movement.

2.6.3.2.2 Underground Waste Handling Forklifts

There are two 6-ton diesel forklifts in the UG that can be equipped with push/pull attachments. The 6-ton diesel forklifts equipped with push/pull attachments capable of handling 8,500 pounds are provided to remove CH Waste assemblies, excluding SLB2, from the UG Transporter and emplace CH Waste assemblies into the waste array. The 6-ton diesel forklift has a 24-gallon hydraulic fluid reservoir and a 37-gallon diesel fuel tank.

A 7.5-ton diesel forklift is used in the UG to handle and emplace approved configurations of MgO super sacks. The 7.5-ton forklift can be equipped with push/pull attachments and has a 24-gallon hydraulic fluid reservoir and a 37-gallon diesel fuel tank.

Diesel forklifts used for UG Waste Handling are equipped with automatic dry chemical FSSs. The automatic FSS on the forklifts has the same features as those on the UG Transporter.

A 13-ton diesel-powered forklift is used to offload SLB2s from the UG Transporter and emplace them into the waste array. The 13-ton forklift is equipped with an automatic FSS and 69-inch-long tines that are used to offload SLB2s. This is achieved by inserting the fork tines between the skids of an SLB2 and lifting the SLB2 from the facility pallet. The 13-ton forklift has a 78-gallon hydraulic fluid reservoir and a 57-gallon diesel fuel tank enclosed in the engine compartment.

2.6.3.2.3 Push/Pull Attachments

The push/pull attachments (Figure 2.6-28 and Figure 2.6-29) are used with a 6-ton forklift to remove the CH Waste Containers, excluding SLB2, from the UG Transporter and emplace the waste in the waste stack. The push/pull attachment shown in Figure 2.6-28 is connected to the forklift front carriage, which requires the removal of the forklift tines. The push/pull attachment shown in Figure 2.6-29 is used to place the MgO super sacks on top of the waste stacks and is installed on the forklift tines. Both types of attachments have a gripper that grips the edge of the slip-sheet on which the Waste Containers sit and a linkage assembly to pull or push the Waste Containers onto or off the platen. After the 6-ton forklift has pulled the Waste Containers from the transporter and has moved the Waste Containers to the emplacement location, the push/pull attachment pushes the Waste Containers into position after the forklift has positioned the platen at the proper height.

2.6.4 Contact-Handled Waste Handling Process

2.6.4.1 Contact-Handled Waste Receiving

On arrival at the gate of the WIPP facility, each incoming CH shipment is inspected to verify the shipment documentation and a security check is performed. A radiological survey of the shipping package is performed either at the gate or in the WHB Parking Area Unit. If radiation or contamination levels exceed the criteria in the *Waste Isolation Pilot Plant Radiation Safety Manual* (WP 12-5), subsequent activities include posting, decontamination, or both.

Following turnover of the shipping documentation, the driver parks the trailer in the WHB Parking Area Unit for CH shipping package trailers near the CH entrances to the WHB. The driver unhooks the tractor and is subsequently released. The number of loaded CH shipping packages on trailers in the WHB Parking Area Unit is coordinated with RH Waste Handling such that the WHB Parking Area Unit limits established in the HWFP are not exceeded.

The TRUPACT-II or HalfPACT shipping packages are unloaded from trailers outdoors using 13-ton battery-powered forklifts, transported through one of three entrance airlocks, and placed in a vacant TRUDOCK position. Each entrance airlock is sized to accommodate a CH shipping package on a 13-ton forklift or a YTV. The CH WH CVS maintains the CH Bay and Room 108 at a pressure lower than the ambient atmosphere to ensure airflow into the CH Bay, preventing the inadvertent release of airborne hazardous or radioactive materials to the outside. The doors of each airlock are interlocked such that only one door can be opened at a time. Typically, no more than a total of 13 loaded pallets and four CH shipping packages are allowed at one time in the CH processing area.

The TRUPACT-III shipping packages are unloaded from trailers outdoors using the 35-ton diesel-powered forklift and placed on a YTV. The loaded YTV then transports the TRUPACT-III into the CH Bay and then into Room 108.

2.6.4.2 TRUPACT-II or HalfPACT Processing

After the TRUPACT-II or HalfPACT is placed in a TRUDOCK the OCV tamper seal is removed. During OCV lid removal, a vacuum may be applied to the outer lid vent port to compress the lid toward the vessel body, enabling the locking ring to rotate, unlocking the lid. The underside of the OCV lid and top of the ICV lid are surveyed for contamination. The OCV lid is removed and placed in an adjacent laydown area using the TRUDOCK 6-ton crane and the ACGLF.

The vacuum pull process is repeated for the ICV lid and a radiological assessment filter is attached to the vent port tool, upstream of a HEPA roughing filter. The radiological assessment filter is checked for radioactive contamination. The TRUDOCK vent hood system is attached to the ICV lid and the lid is raised. The TRUDOCK vent hood system consists of a vent hood assembly, a HEPA filter assembly, a fan to provide airflow, ductwork, and a flexible hose. The TRUDOCK vent hood system provides atmospheric control and confinement of airborne radioactive material and minimizes personnel exposure to VOCs. The air from the vent hood is monitored by an alpha CAM before passing through the roughing filter and then HEPA filters. The air is then released to a Waste Handling ventilation exhaust system that, by design, is not configured to allow recirculation into the building and is exhausted through Station C and an elevated stack outside the WHB.

Before moving the ICV lid aside, contamination surveys under the vent hood are performed on the ICV lid and accessible Waste Container surfaces. If no contamination is detected, the vent hood is removed and the ICV lid is set aside using the TRUDOCK 6-ton crane and lifting fixture. Additional contamination surveys are performed on the Waste Containers. If no contamination is detected, the TRUDOCK 6-ton crane is used to remove and transfer the Shipping Package payload to a prepositioned facility pallet. A typical TRUPACT-II contains 14 drums and a typical HalfPACT contains seven 55-gallon drums that are stretch wrapped or banded together into seven-packs. Each seven-pack, or waste assembly, sits on a molded slip-sheet made of high-density polyethylene or cardboard. A second slip-sheet is placed on top of the seven-pack and the entire assembly is held together by stretch wrap or banding.

Final contamination surveys are conducted and the identification numbers of the Waste Containers are recorded for transfer to the inventory tracking system. For inventory control purposes, CH Waste Container identification numbers are verified against the shipping documentation. Any inconsistencies are resolved with the generator before CH Waste is emplaced. The Shipping Package and Waste Containers are shipped back to the generator if the inconsistencies cannot be resolved. Waste Containers awaiting resolution of discrepancies are stored in the Shielded Storage Room. A damaged Waste Container is overpacked.

A 13-ton forklift or FTV transports the loaded facility pallet to the northeast or southwest corner of the CH Bay for storage. A maximum of seven loaded facility pallets of CH Waste is stored in one location at a time (i.e., northeast corner or southwest corner). An additional facility pallet of waste may be stored in the Shielded Storage Room and at each TRUDOCK. At the TRUDOCKs, the waste shall be stored either on a facility pallet or in the Shipping Package. A minimum aisle space of 44 inches is maintained between facility pallets to allow unobstructed movement of fire-fighting personnel, spill-control equipment, and decontamination equipment that may be used in the event of an off-normal event.

A site-derived waste storage area on the north or southwest wall of the CH Bay is used for collecting derived waste from Waste Handling processes in the WHB. The maximum volume allowed to be stored in the derived waste storage area is approximately 65 ft^3.

Normal operations for receipt and emplacement of drum assemblies containing CH Waste do not include the removal of empty drums received as dunnage in the drum assembly. Normal operations do not involve the opening of Waste Containers. Drum assemblies, consisting entirely of empty drums, are dispositioned in the most cost-effective manner but are typically returned to generator sites.

After the waste assemblies are removed from the shipping package, a final radiological survey and maintenance inspection are performed on the shipping package and the unit is prepared for reuse. When the shipping package is ready for reuse, it is removed from the WHB, loaded on a trailer, and prepared for shipment to a generator site.

2.6.4.3 TRUPACT-III Processing

The YTV transporting a TRUPACT-III shipping package enters the CH Bay through an outside airlock and traverses the CH Bay through Airlock 107 into Room 108 for processing.

The YTV transporting a TRUPACT-III is driven to the bolting station where the shock absorbing cover is removed. The air inside the TRUPACT-III is sampled with a radiological assessment filter. The radiological assessment filter confirms levels are consistent with no TRU radioactivity in the TRUPACT-III before the closure lid is removed.

The bolting robot detensions and removes the bolts from the TRUPACT-III cover. The bolts may also be detensioned and removed by Waste Handling personnel without the assistance of the bolting robot. The exhaust hood is installed over the top of the TRUPACT-III cover and the exhaust flow started. The exhaust hood ensures that any radioactive contamination or airborne radioactivity inside the TRUPACT-III is exhausted into the Battery Exhaust System, which is also HEPA filtered, before discharging to the atmosphere. The exhaust goes through Station C and an elevated stack outside the WHB. A CAM, sampling the exhaust stream, provides an indication of whether there is airborne radioactivity inside the TRUPACT-III. Radiological contamination surveys of the interior surface of the TRUPACT-III cover are performed. If contamination levels are below release limits, the TRUPACT-III cover is then placed on the cover stand.

The TRUPACT-III is positioned at the Payload Transfer Station. The shipping pallet with its SLB2 is extracted from the TRUPACT-III and positioned on the transfer table. The SLB2 is unlatched from the TRUPACT-III pallet and the Payload Transfer Station separates the SLB2 from the TRUPACT-III pallet. The TRUPACT-III pallet is returned to the TRUPACT-III and the YTV is driven back to the bolting station.

The transfer table is positioned out of the lifting area. A FTV with a facility pallet is positioned under the SLB2 and the SLB2 is placed onto the facility pallet. The SLB2 is secured to the facility pallet. The loaded facility pallet is removed from Room 108 and routed to the CH Bay storage area or to the CLR.

At the bolting station, radiological surveys of the interior surfaces of the empty TRUPACT-III are performed. If no contamination is detected, the closure lid and overpack cover are reinstalled and the bolting robot reinstalls the securing bolts and torques the bolts to the specifications. The YTV transports the empty TRUPACT-III to the WHB Parking Area Unit to be loaded on its transport trailer.

2.6.4.4 Conveyance Loading Room

A facility pallet of waste assemblies is moved by a 13-ton forklift or by FTV into the CLR. The 13-ton forklift places the loaded facility pallet on the conveyance loading car. The conveyance loading car must be removed from the CLR before the FTV enters the CLR and positions itself on the rails. The CLR has two sets of doors through which the waste assemblies are moved; one set separates the CLR from the CH Bay and the other set separates the CLR from the Waste Shaft Collar Room. The doors are interlocked such that only one set of doors may be opened at a time. The Waste Shaft Collar Room doors must be opened and the CH Bay doors closed before moving a loaded conveyance loading car or FTV into the Waste Shaft Collar Room. Waste Operations must verify the Waste Shaft Conveyance is at the Waste Shaft Collar before moving the loaded conveyance loading car or FTV into the Waste Shaft Collar Room.

2.6.4.5 Waste Shaft Collar Room

Pivot rails at the Waste Shaft Collar, which are rotated to the horizontal position when loading the Waste Shaft Conveyance, are rotated vertically when not in use. The conveyance loading car or FTV moves the loaded facility pallet onto the Waste Shaft Conveyance. When the conveyance loading car or FTV has positioned the facility pallet on the Waste Shaft Conveyance, it lowers its deck until the loaded facility pallet rests on the facility pallet chairs on the Waste Shaft Conveyance. The conveyance loading car or FTV is moved off the Waste Shaft Conveyance and returned to the CLR. The Waste Hoist lowers the Waste Shaft Conveyance to the Waste Shaft Station.

2.6.4.6 Waste Shaft Station

When the Waste Shaft Conveyance is at the Waste Shaft Station, the shaft station gates are opened and the UG Transporter backs up to the conveyance. The facility pallet is pulled onto the UG Transporter trailer and moved to the active Disposal Room. A Vehicle Exclusion Zone (VEZ) and a procedurally controlled transport notification system alert personnel and vehicle/equipment that waste is in transit from the Waste Shaft Station to the active Disposal Room. Personnel and vehicles are required to move to a crosscut or leave the disposal path/area to minimize the likelihood of collisions with the transporter.

2.6.4.7 Underground Contact-Handled Waste Disposal Area

In the UG, waste is transported from the Waste Shaft Station within a VEZ to the ventilation intake drift of the active Disposal Room. When RH Waste emplacement or borehole drilling is ongoing in the Disposal Room air intake drift, CH Waste may be rerouted from the intake to the exhaust side of the panel and back to the intake side through non-active Disposal Rooms. Operations personnel administratively control access to the active Disposal Room to coordinate RH and CH disposal activities.

At the waste Disposal Room, the Waste Containers, excluding the SLB2, are removed from the facility pallet on the UG Transporter using a diesel-powered forklift with a push/pull attachment and placed at the Waste Face. A 13-ton forklift with 69-inch long forks removes the SLB2 from the facility pallet and places the SLB2 at the Waste Face. In the event of UG contamination, a contaminated zone boundary and a radiation buffer area will be established. The waste transfer from the facility pallet to the forklift will occur at the contaminated zone / radiation buffer area boundary. Empty facility pallets destined for the surface will be surveyed and decontaminated if necessary.

The CH Waste Containers are stacked with assemblies of drums, SWBs, and TDOPs intermixed, with TDOPs and SLB2s on the bottom row. For stability, 85-gallon drums in four-pack assemblies and 100-gallon drums in three-pack assemblies are placed on the top row of the waste stack or on like assemblies (shown in Figure 2.6-30). Shielded container assemblies are only stacked on the floor against the wall or on each other, for a maximum of two high. One super sack of MgO is typically placed on every other waste column. Additional MgO super sacks may be added as required. Empty facility pallets can be stored in the UG or returned to the surface.

The waste is emplaced in each room, starting in Room 7, of a panel until the panel is full. When the panel is full, the panel closure system is installed. Panels 9 and 10 may be used to reach the full authorized capacity of 6.2 million ft^3. Panels 1, 2, and 5 have been filled and isolated with an explosion-isolation wall. Panels 3 and 4 have been isolated with a substantial barrier and isolation bulkhead. Once a waste Disposal Room is mined and initial ground control established, ventilation control equipment is constructed at the exit of each Disposal Room.

When combined CH and RH operations take place in a panel, RH emplacement boreholes are drilled into the ribs of rooms in advance of disposal operations. A ventilation control point consisting of a bulkhead with a ventilation regulator is also installed in each room. The ventilation control point may also include man doors and/or vehicle doors. For CH Waste emplacement, the ventilation control point is installed on the exhaust side of the room. The ventilation control point may be located as necessary to allow RH equipment or RH Waste movement to access boreholes in the intake and exhaust portions of a room. RH Waste emplacement precedes CH Waste emplacement to preclude CH Waste from blocking RH borehole access.

CH Waste emplacement starts at the exhaust side of an active Disposal Room and proceeds through the room to the intake. The sequence of RH emplacement varies to minimize RH equipment moves because of its size. Brattice cloth and chain-link ventilation barricades, are installed to isolate a filled room from the ventilation system. This process is repeated for the remaining rooms until the panel is filled.

When a panel is filled, the panel closure system or substantial barriers and isolation bulkheads are constructed in the entries to the filled panels, in accordance with the Closure Plan in the HWFP.

2.6.5 Process Interruptions

The CH and RH Waste Handling process interruptions fall into two categories: routine and emergency/abnormal.

2.6.5.1 Routine Interruptions

Routine process interruptions include inspections and scheduled and unscheduled maintenance. Actions taken during routine process interruptions are conducted in accordance with established procedures. Plant parameters are monitored to ensure that radioactive and non-radioactive HAZMAT releases do not occur.

2.6.5.2 Emergency/Abnormal Interruptions

Emergency interruptions are process interruptions that occur because of operational accidents, man-made external events, or natural events that include earthquakes or severe weather. Chapter 15.0 discusses the emergency management program, which reflects lessons learned for the February 2014 fire event.

Plant operations may be suspended following an earthquake. In the event of earthquakes involving accelerations at an appreciable fraction of the DBE (e.g., 0.015 g compared to the 0.1 g DBE), some systems automatically shutdown (e.g., WHB ventilation dampers), and inspection of structures and equipment is required before resuming normal operations. The length of the interruption will depend on the results of the inspection.

Plant operations may be suspended during a tornado or a high-wind condition warning. A tornado or high-wind condition warning is based on information provided by the National Weather Service or local observation. If a severe weather emergency condition occurs at the WIPP site, inspections of structures and equipment may be required before resuming normal operations. The length of the interruption depends on the results of the inspection.

Normal plant operations may be suspended in the event of a fire. Chapter 11.0, “Operational Safety,” describes the response to a fire in the UG. The occurrence of a fire may require evacuation of personnel and response by appropriate emergency personnel. After extinguishing the fire, the area will be surveyed, controls will be established to mitigate any problems, the incident may be investigated, the affected area may be remediated, and the area will be returned to normal operations.

Abnormal interruptions include unplanned and unexpected changes in a process condition or variable adversely affecting safety, security, environment, or health sufficient to require stopping Waste Handling or putting Waste Handling on hold for greater than four hours.

Waste retrieval from the UG disposal area is considered an abnormal interruption. In the event that waste needs to be retrieved from the UG, a work plan is generated and sent to CBFO for approval.

In the event of other abnormal interruptions, Waste Handling or any other site activity is stopped, the site is placed in a safe condition, assessments may be conducted, and corrective actions may be enacted before resuming operations. For example, the loss of offsite power affects all site electrical equipment. Any suspended load is maintained “as is” until power is returned or it can be safely lowered to a safer configuration. When power returns, loads are lowered. All cranes and hoists hold their loads on loss of power. A manually started diesel generator supplies selected loads as described in Section 2.9.1.2. Some equipment, such as the CMS and the UG CAMs, have an uninterruptible power supply (UPS) or battery backup for loss of power.

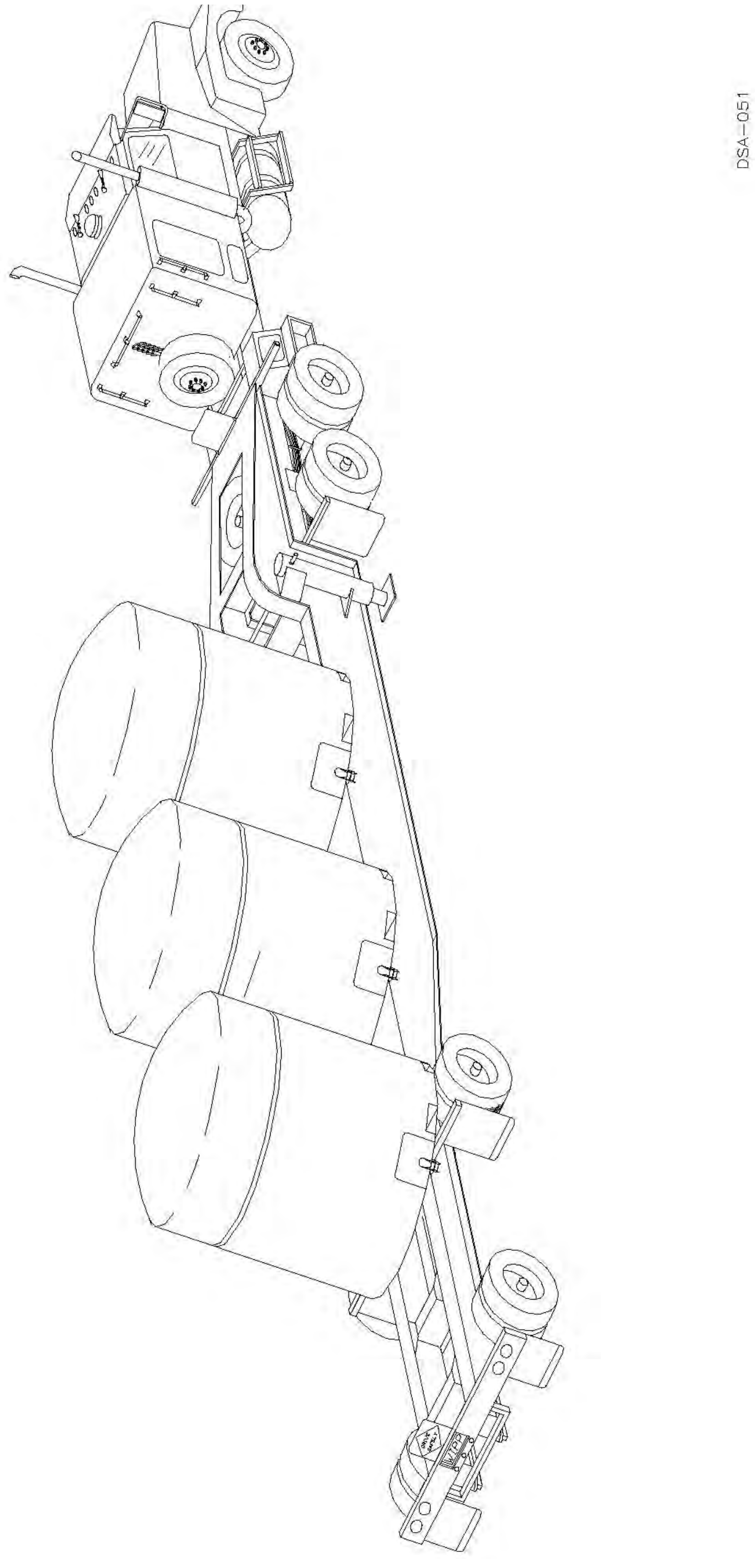


Figure 2.6-1. Truck, TRUPACT-IIs, and Trailer

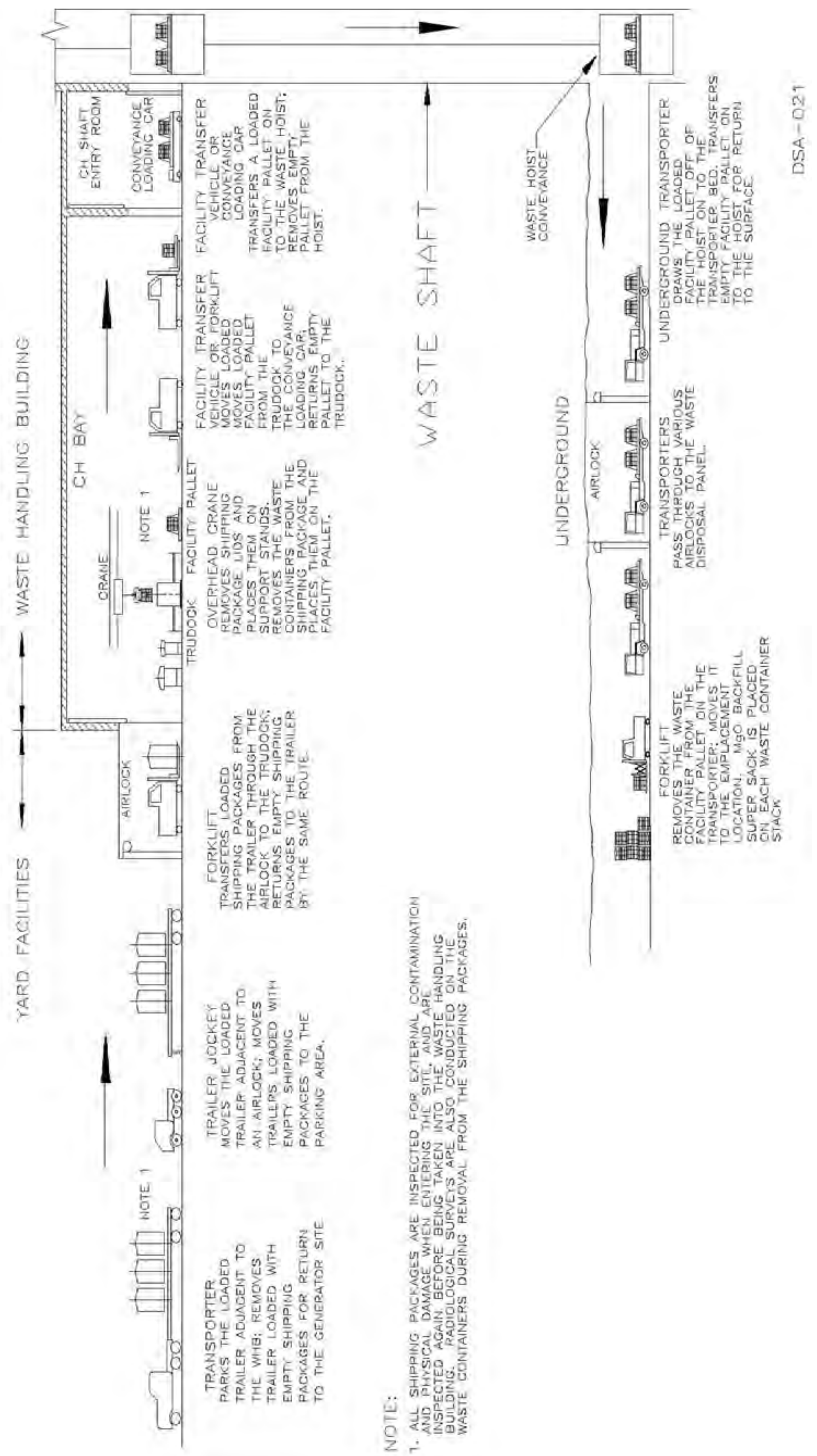


Figure 2.6-2. Contact-Handled Waste Handling Process

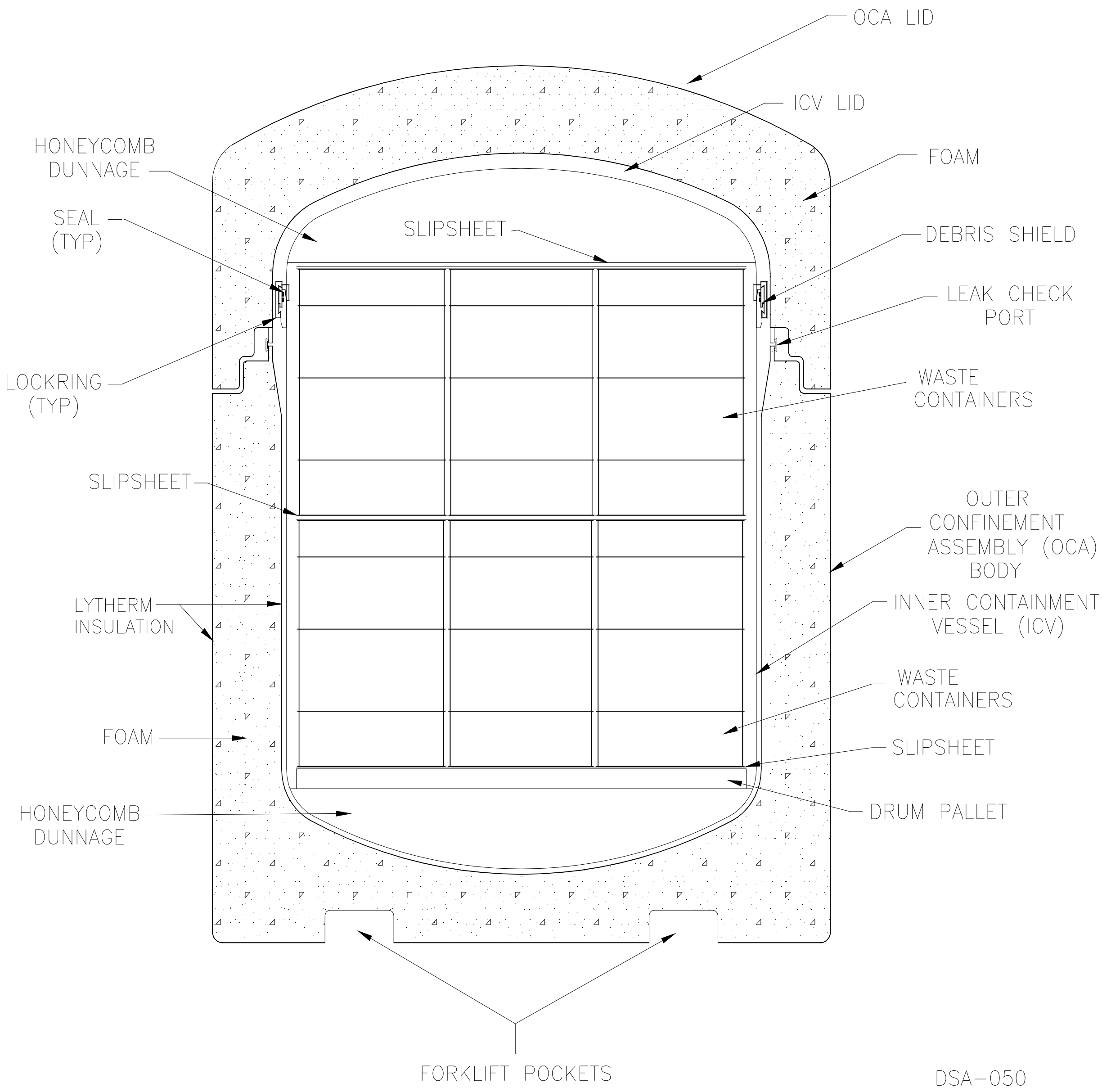


Figure 2.6-3. TRUPACT-II Shipping Package

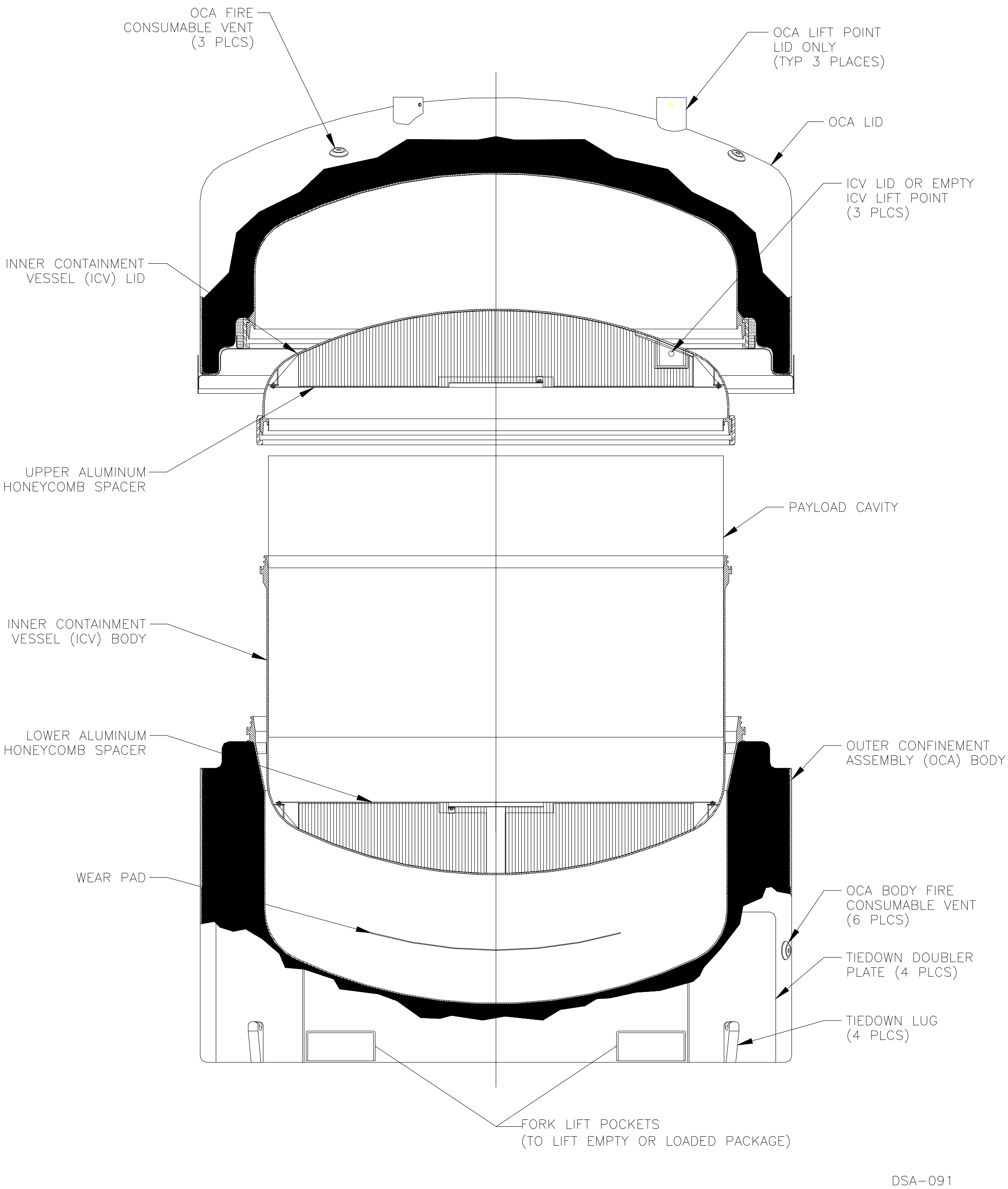


Figure 2.6-4. HalfPACT Shipping Package

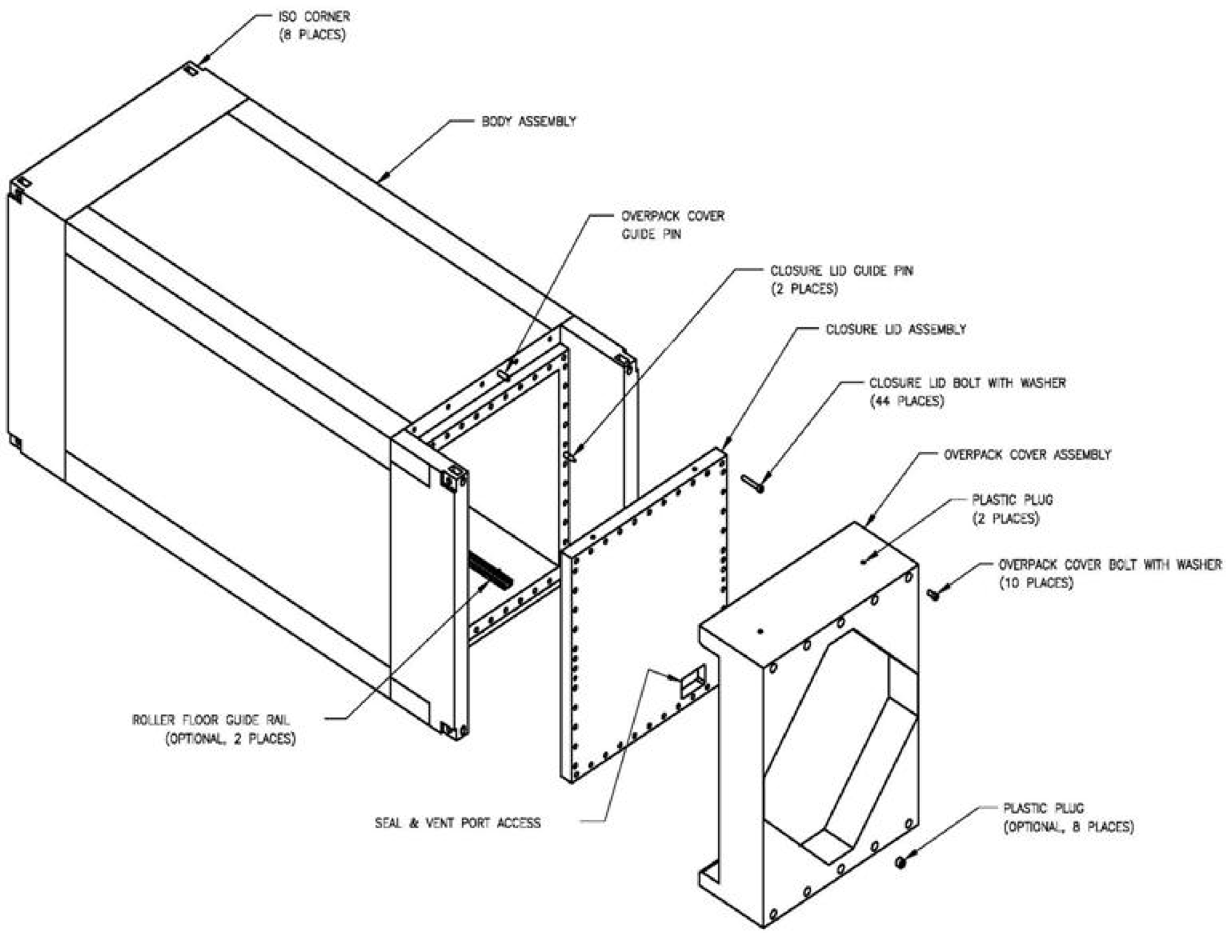


Figure 2.6-5. TRUPACT-III Shipping Package

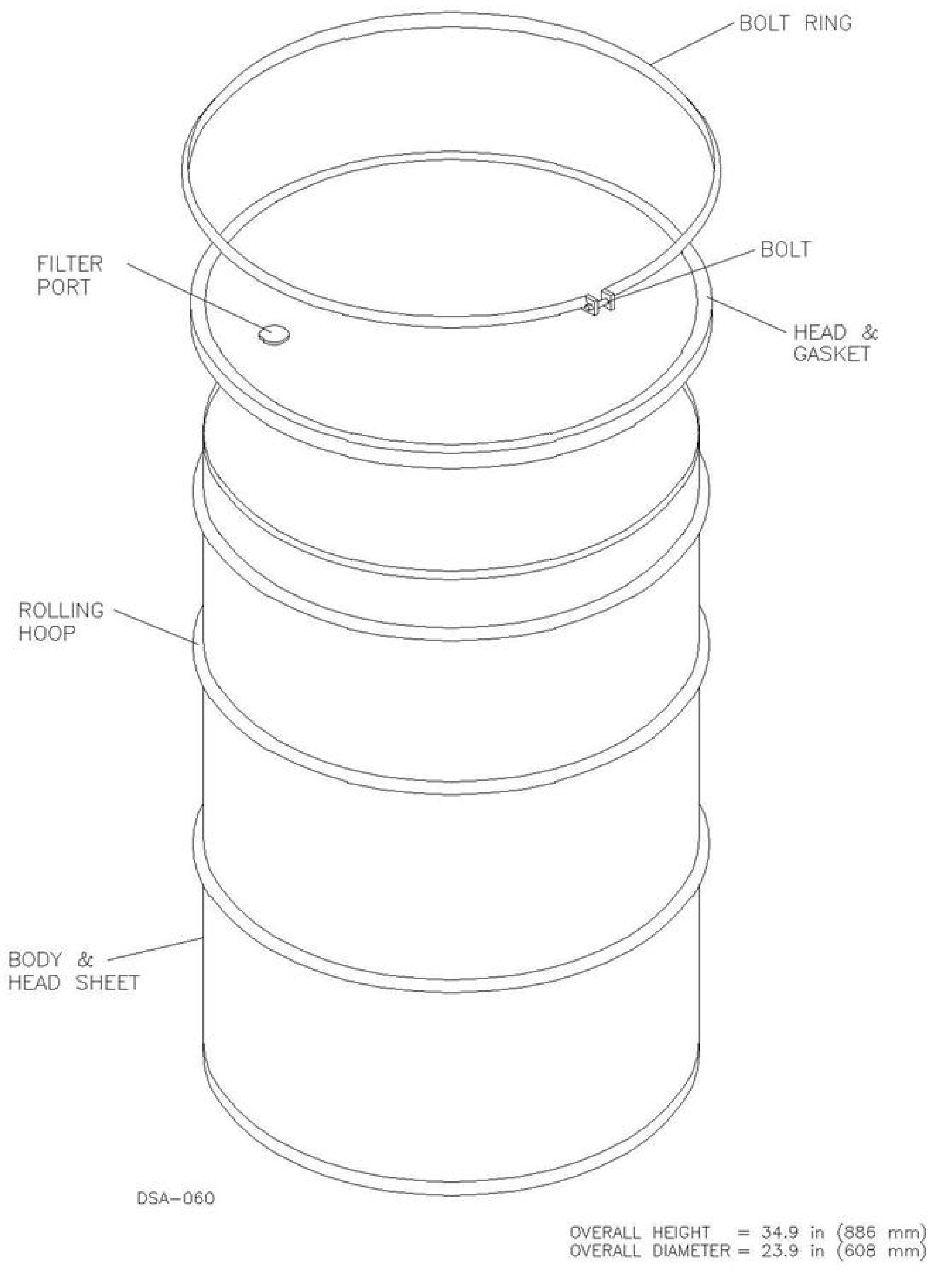


Figure 2.6-6. 55-gallon Drum

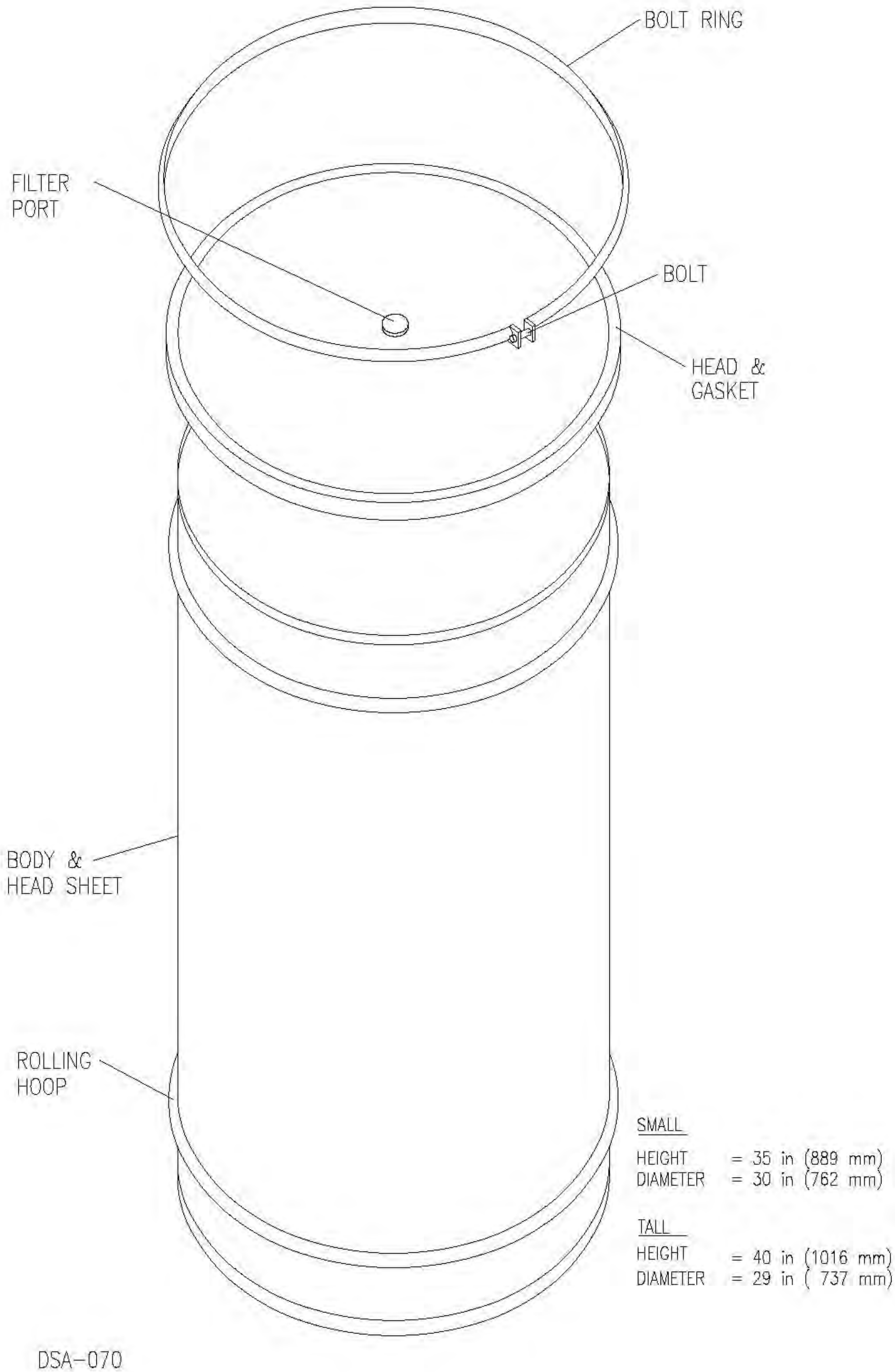


Figure 2.6-7. 85-gallon Drum

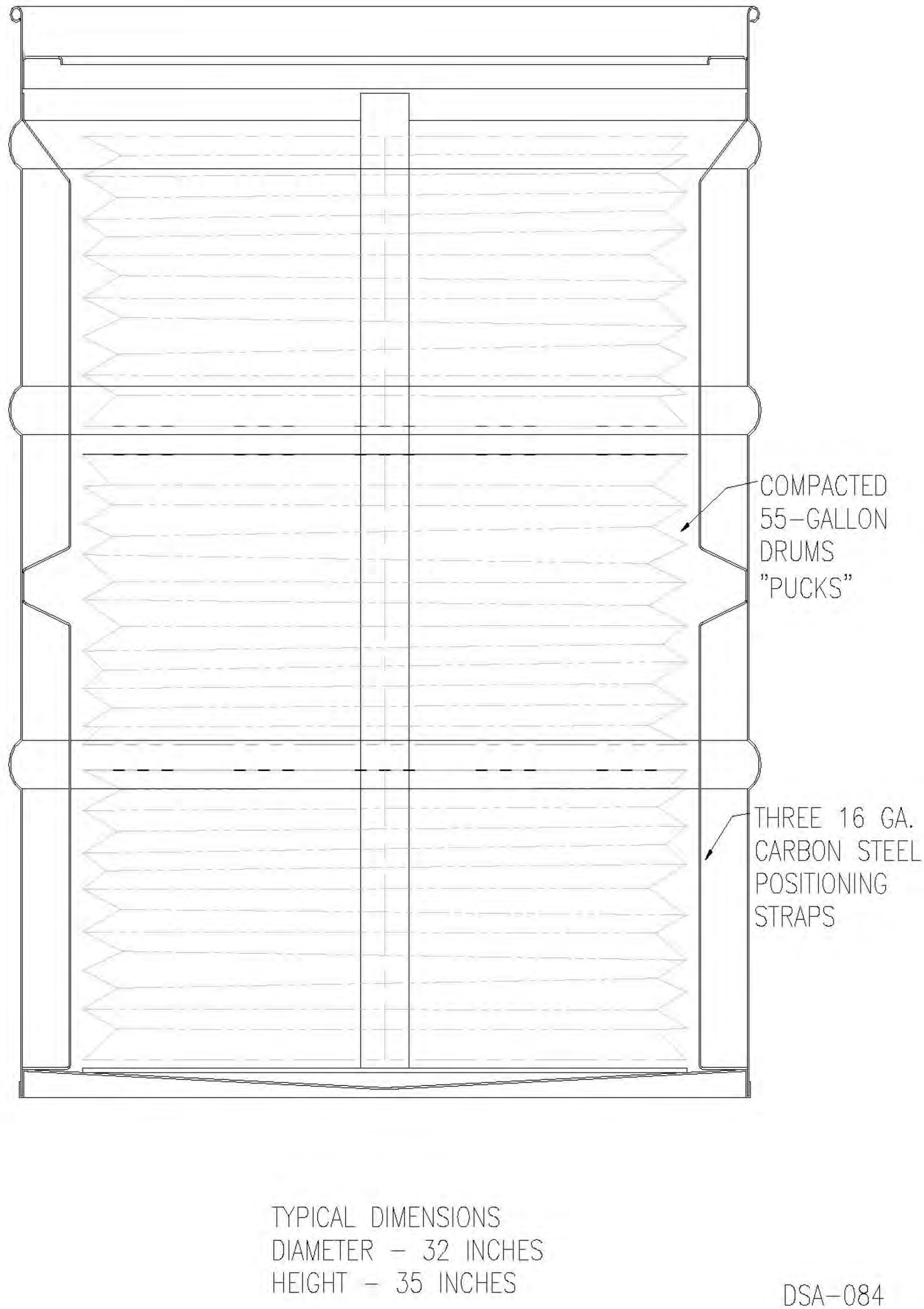


Figure 2.6-8. 100-gallon Drum

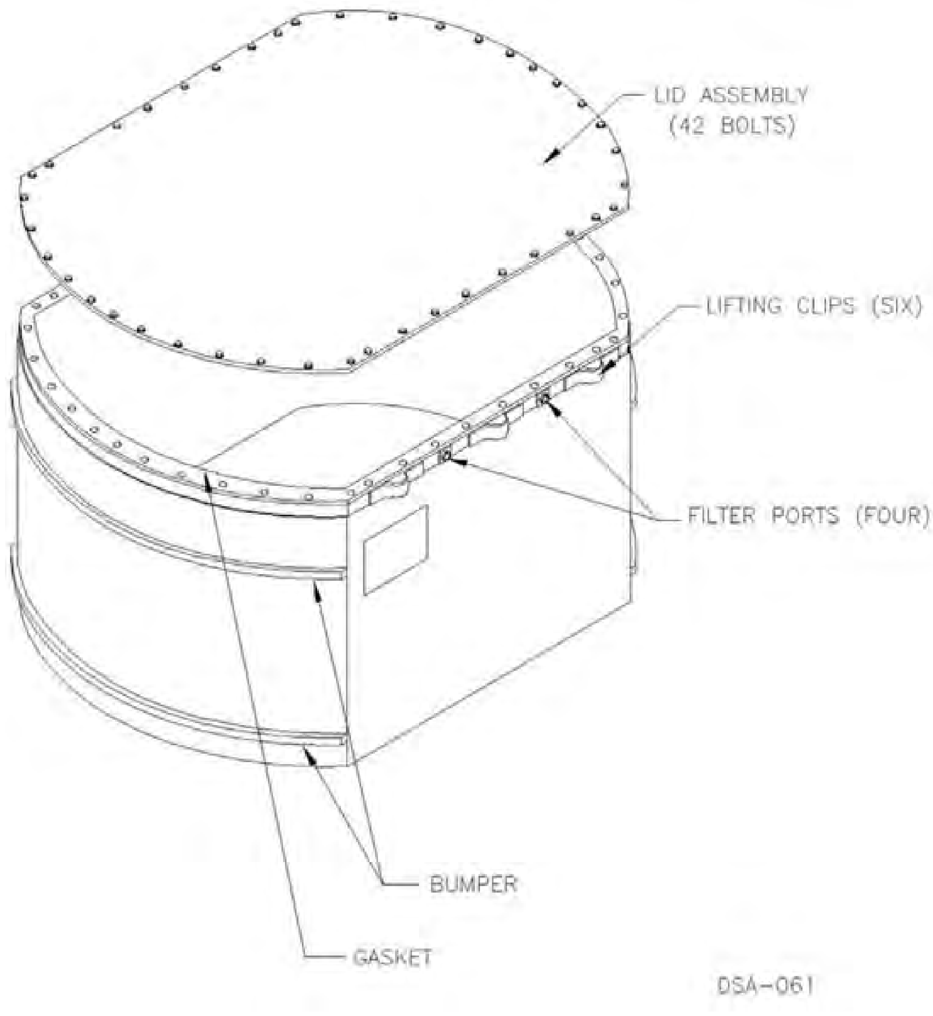


Figure 2.6-9. Standard Waste Box

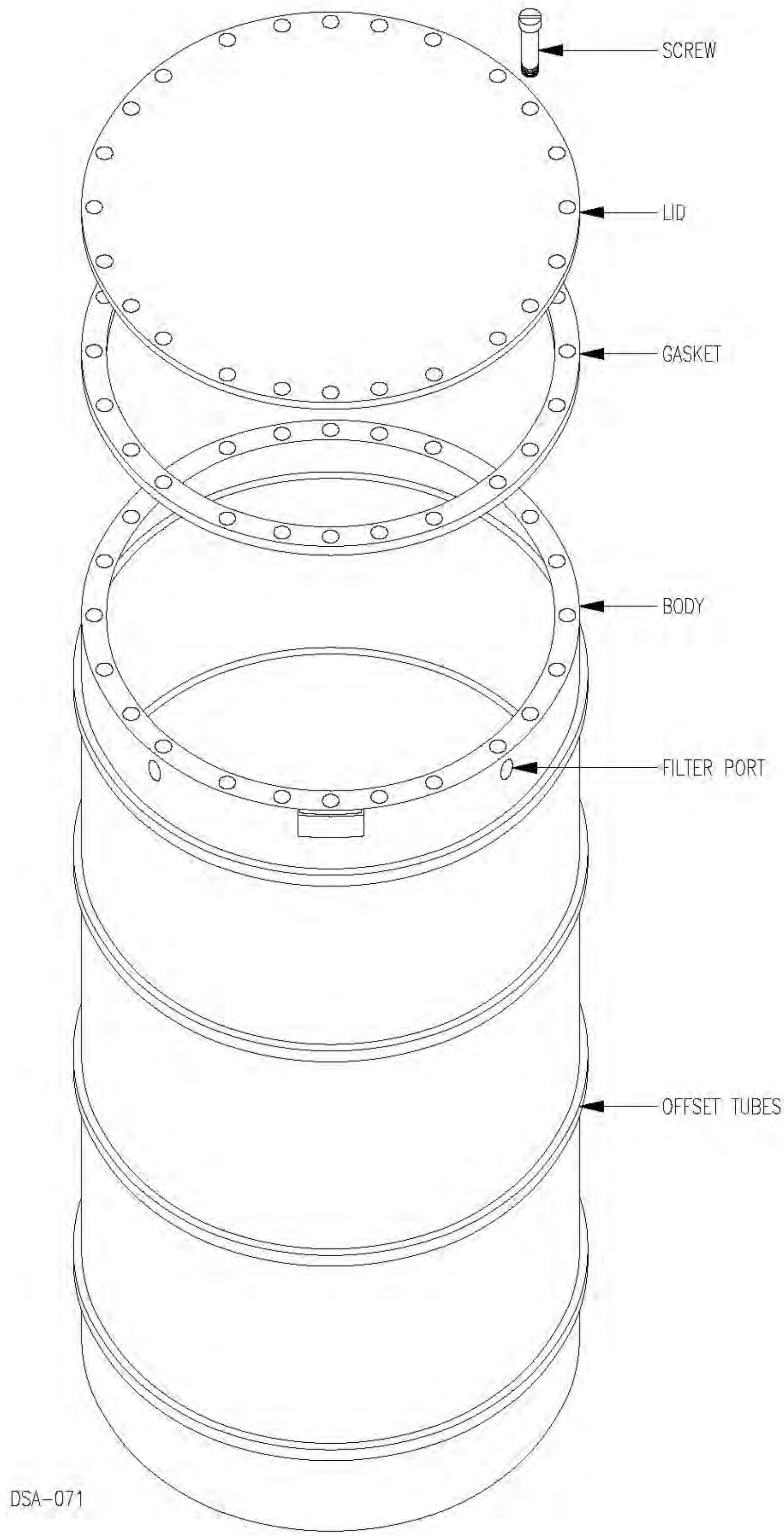


Figure 2.6-10. 10-Drum Overpack

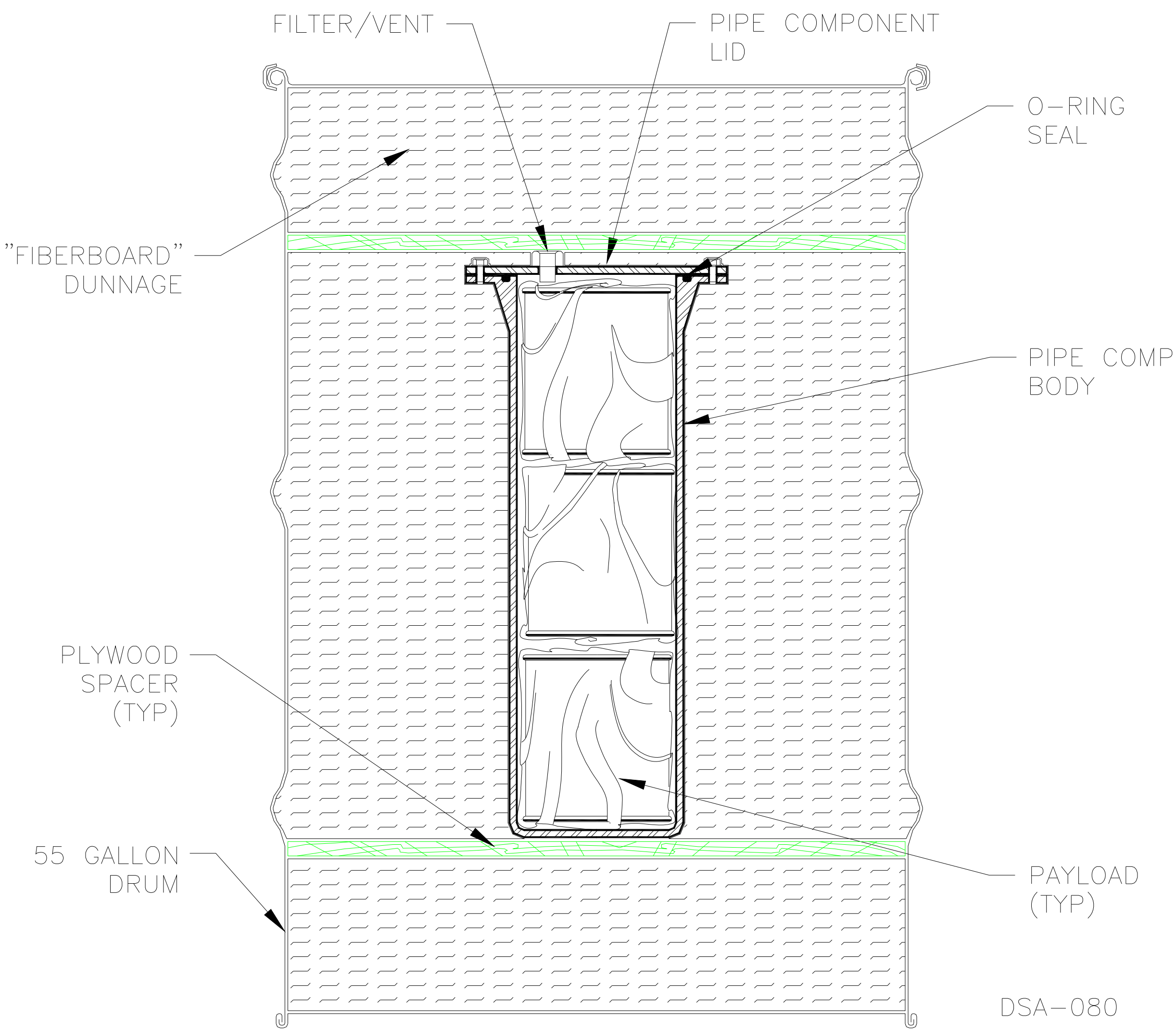


Figure 2.6-11. Standard Pipe Overpack

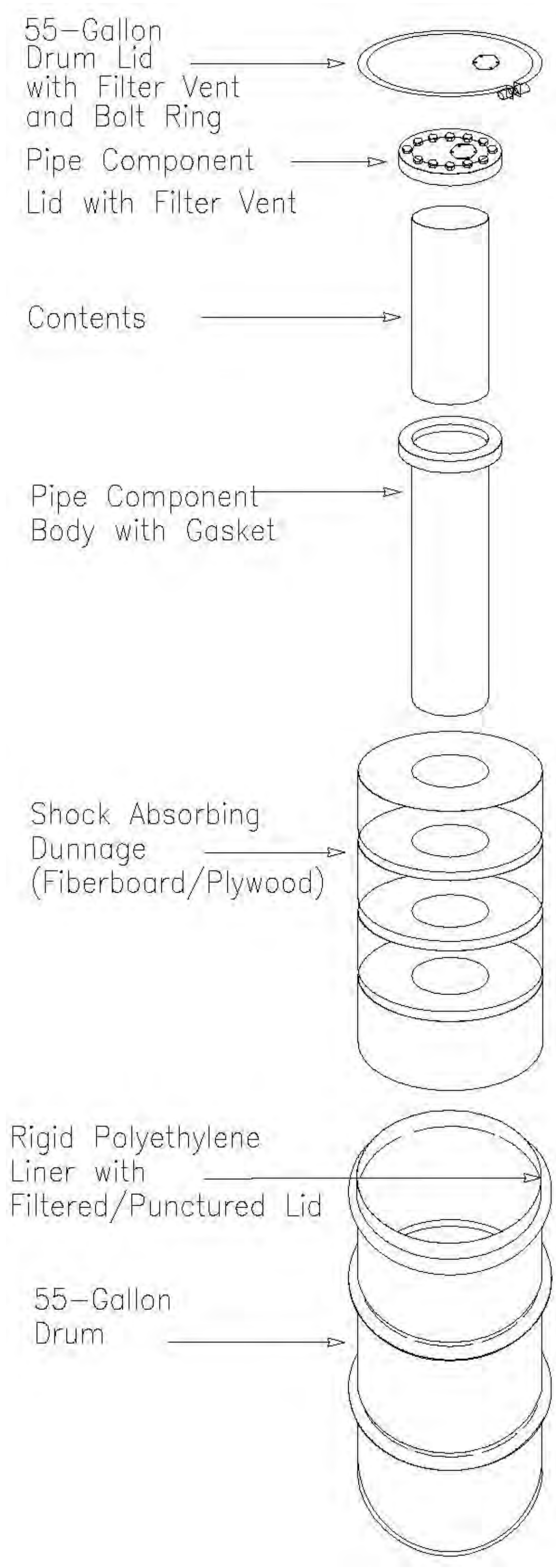


Figure 2.6-12. Standard Pipe Overpack Components

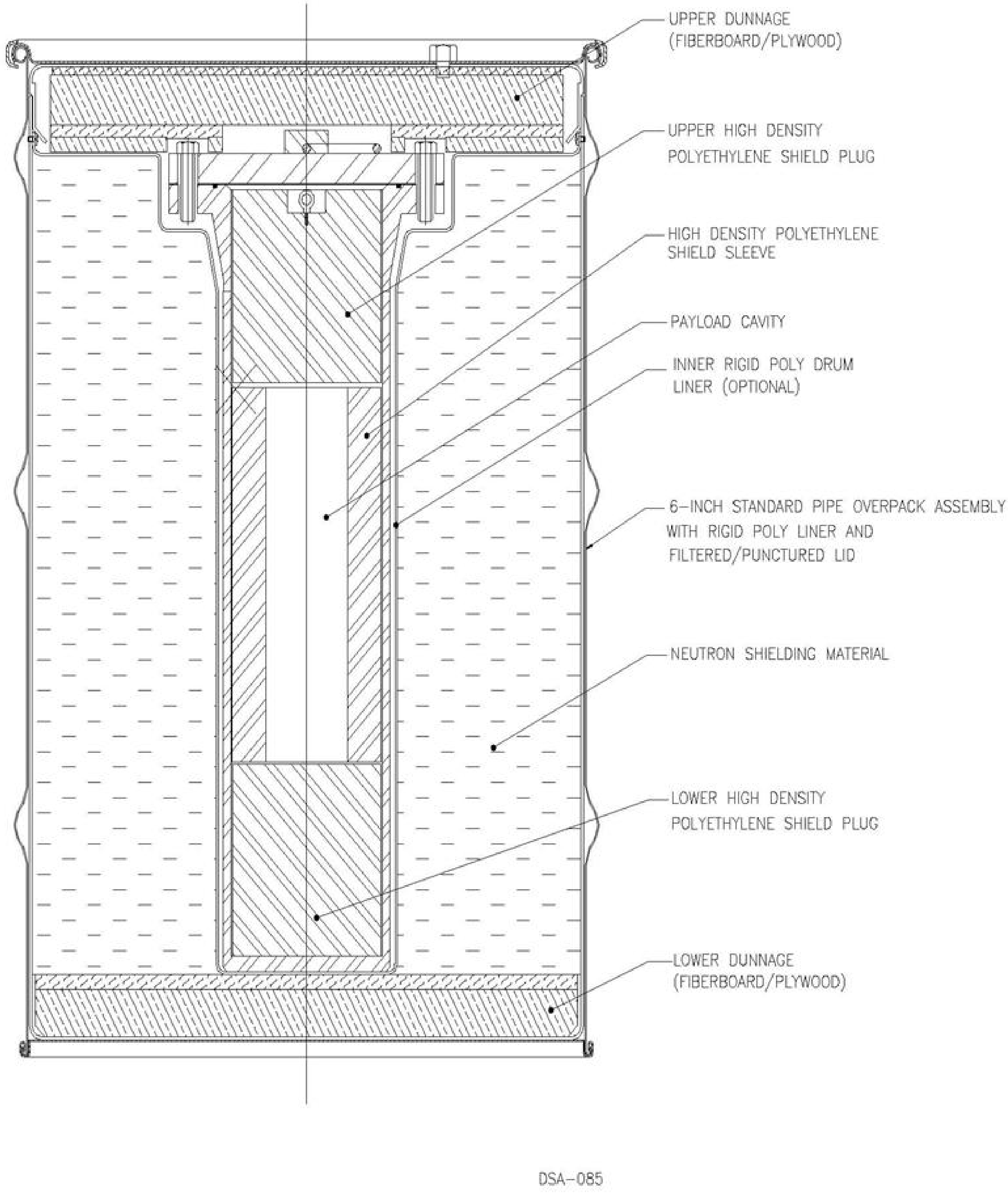


Figure 2.6-13. S100 Pipe Overpack

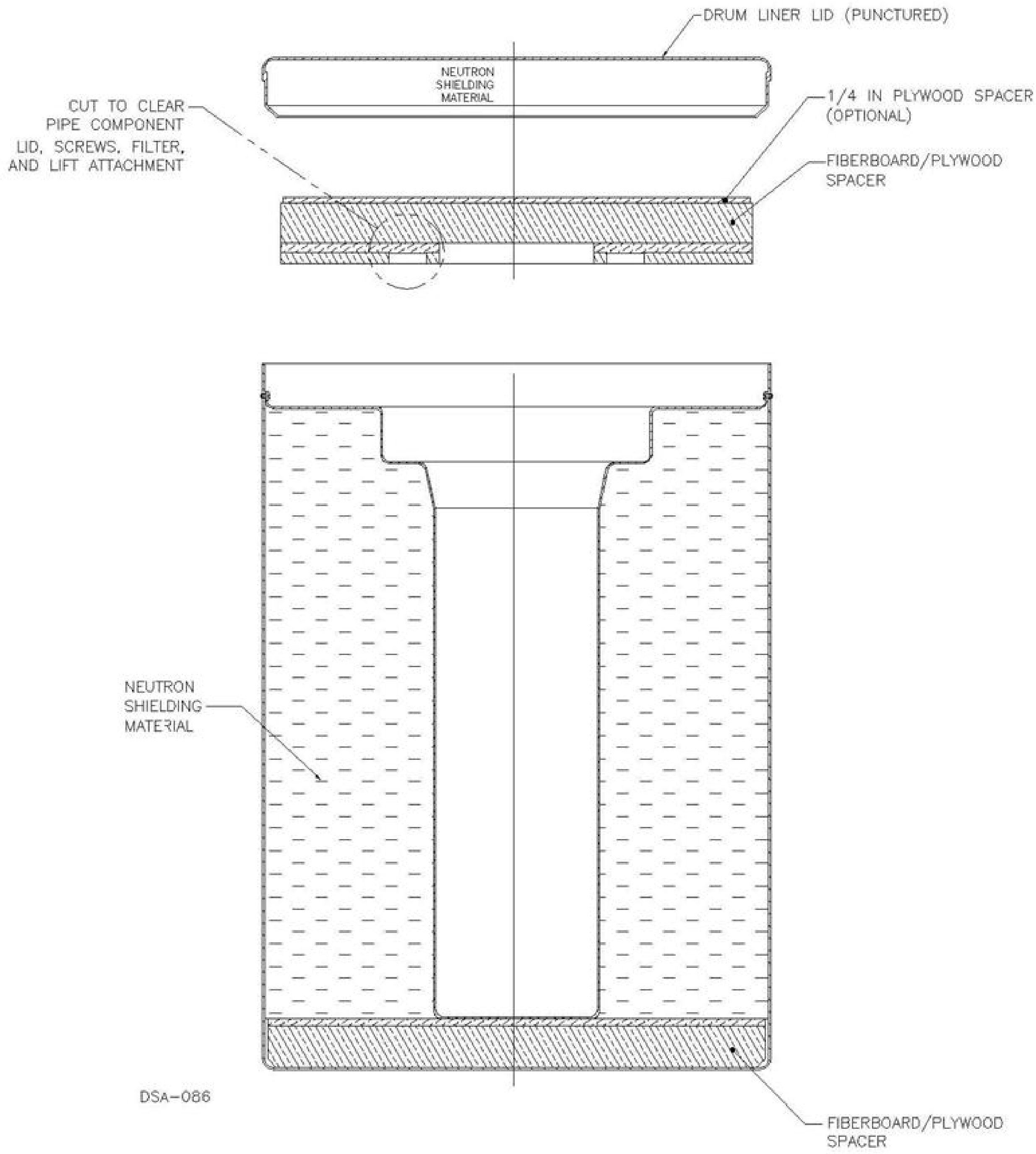


Figure 2.6-14. S300 Pipe Overpack Shield Insert

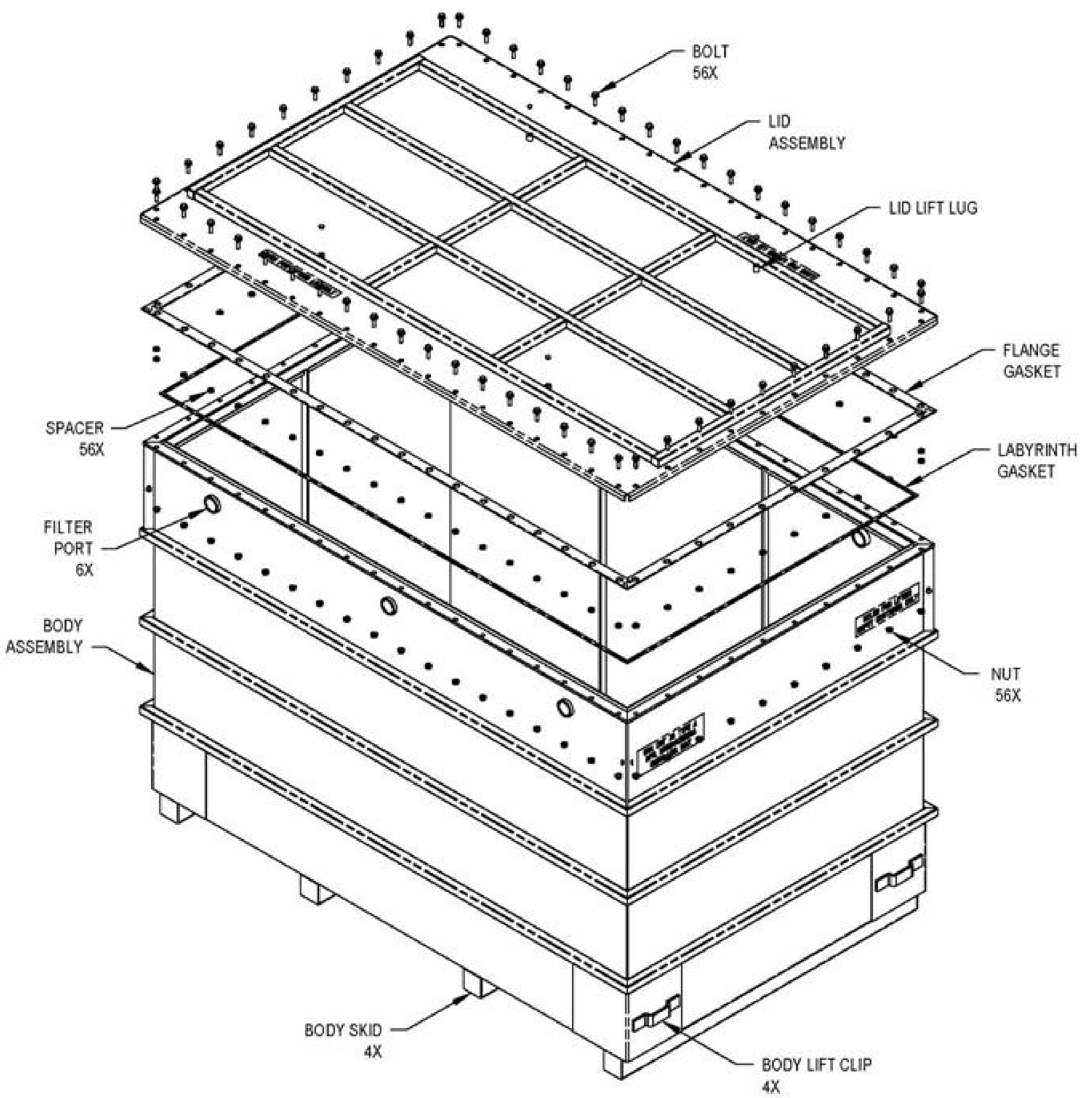


Figure 2.6-15. Standard Large Box 2

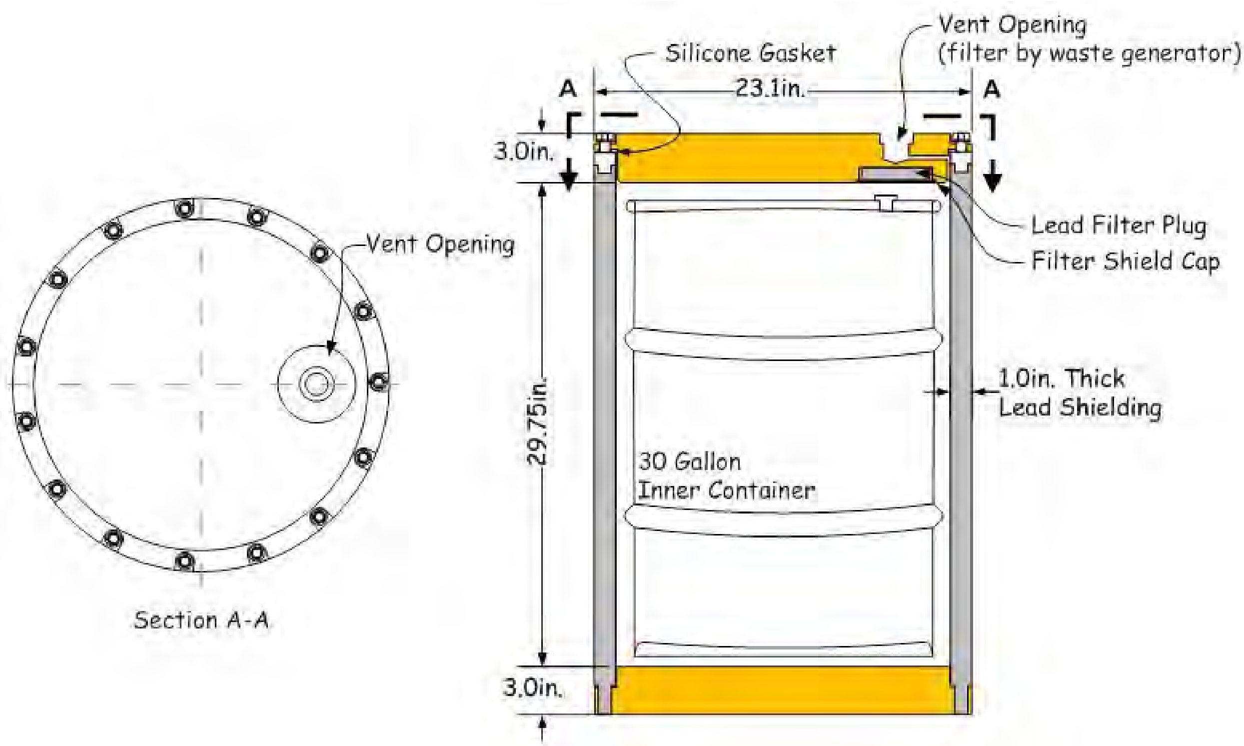


Figure 2.6-15a. Shielded Container

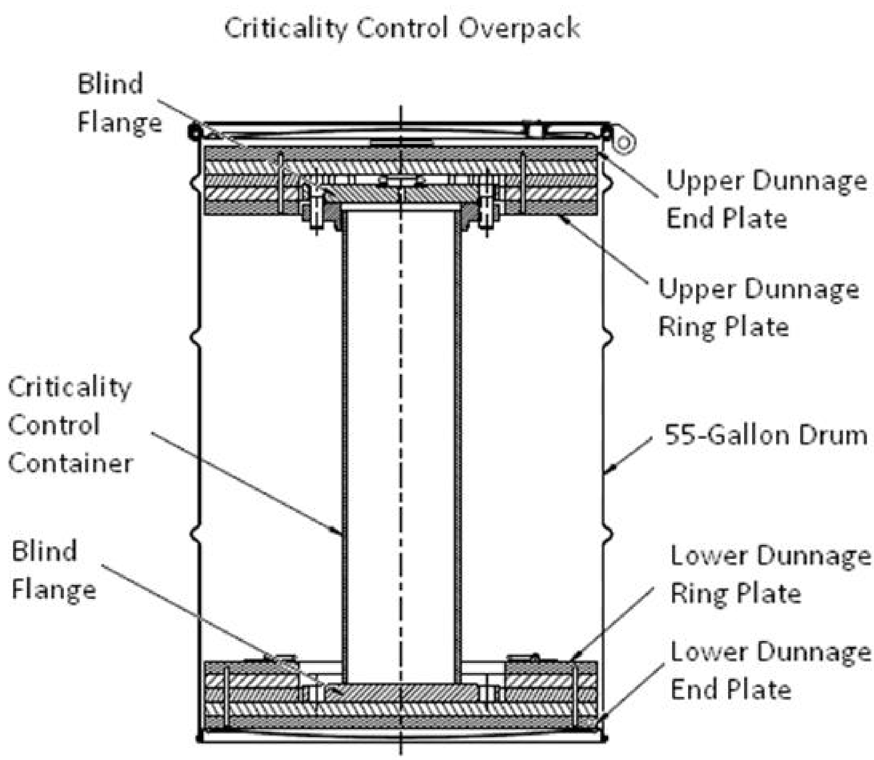


Figure 2.6-15b. Criticality Control Overpack

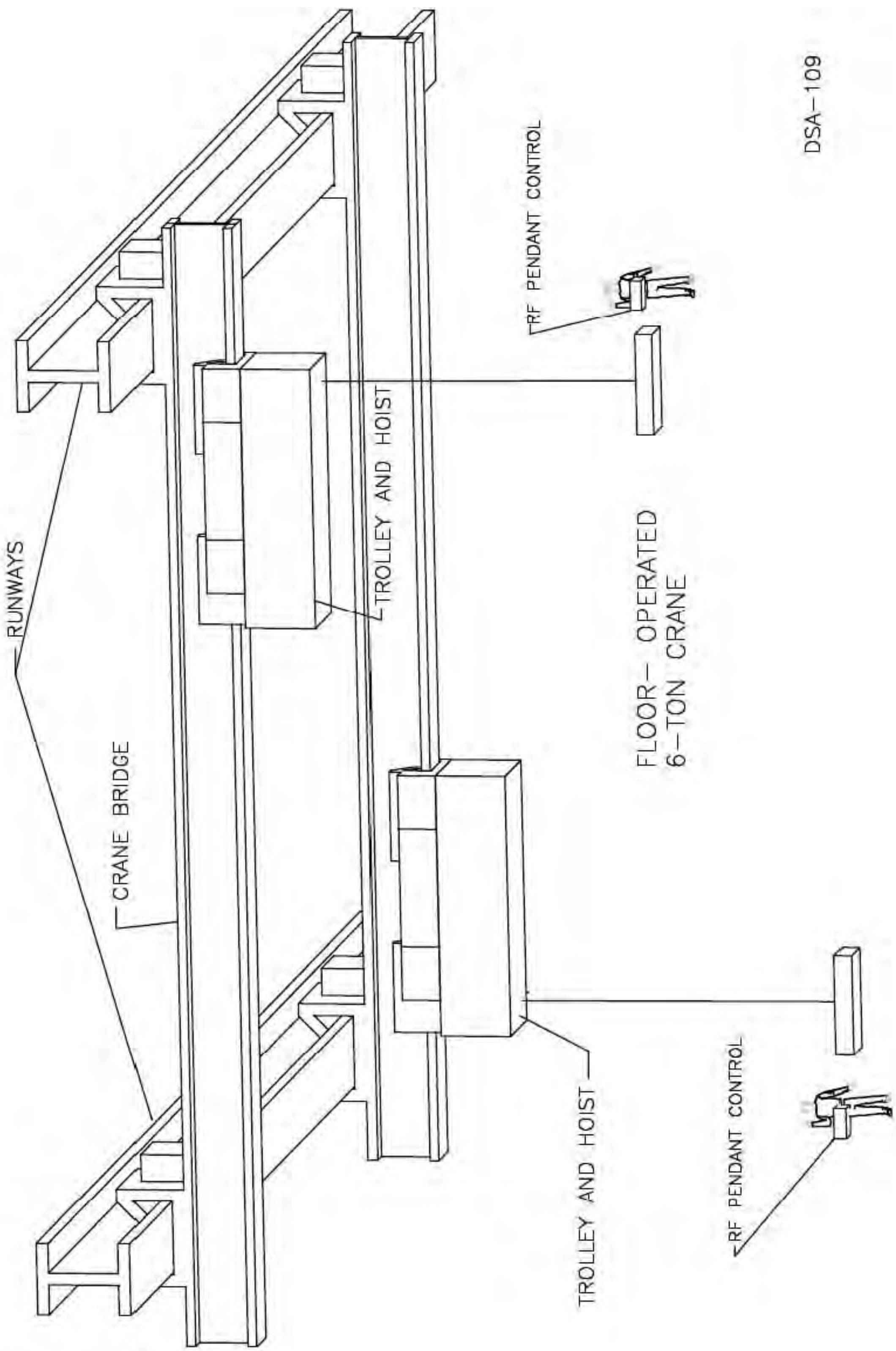


Figure 2.6-16. Typical Overhead Crane

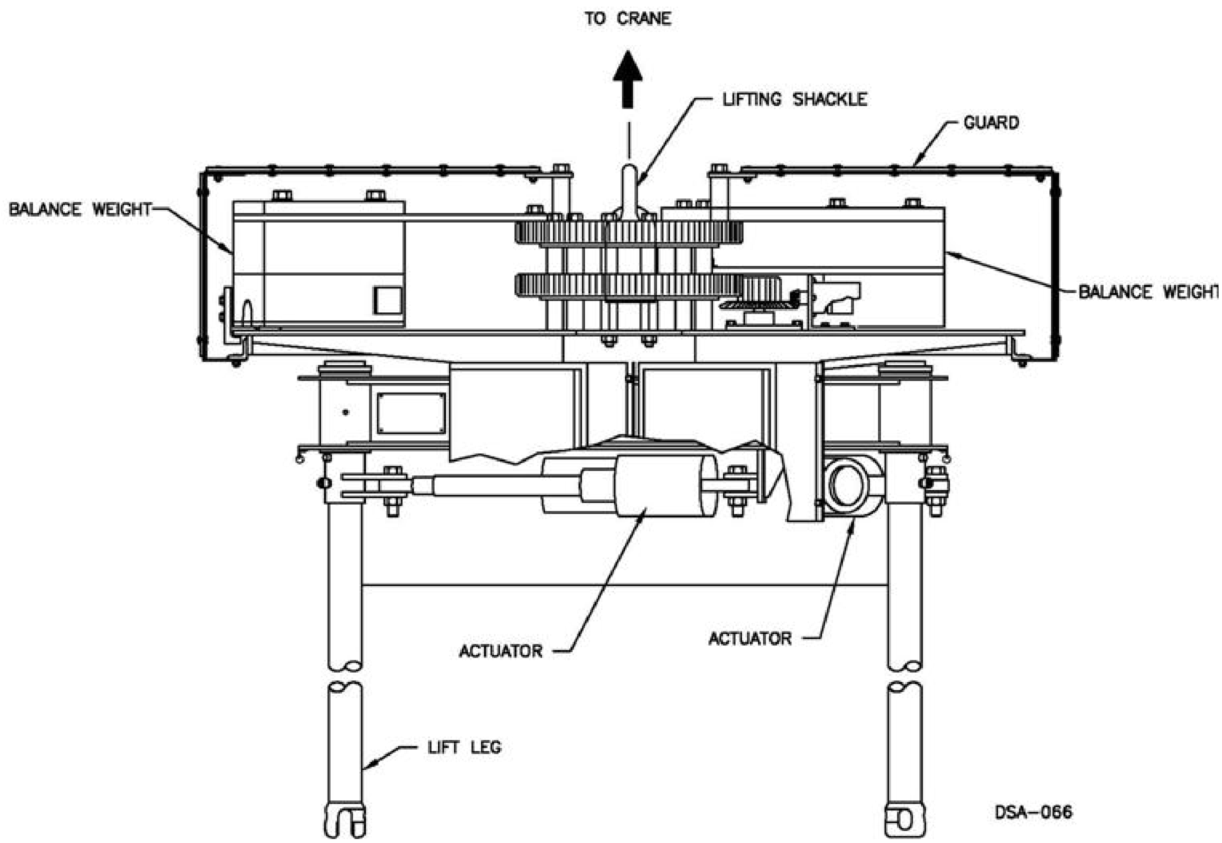


Figure 2.6-17. Adjustable Center-of-Gravity Lifting Fixture

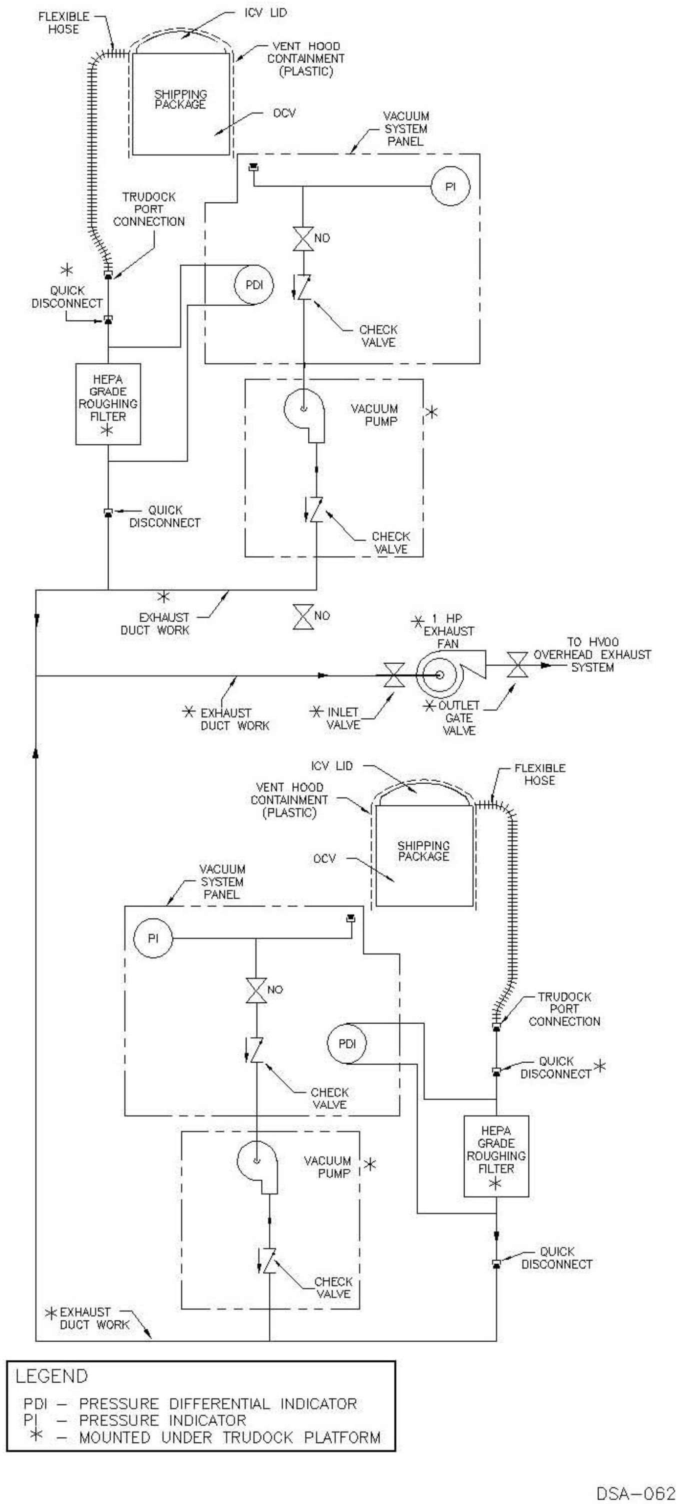


Figure 2.6-18. TRUDOCK Vent Hood System

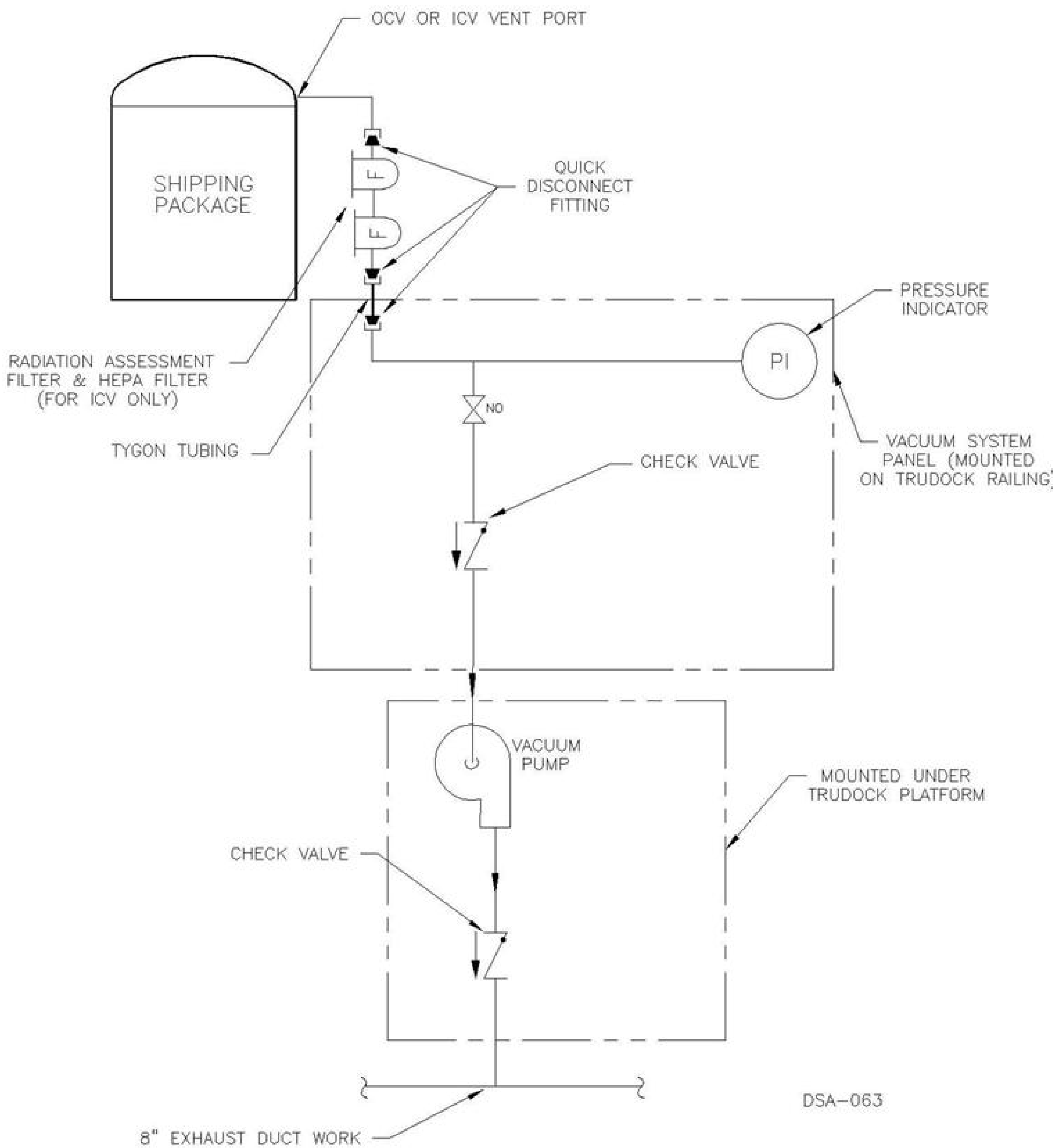


Figure 2.6-19. TRUDOCK Vacuum System

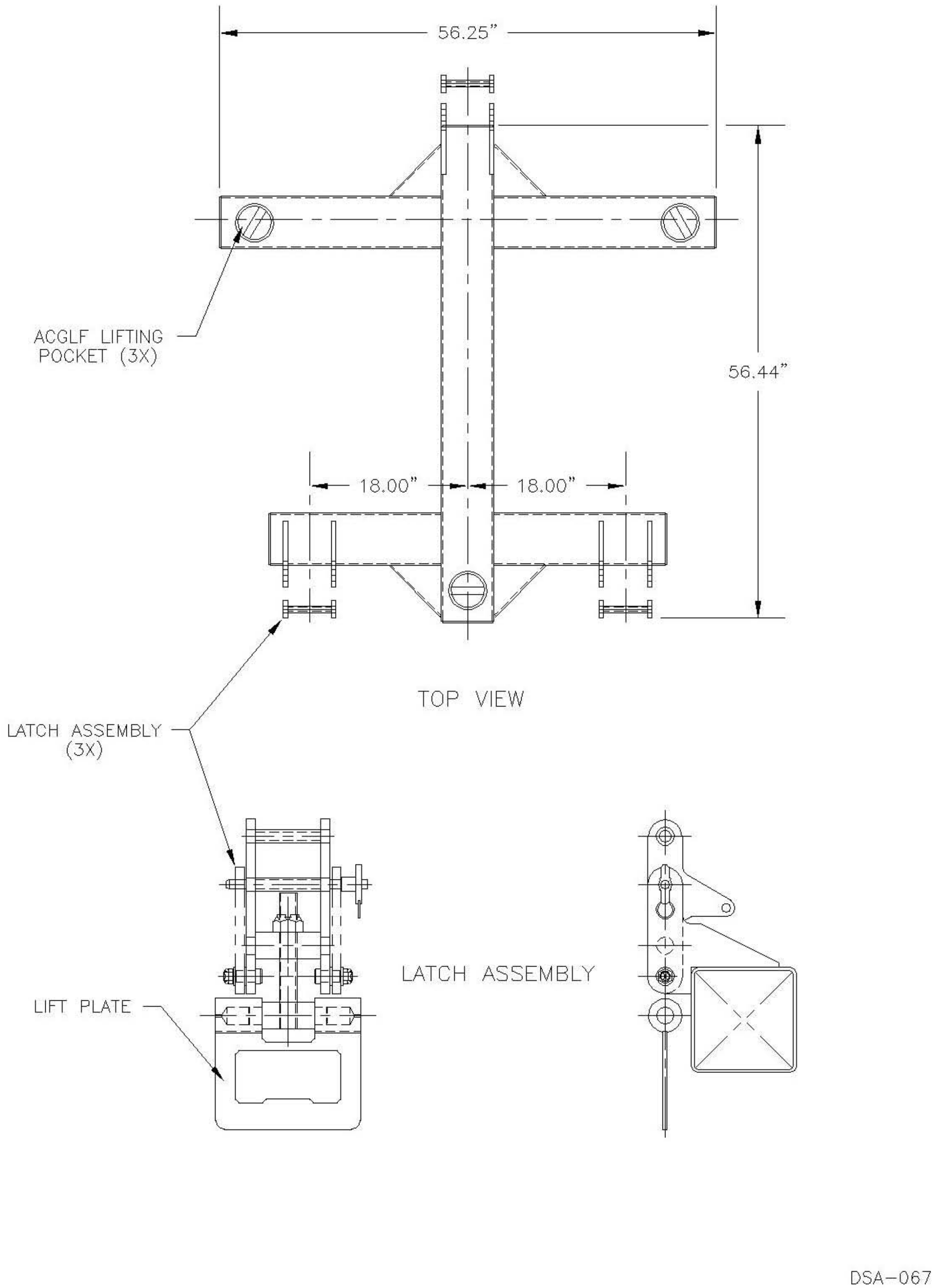


Figure 2.6-20. Standard Waste Box Lifting Fixture Adapter

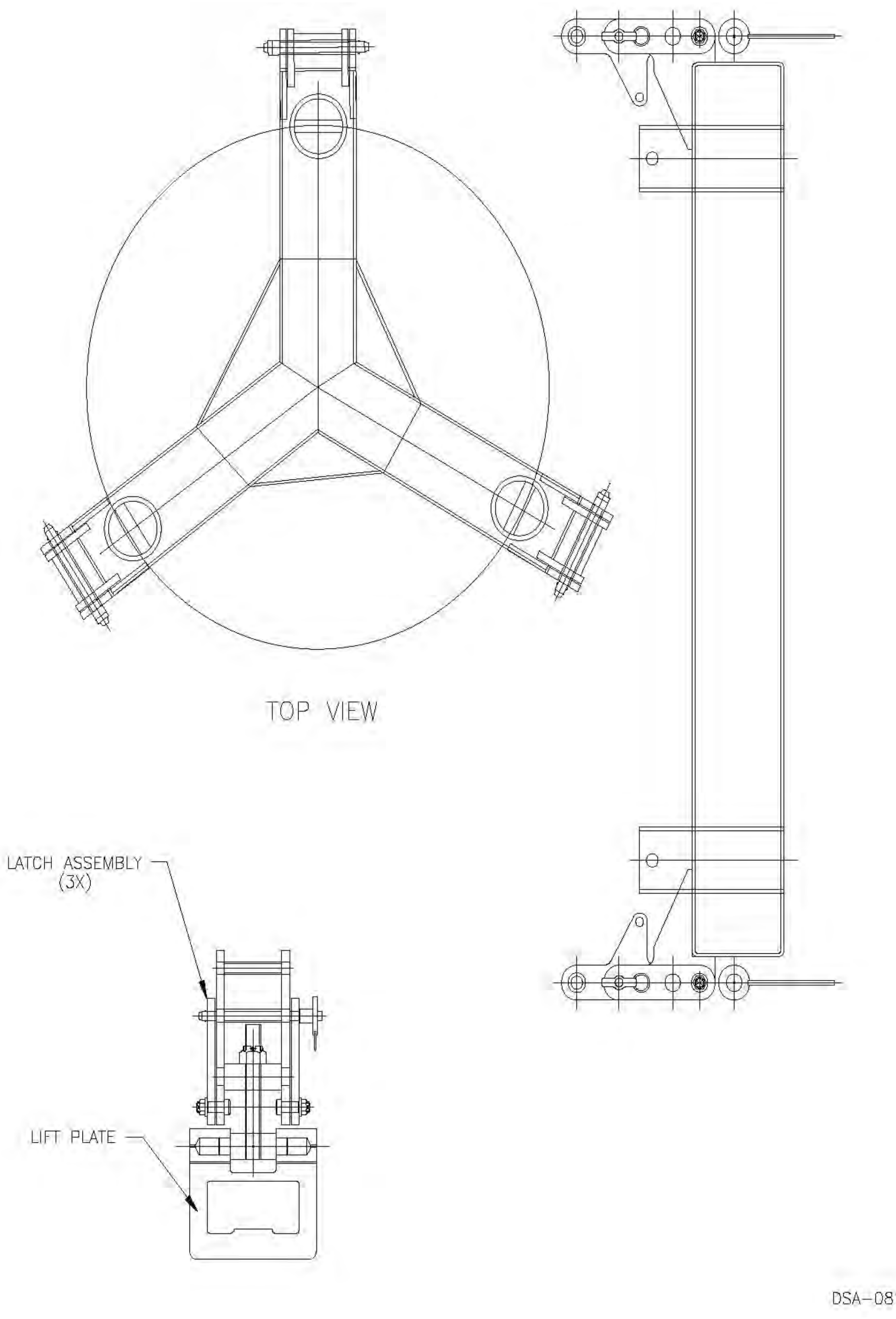


Figure 2.6-21. 10-Drum Overpack Lifting Fixture Adapter

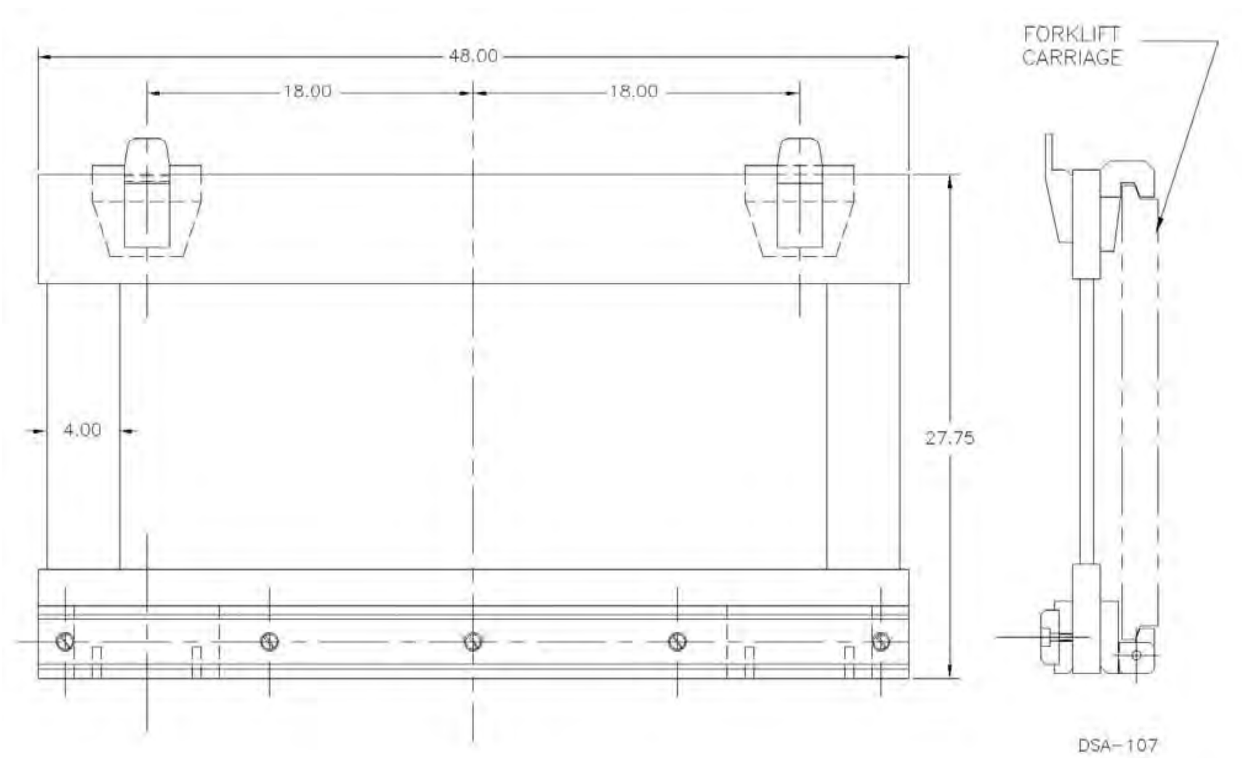


Figure 2.6-22. Standard Waste Box Forklift Fixture

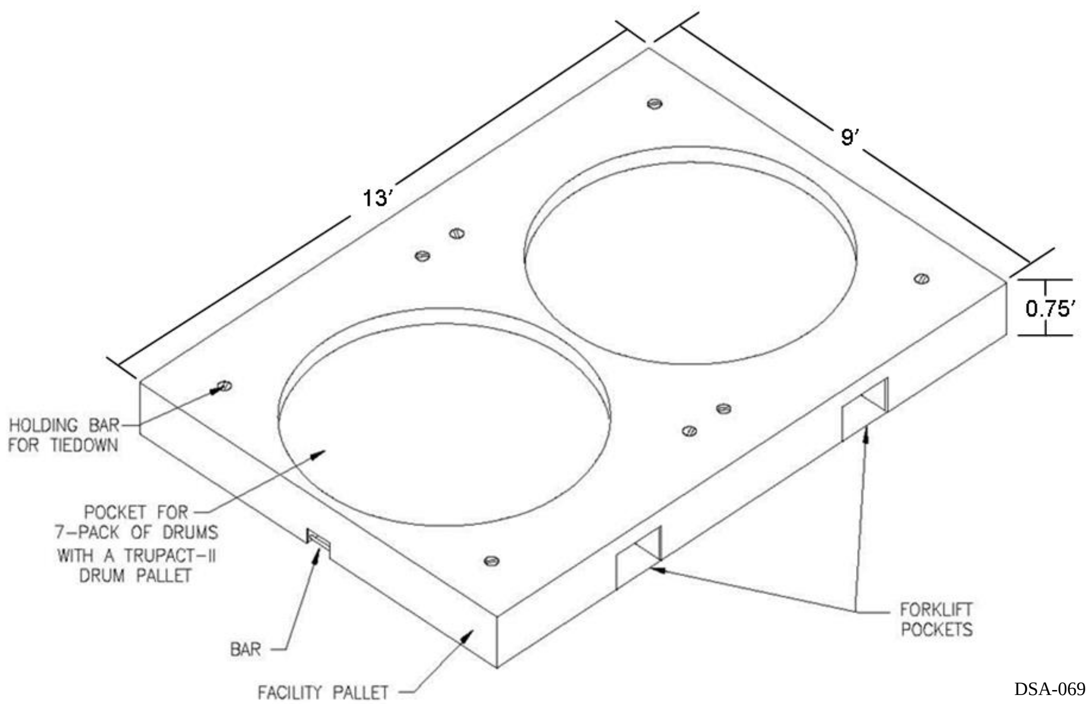


Figure 2.6-23. Facility Pallet

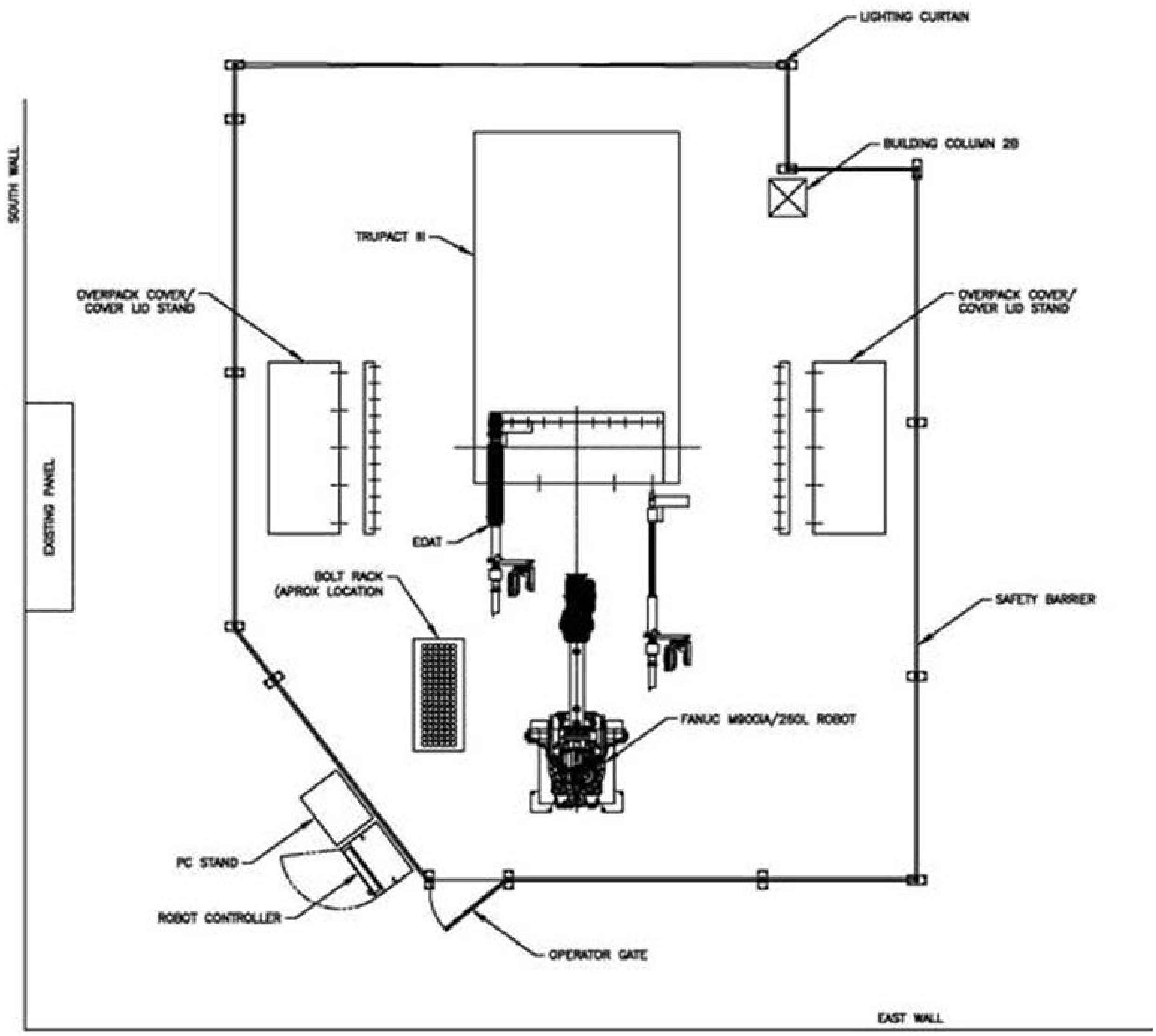


Figure 2.6-24. Bolting Station

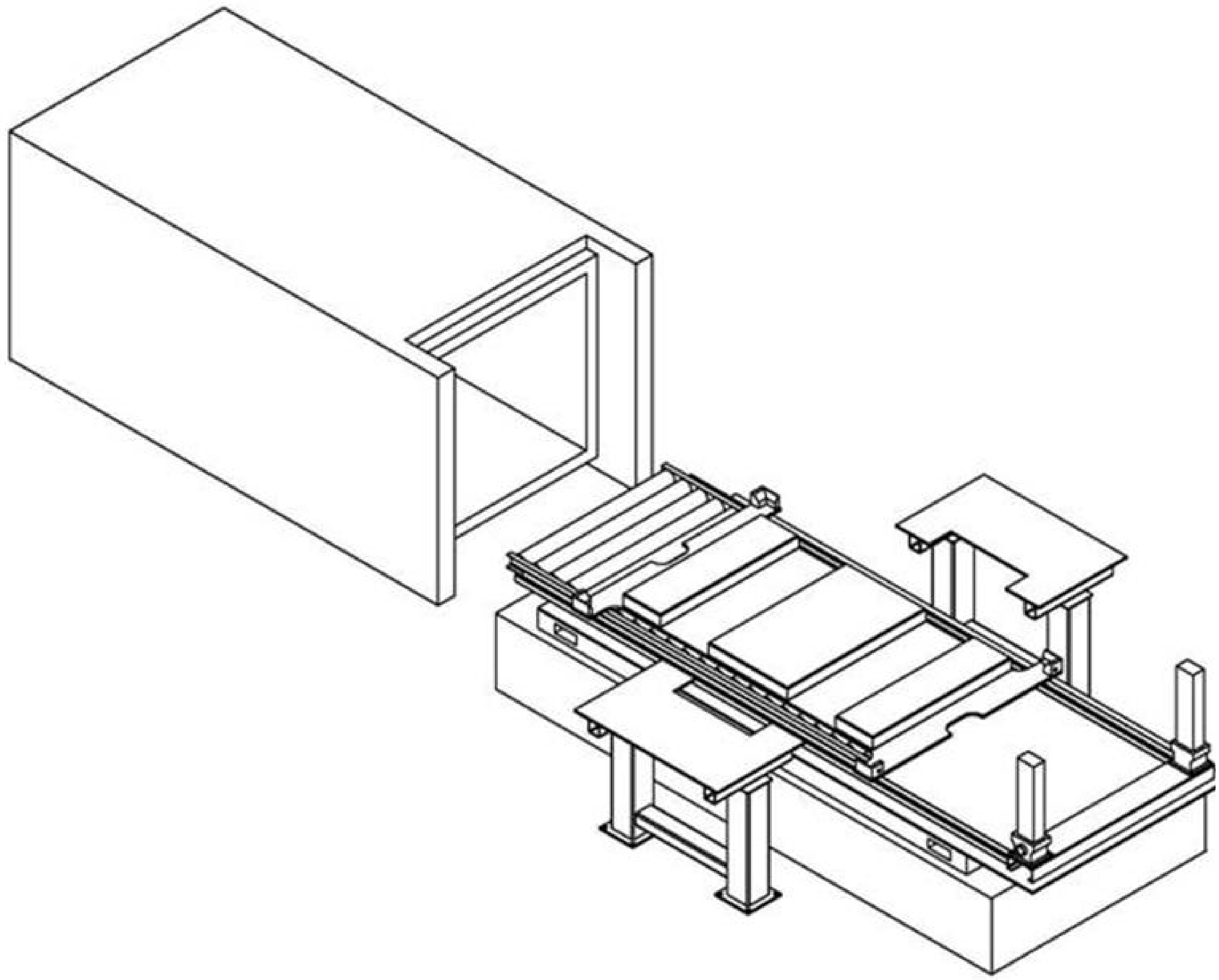


Figure 2.6-25. Payload Transfer Station

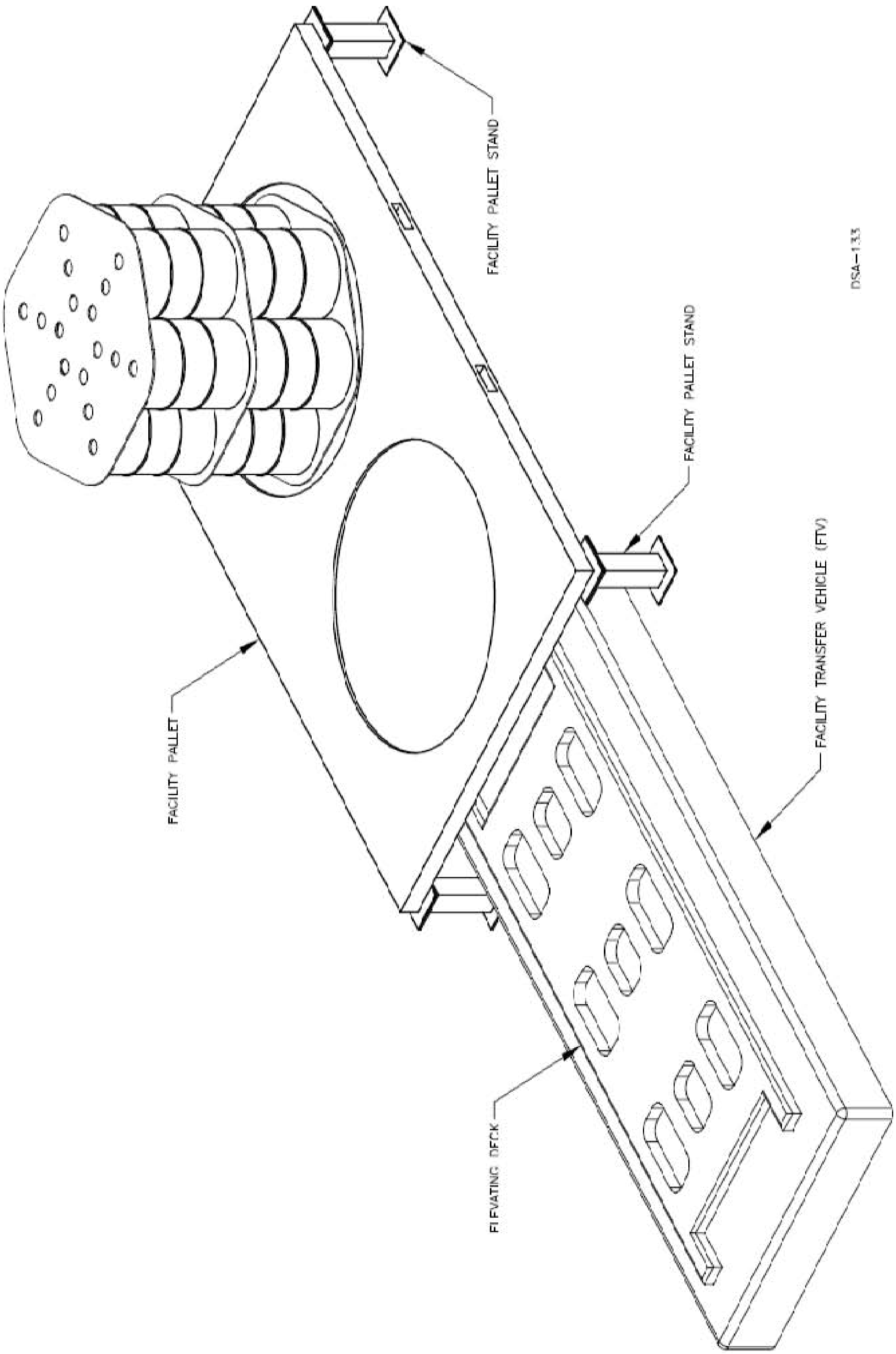


Figure 2.6-26. Facility Pallet on Stand and Facility Transfer Vehicle

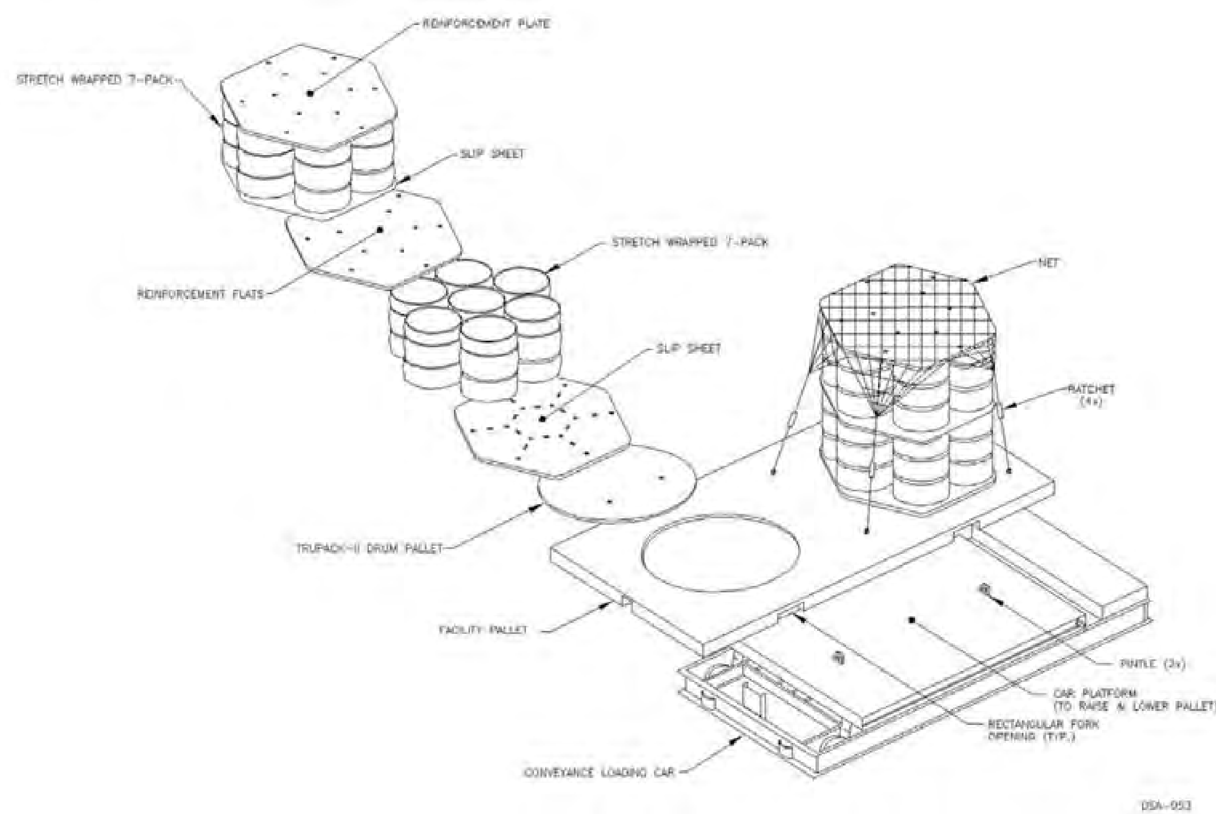


Figure 2.6-27. Facility Pallet on Conveyance Loading Car

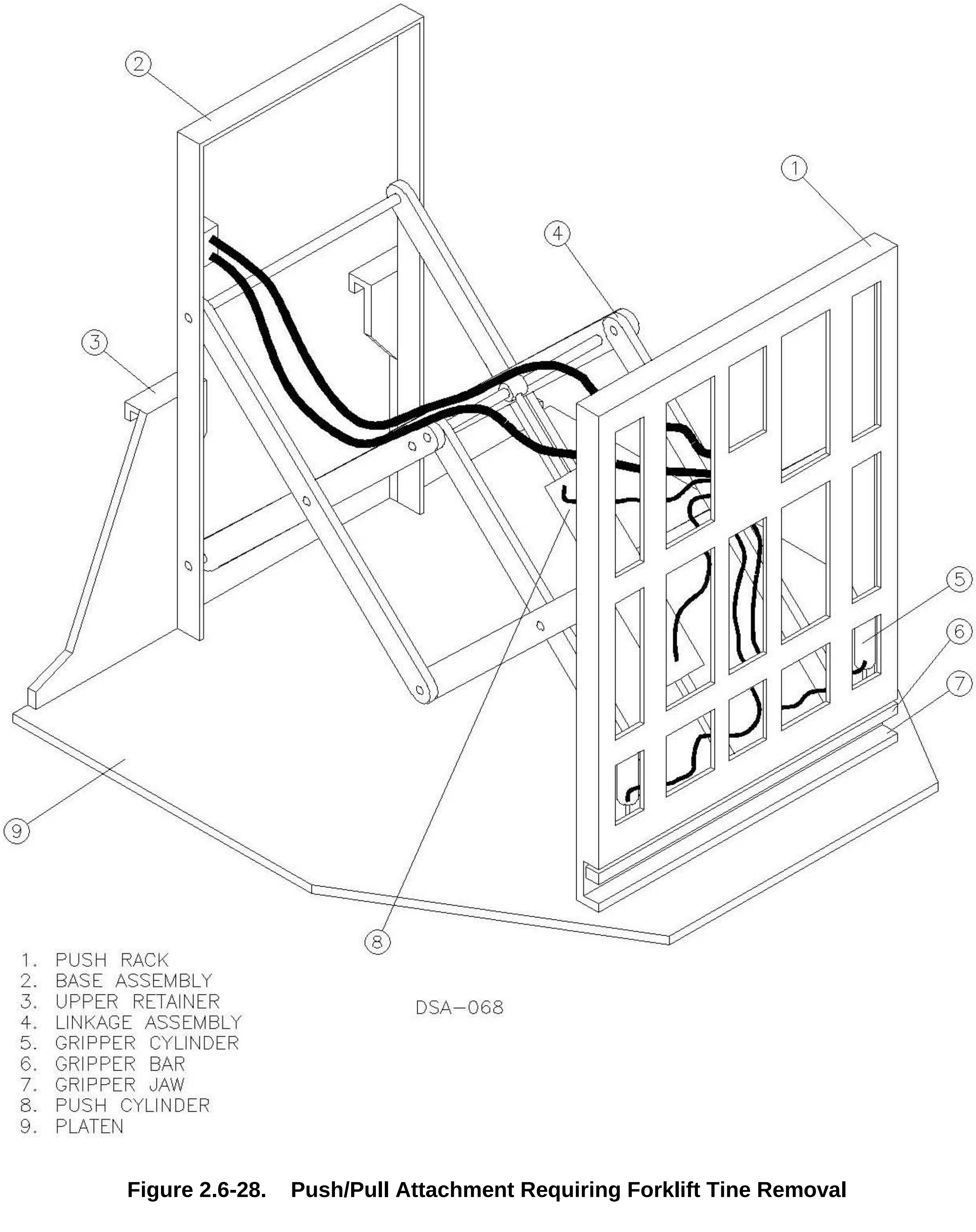


Figure 2.6-28. Push/Pull Attachment Requiring Forklift Tine Removal

Figure 2.6-29. Push/Pull Attachment Installed on Forklift Tines

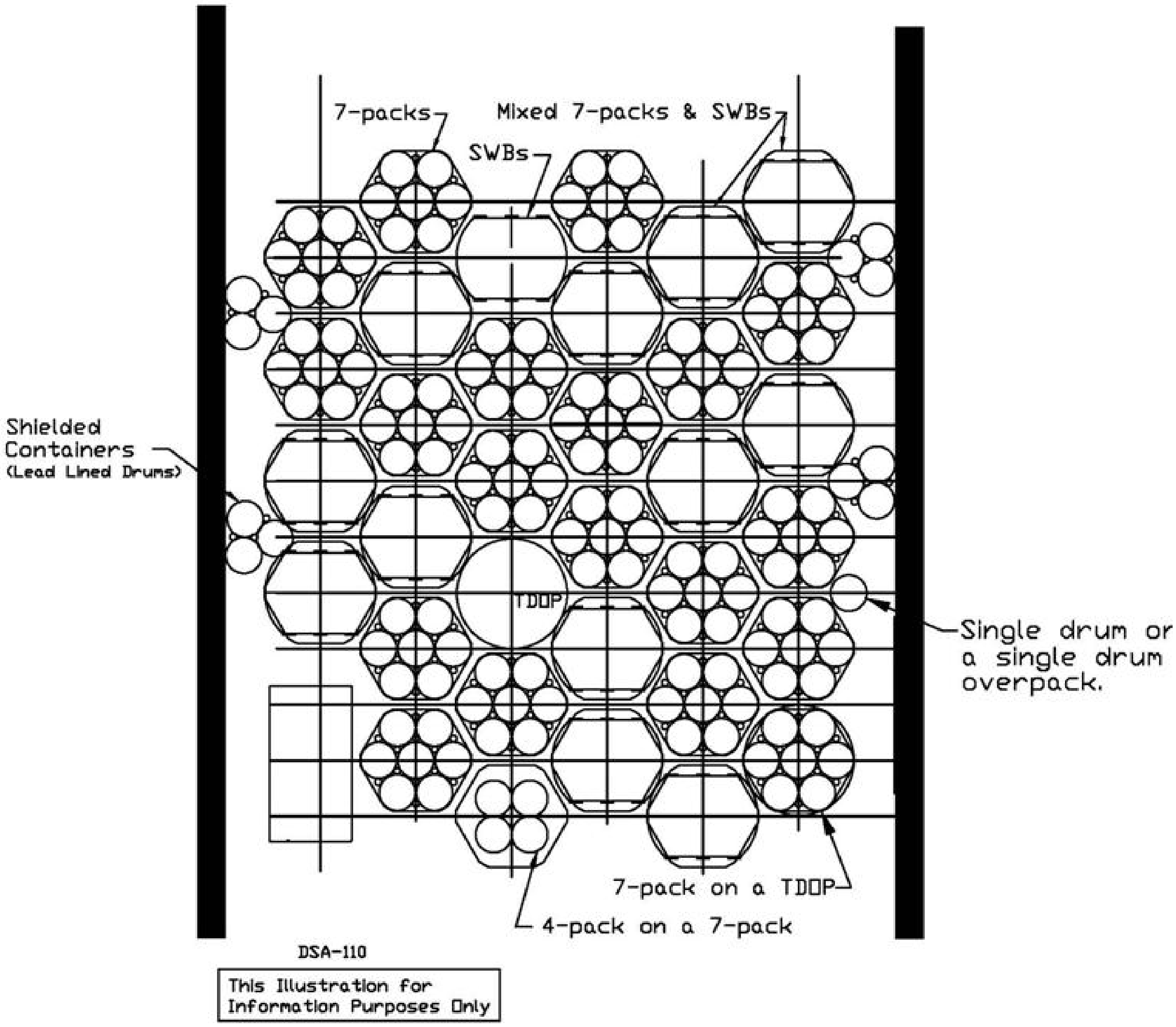


Figure 2.6-30. Arrangement of Typical Waste Stack (Magnesium Oxide not shown)

2.7 CONFINEMENT SYSTEMS

The WIPP confinement systems consist of static and dynamic barriers that prevent or minimize the following:

- The spread of radioactive and non-radioactive HAZMAT in occupied and unoccupied process areas.
- The release of radioactive and non-radioactive HAZMAT in facility effluents during normal operation and process interruptions.
- The release of radioactive and non-radioactive HAZMAT resulting from Design Basis Accidents (DBAs) including severe natural events and man-made events.

Static barriers are structures that confine contamination by their physical presence and dynamic barriers control the airborne radioactive material. Static barriers include Waste Containers, building structures, the UG repository, and HEPA filtration and non-radioactive HAZMAT enclosures. Dynamic barriers consist of the active portion of surface and UG ventilation systems. The primary confinement is the Waste Container and the secondary confinement consists of the WHB and the UG. The WHB is designed to withstand the effects of tornadoes, high winds, and earthquakes. The UG is unaffected by tornadoes and high winds. The WIPP confinement systems meet the requirements of DOE Order 420.1C.

2.7.1 Waste Handling Building

Static and dynamic barriers that ensure confinement are incorporated into the design of the WHB. The WHB is designed to maintain its integrity following a DBT or DBE. The WHB and Hot Cell Complex use airlocks to ensure that contamination or airborne radioactive material is not easily transported from the immediate area.

2.7.2 Underground

The primary confinement for TRU Waste in the UG is the Waste Container itself. Additional confinement includes the UVS, which provides differential pressure control such that air flow is from the non-waste areas to the disposal area.

The UVS exhausts solely through the Exhaust Shaft. Operation of the SVS would use pressure differentials, bulkheads, and air regulators to divide the mine into two exhaust pathways: one uncontaminated and one for the contaminated area (including areas of potential contamination). The exhaust air from the uncontaminated areas of the UG would be directed through upcasting through the Salt Handling Shaft. The exhaust air from the contaminated areas of the UG would then be directed through HEPA filters located on the surface to mitigate any potential radiological releases from the UG. The SVS will be interlocked with differential pressure sensors through software means via CMS programs in the UG. This addresses the issue of flow reversal and minimizes the potential spread of contamination. Bulkheads would separate the different air circuits with the airflow arranged so any air leakage would go from the uncontaminated side to the contaminated side. When the SVS fan would not be in operation, the ventilation flow would revert to exhaust only through the UVS HEPA filters. Airflow during SVS operation is shown in Figures 2.7-10 and 2.7-11.

2.7.3 Ventilation Systems

The WIPP ventilation systems are designed to provide a suitable environment for personnel and equipment during plant operations and to provide radiological control during postulated Waste Handling accidents and process interruptions. Ventilation systems, where appropriate, are used for space heating and cooling. The WIPP ventilation systems are designed to meet the emissions limitations in *Radiation Protection of the Public and the Environment* (DOE Order 458.1, Change 2), using the following guidelines:

- Ventilation airflow is from areas of lower to areas of higher potential for contamination.
- In building areas that have a potential for contamination, a negative air pressure is maintained to minimize the spread of contaminants.
- Consideration is given to the temporary disruption of normal airflow patterns because of maintenance operations by providing dual trains of HEPA filters and exhaust equipment.
- Ventilation systems are designed to reestablish airflow patterns in the event of a temporary disruption. Ducts that carry potentially contaminated air are routed away from occupied areas.
- Systems are designed so that some components can be taken out of service for maintenance while the system continues to operate as designed.

2.7.3.1 Surface Ventilation Systems

There are independent ventilation systems for each of the following areas:

- Waste Hoist Tower.
- CH Waste Handling area.
- RH Bay including the FCLR, HEPA filter gallery, and Upper Hot Cell Operating Gallery.
- RH Hot Cell Complex including Upper Hot Cell and Transfer Cell.
- WHB Mechanical Equipment Room.
- Battery Exhaust, including the TRUDOCKs and TRUPACT-III.
- EFB.
- Central Monitoring Room.

The CH Waste Handling area ventilation system can operate in a once-through and Recirculation Mode. Exhaust air recirculation systems have been installed on the CH Waste Handling (CH Bay and Room 108) and RH Bay ventilation systems. The recirculation systems have dampers located between the HEPA filter exhaust fans and the WHB common exhaust plenum ducted to Station C to allow HEPA-filtered, conditioned air to be recirculated into the ventilation system supply intake. The recirculation system can be controlled manually from the CMR. The CMR operator will manually convert to a once-through system on receipt of an alarm from a CAM. The ventilation systems maintain pressure differentials that control potentially contaminated air between building interior zones and the outside environment. The WHB ventilation systems continuously filter the exhaust air from Waste Handling areas to reduce the potential for release of radioactive effluents to the environment.

Airlocks for ventilation differential pressure control are electrically interlocked such that only one door at a time can be open and are provided in the following locations:

- At entrances to potentially contaminated areas to maintain a static barrier.
- Between areas of large pressure differences to provide a pressure transition and to eliminate high air velocity.
- Between areas where pressure differentials must be maintained.
- To minimize air movement from the WHB to the Waste Shaft.

The ventilation systems include instrumentation to the following operating parameters:

- Pressure drop across each prefilter and HEPA filter bank.
- Airflow rates at selected points.
- Pressure differentials surrounding areas of high potential for contamination levels.

The operation of the supply and exhaust fans for the WHB is controlled to maintain differential pressures between rooms. The WHB exhaust fans and controls can be supplied by backup power in the event that normal power is interrupted.

2.7.3.2 Waste Handling Building Contact-Handled and Remote-Handled Waste Handling Area Ventilation Systems

The CH WH CVS and RH Bay ventilation are separate independent ventilation systems shown on schematic flow diagrams (Figure 2.7-1 through Figure 2.7-4). The figures show that the ventilation airflow is from areas of lower to areas of higher potential for contamination (e.g., the CH Bay and Room 108 are more negative than the rest of the CH portion of the WHB; the upper Hot Cell is more negative than the Transfer Cell, that is more negative than the rest of the RH portion of the WHB). The Hot Cell Complex has a separate CVS with its HEPA filters in the HEPA filter room across from the north wall of the RH portion of the WHB. The ventilation systems for each WHB subsystem supply air to the rooms of the areas served. Each supply air-handling unit consists of filters, cooling coils, heating elements, fans with associated ductwork, and controls to condition the supply air, maintaining the design temperature during winter and summer. Fan operating status, filter bank pressure drops, and static pressure differentials are monitored in the CMR. Excess filter pressure drop and loss of flow initiates an alarm in the CMR. The CVS consists of prefilters and HEPA filters sized in accordance with design airflows, using industry standards for maximum efficiency, and exhaust fans that pull ventilation air through the HEPA filters before exhausting out the WHB exhaust vent.

Each ventilation system’s supply fan and exhaust fan are designed to maintain building pressure negative with respect to atmospheric pressure and maintain the design airflow pattern. During normal operation, if the operating exhaust/supply fan fails, the corresponding supply/exhaust fan is stopped. The standby system starts automatically or can be started manually.

The internal cavity of each RH shipping container is vented into a vacuum system that collects any airborne particulate contamination on a swipe medium. The sample system exhausts headspace gas and potential airborne particulate contamination through a HEPA filter before exhausting air into the RH Bay ventilation system.

The Station C effluent sampling system continuously samples the air discharged from the WHB exhaust vent downstream of HEPA filtration.

Tornado dampers, constructed to withstand a DBE and DBT, are installed in all HVAC inlets and exhaust openings in the WHB. Dampers installed in the air intakes open in the same direction as the normal airflow and close automatically to prevent a reversal of flow. Dampers in exhaust air openings open against the direction of normal airflow and are held open by springs. When tornado pressure on the open damper blades overcomes the spring tension, the blades close. In the event of a tornado, the WHB tornado dampers will automatically close to prevent the outward rush of air caused by a rapid drop in atmospheric pressure mitigating damage to HEPA filters from a potential high differential pressure. The WHB tornado dampers are also designed to close in the event of a DBE. A damper closure automatically stops the WHB ventilation exhaust fans.

In case of an offsite power failure, exhaust fans can be switched to the backup power system to continue to exhaust air in the designed flow pattern as noted in Section 2.9.1.2.

Instrumentation is provided that enables the operator to monitor equipment from the CMR. The monitored parameters include fan operating status, filter bank differential pressure, and static pressure differential in areas of the WHB. Filter differential pressure is displayed in the CMR. An alarm for a pressure drop, indicating filter replacement is needed, actuates at a predetermined differential pressure across the HEPA filters.

Instruments and system components are subject to periodic testing and inspection during normal plant operation.

All nuclear-grade HEPA filter banks are tested for conformance with *Testing of Nuclear Air-Treatment Systems* (ANSI/ASME N510) and have greater than or equal to 99 percent removal efficiency (SDD HV00, *Heating, Ventilation and Air Conditioning System System Design Description (SDD)*).

2.7.3.3 Waste Handling Building Mechanical Equipment Room Ventilation System

The Mechanical Equipment Room is maintained at a pressure slightly below atmospheric to minimize leakage of room air, which may contain airborne radioactive contaminants. Negative pressure is maintained by the same exhaust fan systems that exhaust air from the CH Waste Handling areas.

2.7.3.4 Waste Handling Building Waste Shaft/Waste Hoist Tower Ventilation System

The ventilation system provides filtration of supply air, unit heaters for freeze protection, and a unit cooler to provide cooling of equipment in summer. Exhaust airflow is down through the tower and into the Waste Shaft, where it combines with incoming air from the Waste Shaft auxiliary air intake tunnel as shown in Figure 2.7-4.

A pressurization system serves the airlock to the Crane Maintenance Room and pressurizes the airlock, preventing the release of potentially contaminated air from the Crane Maintenance Room to the access corridor.

2.7.3.5 Battery Exhaust System

The Battery Exhaust System provides ventilation for the WHB Battery Charging Area and for HEPA filtration of exhaust from; the TRUDOCK vent hoods (Figure 2.6-18), TRUDOCK vacuum system (Figure 2.6-19), and the TRUPACT-III exhaust hood. The Battery Exhaust System exhaust combines with exhaust from other WHB ventilation systems before the Station C effluent sampling system, prior to exhaust to the environment. The Battery Exhaust System is interlocked with the TRUDOCK Exhaust System and the TRUPACT-III exhaust fan such that the TRUDOCK and TRUPACT-III exhaust fans will not operate if the battery exhaust system is not operating.

2.7.3.6 Exhaust Filter Building Ventilation System

A schematic flow diagram of the EFB ventilation system is shown in Figure 2.7-5. The EFB supports the operation of the UVS and contains the UVS HEPA filters. The function of the ventilation system in the EFB, major components, operating characteristics, safety considerations, and controls are similar to those of the CH WH CVS in the WHB. Each supply air-handling unit in the EFB consists of prefilters, an electric heating coil, and a fan to condition the air as required to maintain the design temperature. The EFB ventilation system exhausts air from all potentially contaminated areas of the building through two filter housings, each containing a bank of prefilters and two stages of HEPA filters, and two exhaust fans before discharging to the atmosphere. The EFB exhaust air is discharged into the discharge duct of the 860 fans so that it can be monitored for airborne radioactive contaminants.

2.7.3.7 Central Monitoring Room Ventilation System

The CMR is located in the Support Building. The CMR ventilation system provides a suitable environment for personnel occupancy under normal operations and HEPA filtration operation and maintains a slightly positive pressure in the CMR. The CMR has features to allow its use during both normal and emergency conditions, including two-hour fire walls, redundant ventilation systems, supply and exhaust systems capable of being connected to the backup electrical power system, and a manual shift to HEPA filtration of intake air. Major components of the CMR HVAC system include supply air-handling units that condition (heat/cool) the air, HEPA filters, and exhaust fans.

The CMR is served by two 100 percent capacity air-handling units. One is in service and one is in standby status. The standby unit will automatically start in the event the operating unit fails. The schematic airflow diagram for the CMR HVAC system is shown in Figure 2.7-6.

2.7.3.8 Underground Ventilation System

The UVS serves the WIPP UG to provide acceptable working conditions and a life-sustaining environment during normal operations and off-normal events, including Waste Handling accidents. In the event of a breach of Waste Containers, the UVS assists in the confinement of released material. The UVS is designed, maintained, and operated (Figure 2.7-7 and Figure 2.7-8) to meet or exceed the criteria specified by 30 CFR 57, the New Mexico Mine Safety Code for All Mines, Including Open-Cut and Open-Pit (19.6.5 NMAC), and applicable parts of DOE Order 420.1C and DOE-HDBK-1169, *Nuclear Air Cleaning Handbook.*

The UVS is composed of: three centrifugal exhaust fans (700 fans), each capable of providing 260,000 acfm and any pair of 700 Fans capable of providing 425,000 acfm; three centrifugal exhaust fans (860 Fans), each capable of approximately 60,000 acfm; two identical HEPA filter assemblies arranged in parallel in the EFB; two skid mounted centrifugal exhaust 960 fans, each capable of providing 27,000 acfm; two interim skid mounted filter assemblies; a skid-mounted vane axial 1060 fan; filter bypasses; isolation and backdraft dampers; and associated ductwork.

UG ventilation is divided into four separate flow paths supporting the waste disposal area, the construction area, the north area, and the Waste Shaft Station. The waste disposal, construction, and north areas receive their air supply from the Air Intake Shaft and the Salt Handling Shaft. Use of the SVS will alter this flow pattern as described in Section 2.7.3.8.3. The Waste Shaft Station receives its air supply from the Waste Shaft via the Waste Hoist Tower and the Auxiliary Air Intake Tunnel. Airlocks and bulkheads separate the different circuits. The four air circuits combine near the Exhaust Shaft, which is the common discharge from the UG.

Filtration Mode mitigates the consequences of a UG accident involving waste by reducing the airflow rate and directing the UG exhaust through at least two of four HEPA filter assemblies located on the surface. Since the 2014 events, the UVS now operates and will remain operating in the Filtration Mode.

The operating status of each exhaust fan is displayed in the CMR. Instruments and system components are accessible for periodic testing and inspection during normal plant operation. Under normal operating conditions, the ventilation system functions continuously.

The bulkheads, overcasts, airlocks, and ventilation regulators in bulkheads used to segregate the UG ventilation circuits are made of noncombustible material, except for flexible flashing used to accommodate salt movement and in accordance with 30 CFR 57. Figure 2.7-9 shows a typical bulkhead with an airflow regulator installed.

Air is directed to active Disposal Rooms in a panel using bulkheads and air regulators. After a Disposal Room is filled, it is closed against entry and isolated from the mine ventilation system.

2.7.3.8.1 Underground Ventilation Filtration System

The Underground Ventilation Filtration System (UVFS) is the filtration system in use prior to the 2014 events. It is composed of: three centrifugal exhaust fans (860 fans), each capable of approximately 60,000 acfm; two identical HEPA filter assemblies arranged in parallel; isolation and backdraft dampers; and associated ductwork. The 860 fans are located on the surface near the Exhaust Shaft adjacent to the EFB on the east side of the building. During filtration operations, only one 860 fan operates, while the 700 fans do not operate.

Since the February 14, 2014 event the 700 fans have been taken out of operation. Two of the 700 fans are locked out and one of the 700 fans has been disconnected from the UVS ductwork. Additionally, the associated filter bypass has been sealed with foam. The UVS permanent Operational Mode is now three operational 860 fans pulling (one fan operating at a time) through two identical HEPA filter assemblies arranged in parallel. Two 700 fans can provide an unfiltered flow path, but this mode of operation is not evaluated or authorized by this DSA revision and, as noted above, the 700 fans have been taken out of service.

UG operations are limited depending on the quantity of air available. In particular, construction and emplacement can no longer take place simultaneously. All three 860 fans, one operating at a time, could be connected to the backup power supply in the event that normal power is lost. Changeover to backup power is manual.

2.7.3.8.2 Interim Ventilation System

The IVS consists of two skid mounted centrifugal exhaust 960 fans; two skid mounted filter housings; isolation dampers; and associated ductwork. The 960 fans can each provide a filtered flow of 27,000 acfm (or 54,000 acfm combined). The 960 fans are located on the surface near the 700 fans and the Exhaust Shaft.

The IVS receives Exhaust Shaft flow through a connection to the ductwork which previously supplied a 700 fan and exhaust into the existing monitored discharge. Figure 2.4-13 shows the IVS layout. The function of the IVS is to increase the filtered flow through the Exhaust Shaft during normal operation, acting as secondary fans to the 860 fans. During filtration operations typically one of three 860 fans in the EFB operates with at least one of two of the IVS fans, while the 700 fans do not operate. The 960 fans cannot be operated on backup power.

2.7.3.8.3 Supplemental Ventilation System

The SVS equipment is onsite but its use is not yet authorized. The SVS would, when authorized, provide additional ventilation airflow to the UG and minimize the deposition of salt on the filter assemblies during construction activities. The SVS will consist of one skid-mounted vane axial 1060 fan (including flow element, direct driven fan, and fan driver on a common skid), located in the UG in the S-90 Drift near the Air Intake Shaft. The fan assembly will include a fan, variable frequency drive, and instrumentation and controls. The skid system (including the fan train of silencers, inlet/outlet bells, regulator, etc.) is installed directly onto the salt floor of the S-90 Drift. The 1060 fan can deliver approximately 130,000 acfm.

The mine infrastructure changes supporting the SVS includes installation of new bulkheads, installation of new equipment/instrumentation and configuration of flow paths.

Operation of the SVS would revise the ventilation flow paths such that the construction and north circuits will receive their supply airflow from the Air Intake Shaft. Uncontaminated air will be discharged through the Salt Shaft, while potentially contaminated air will be directed through the Exhaust Shaft.

The SVS would be interlocked with differential pressure sensors in the UG. This will address the issue of flow reversal and minimize the spread of contamination.

Figures 2.7-10 and 2.7-11 show the flow paths and schematics for SVS operation.

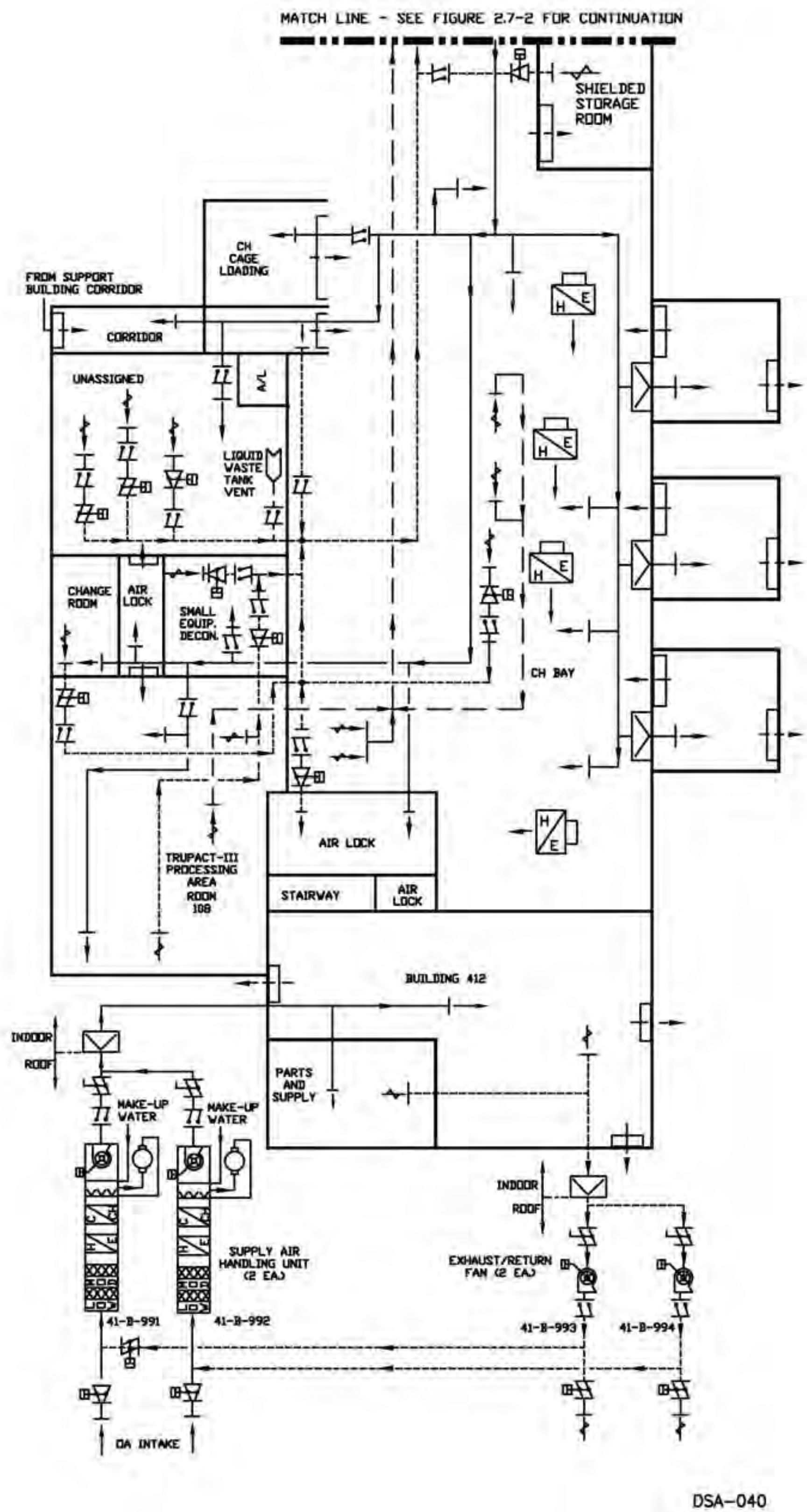


Figure 2.7-1. Waste Handling Building and TRUPACT Maintenance Facility

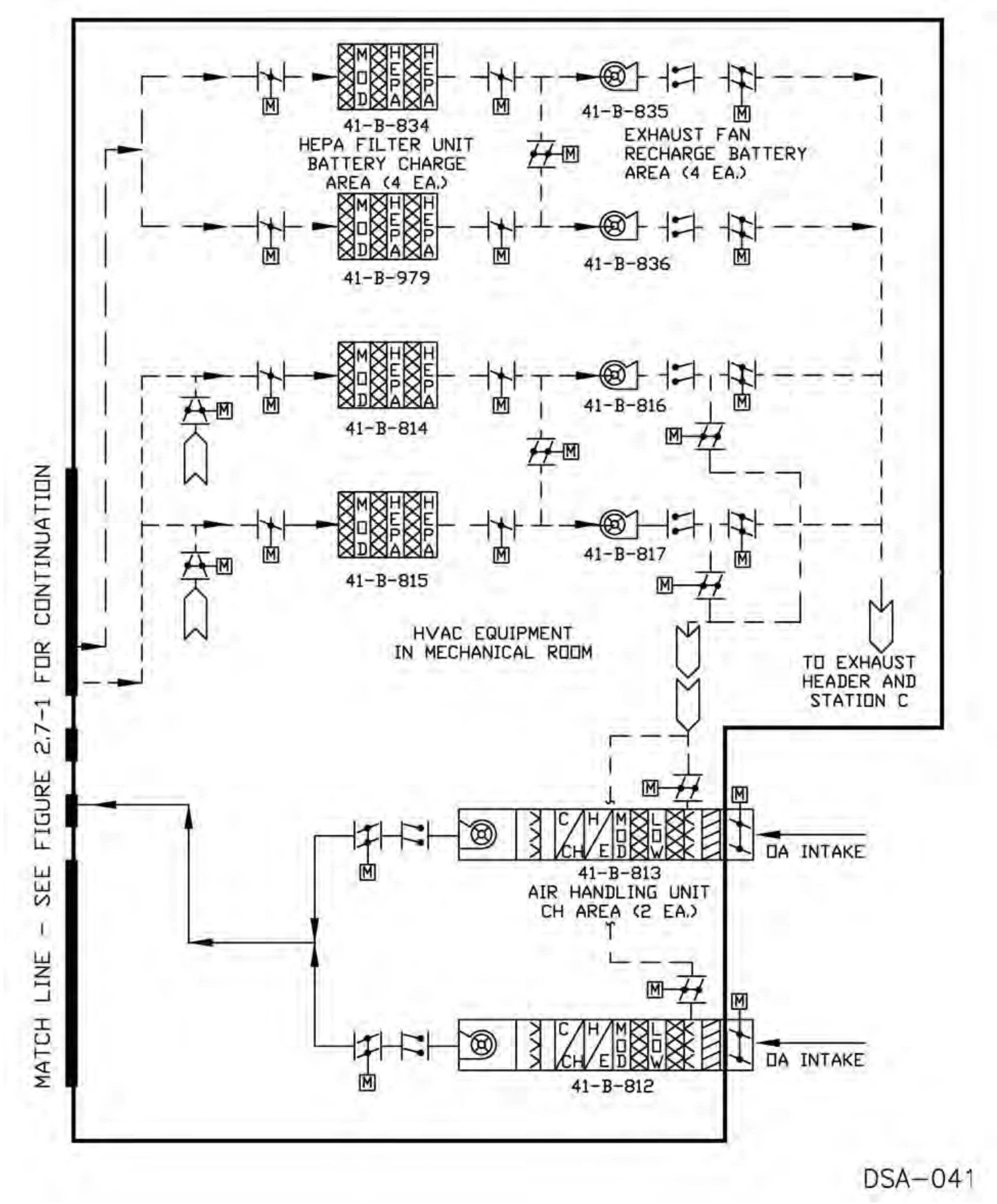


Figure 2.7-2. Waste Handling Building Contact-Handled HVAC Flow Diagram

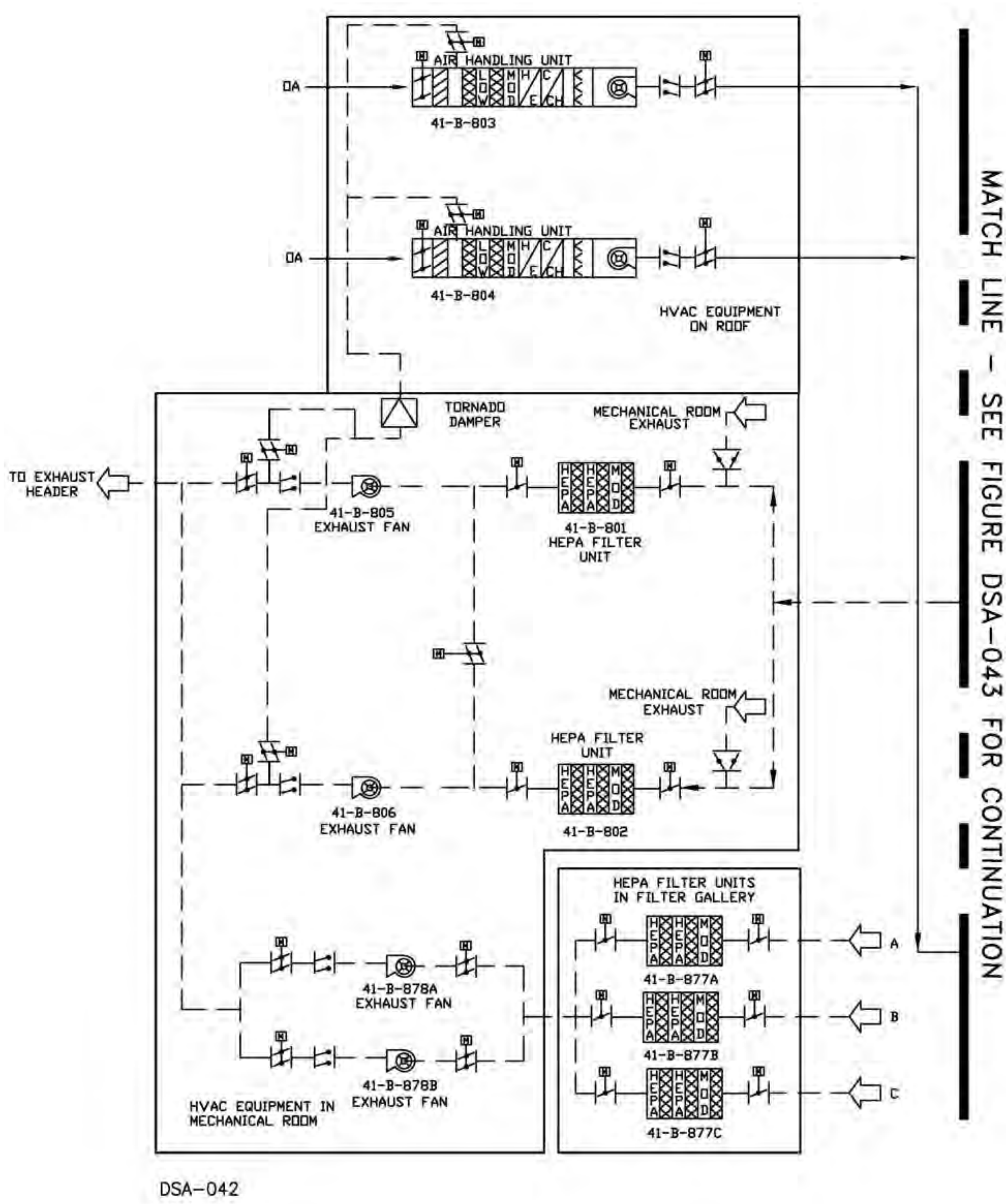


Figure 2.7-3. Waste Handling Building Remote-Handled HVAC Flow Diagram

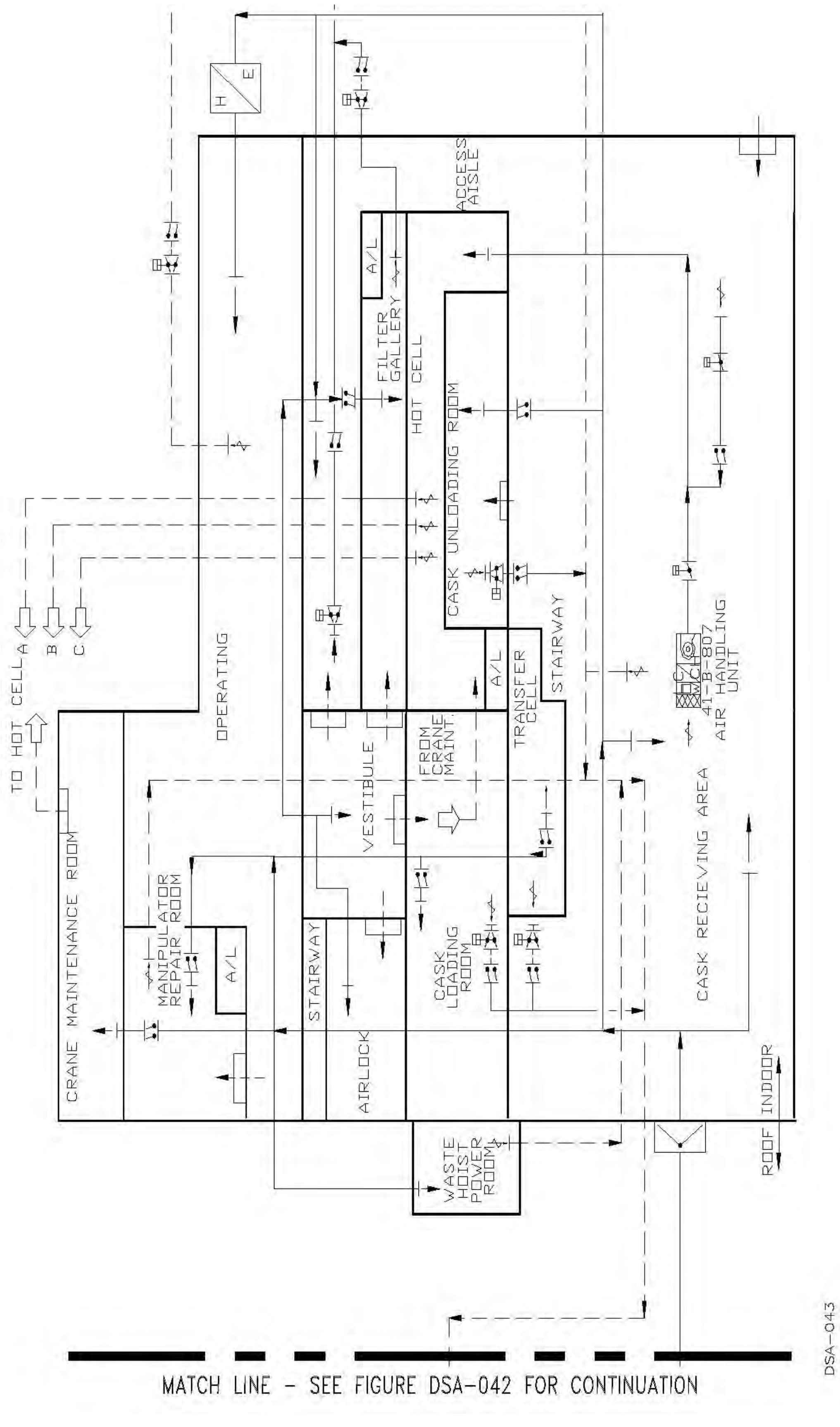


Figure 2.7-3. Waste Handling Building Remote-Handled HVAC Flow Diagram (continued)

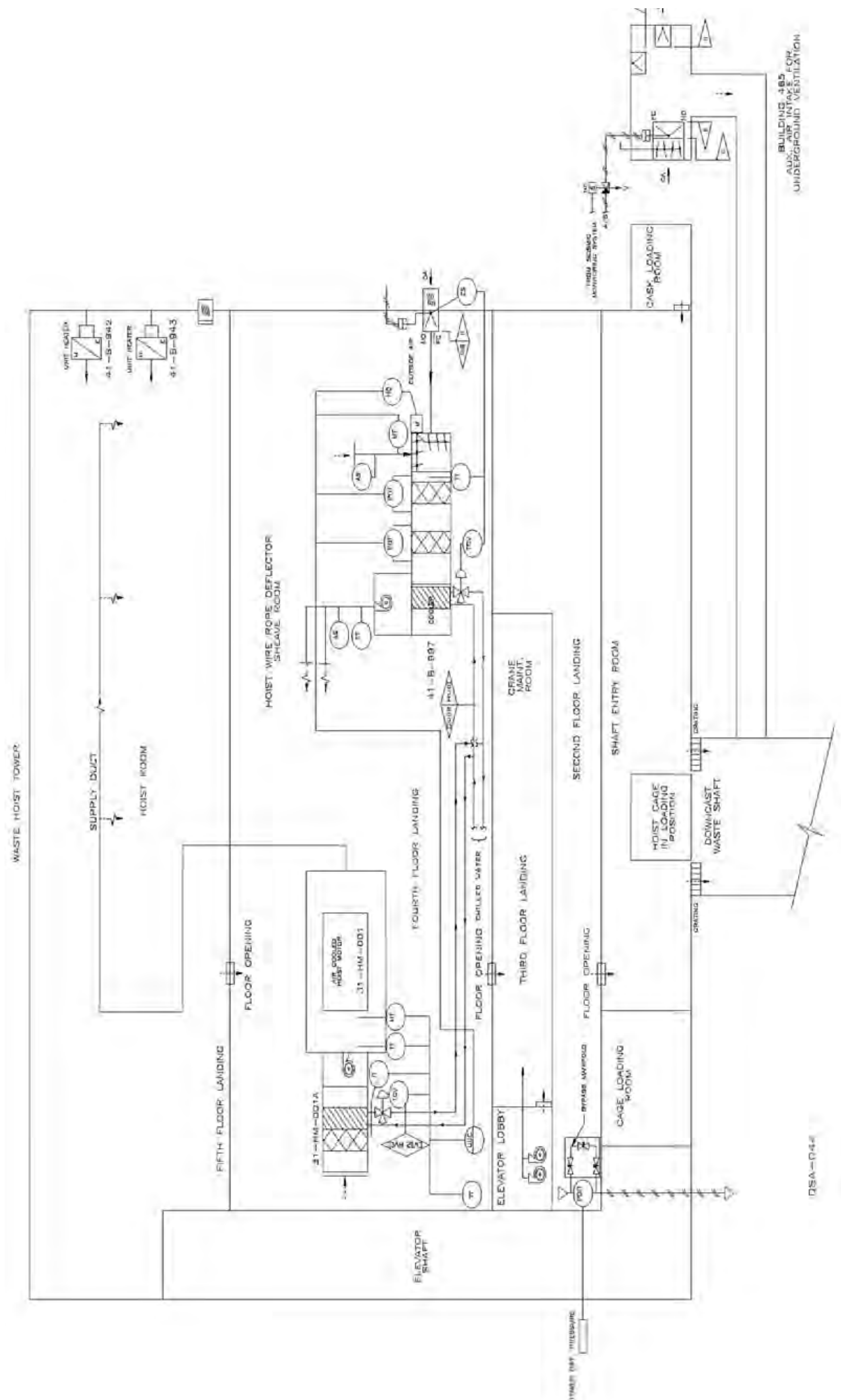


Figure 2.7-4. Waste Shaft / Waste Hoist Tower HVAC Flow Diagram

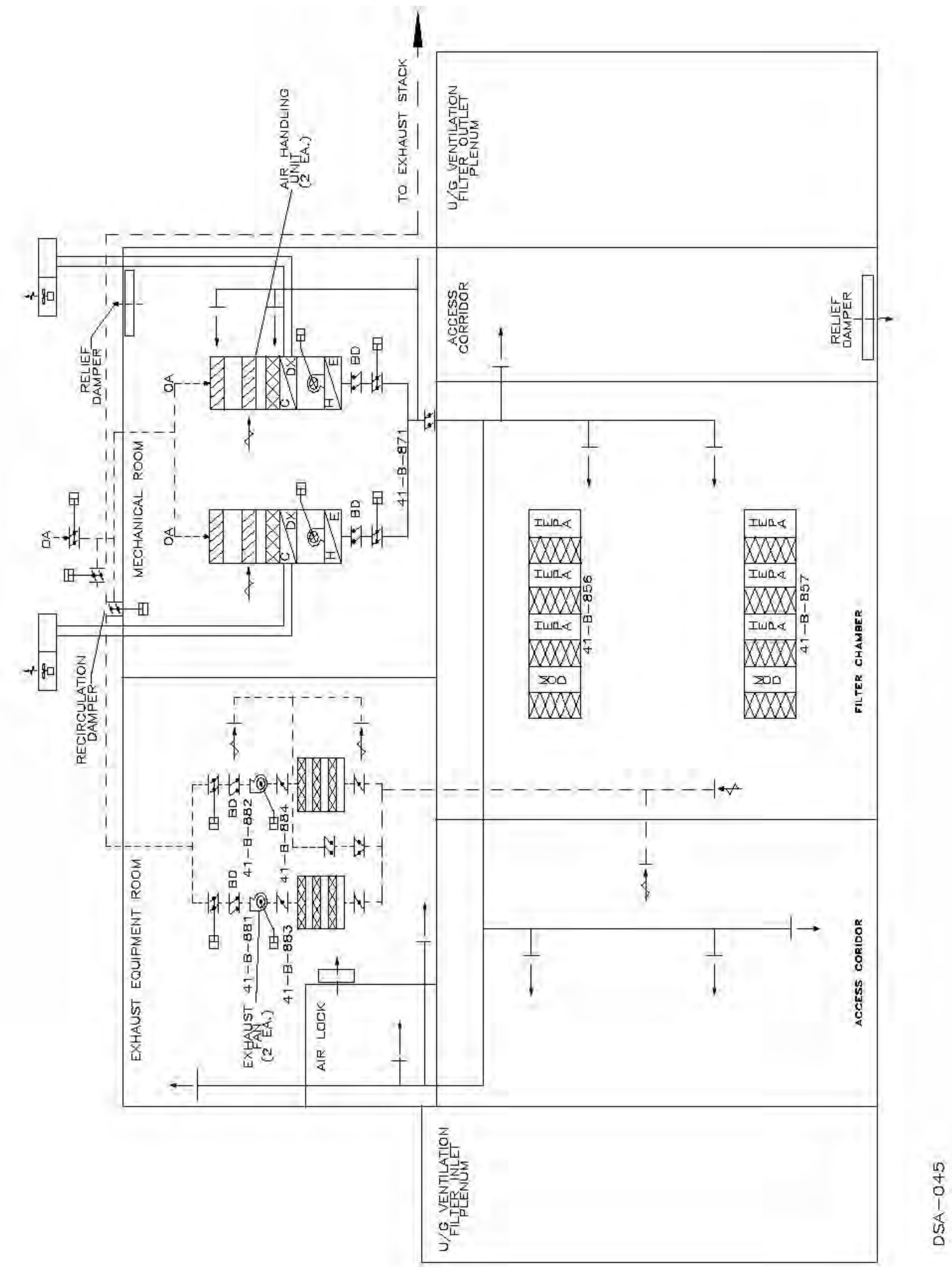


Figure 2.7-5. Exhaust Filter Building Heating, Ventilation, and Air Conditioning Flow Diagram

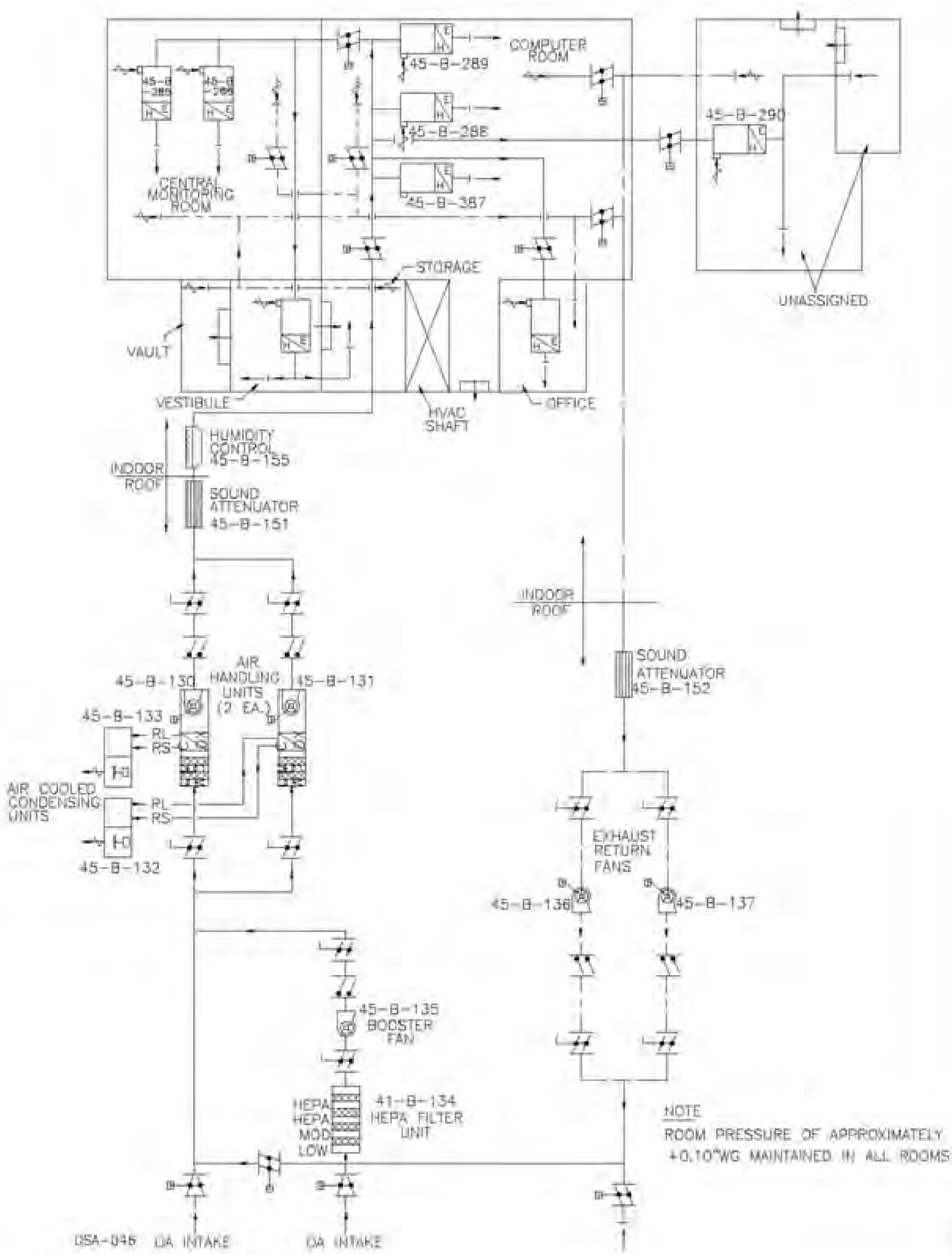


Figure 2.7-6. Support Building Central Monitoring Room HVAC Flow Diagram

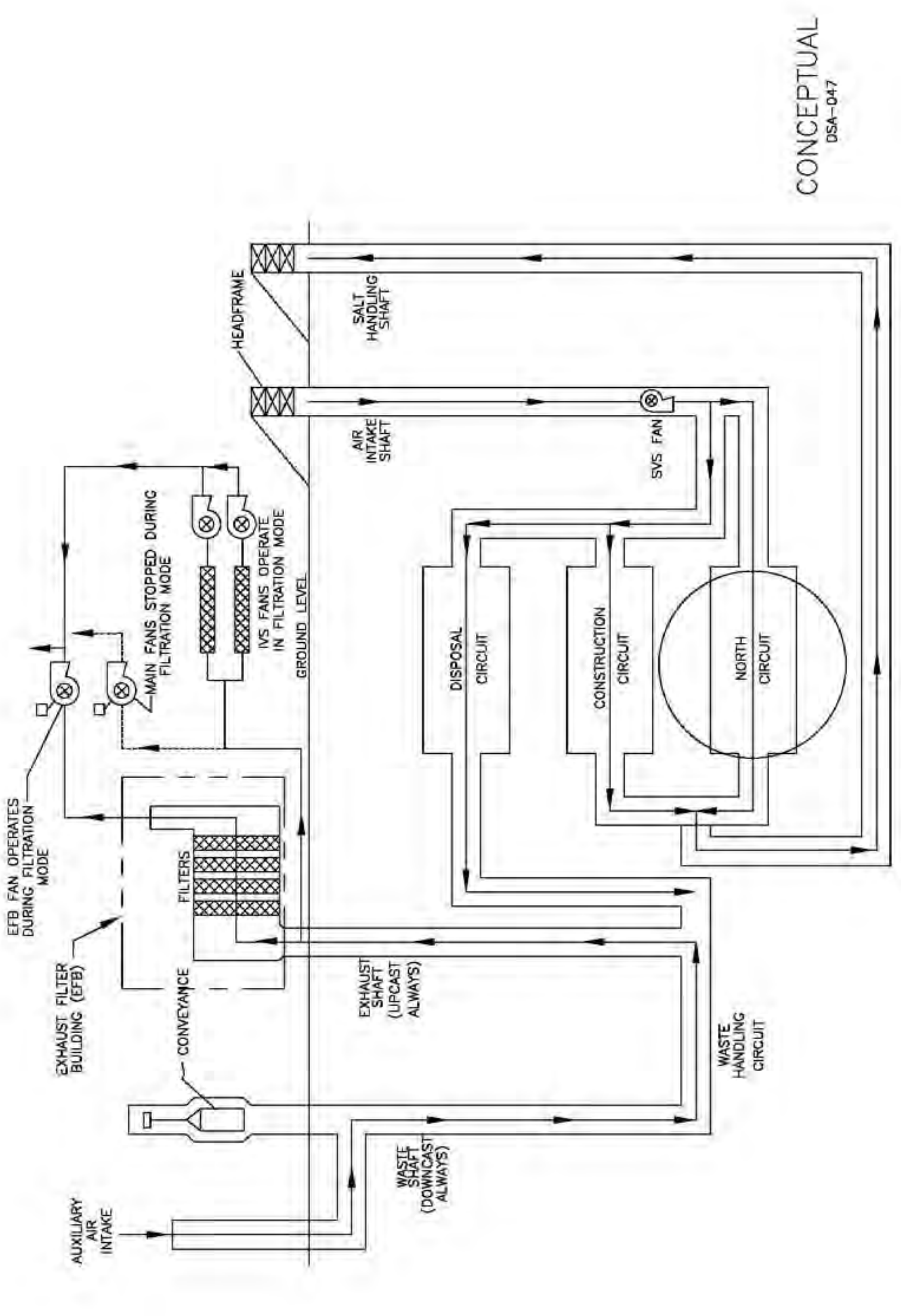


Figure 2.7-7. Underground Ventilation Airflow Diagram

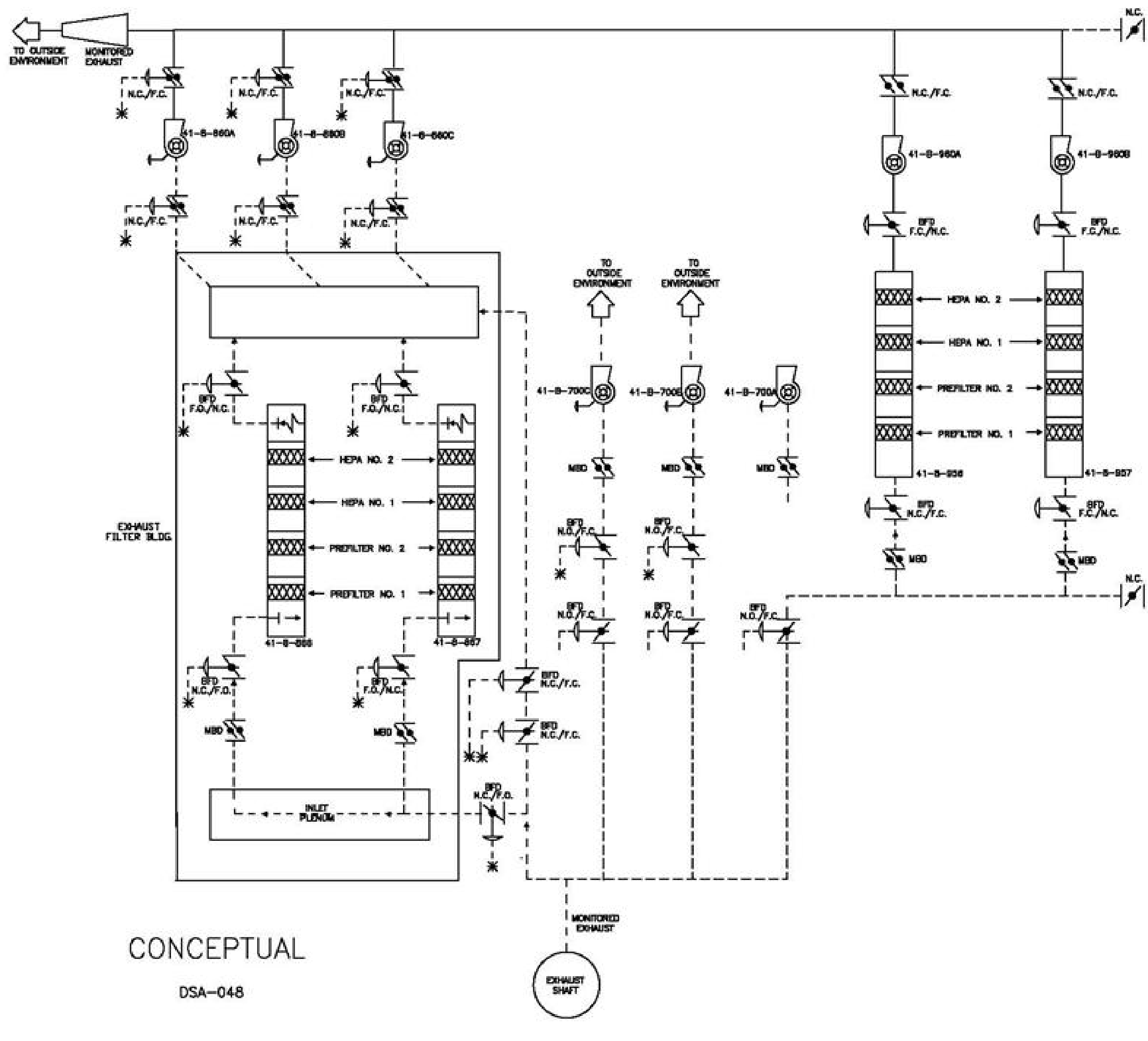


Figure 2.7-8. Main Fan and Exhaust Filter System Schematic

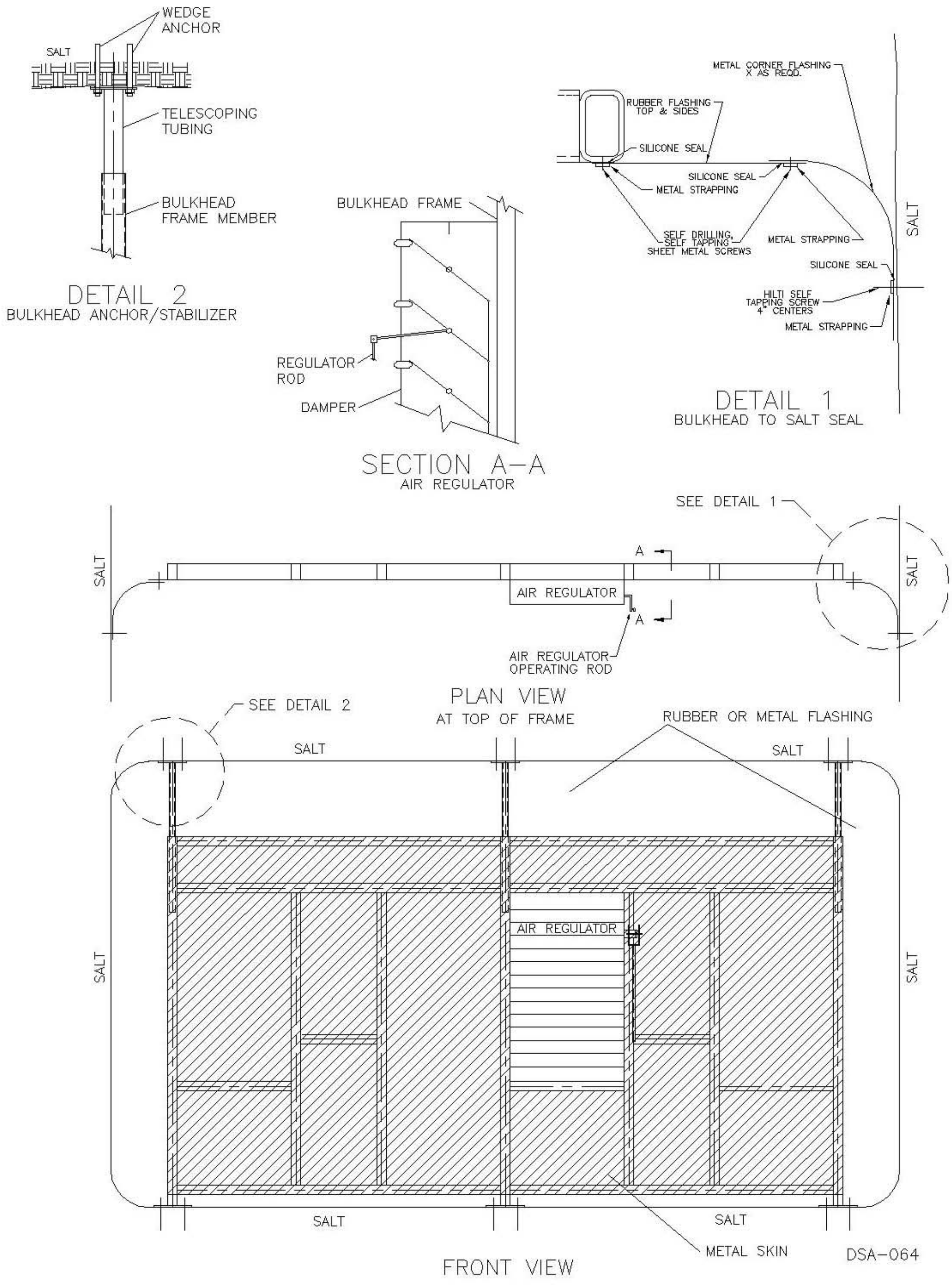


Figure 2.7-9. Typical Bulkhead Design and Components

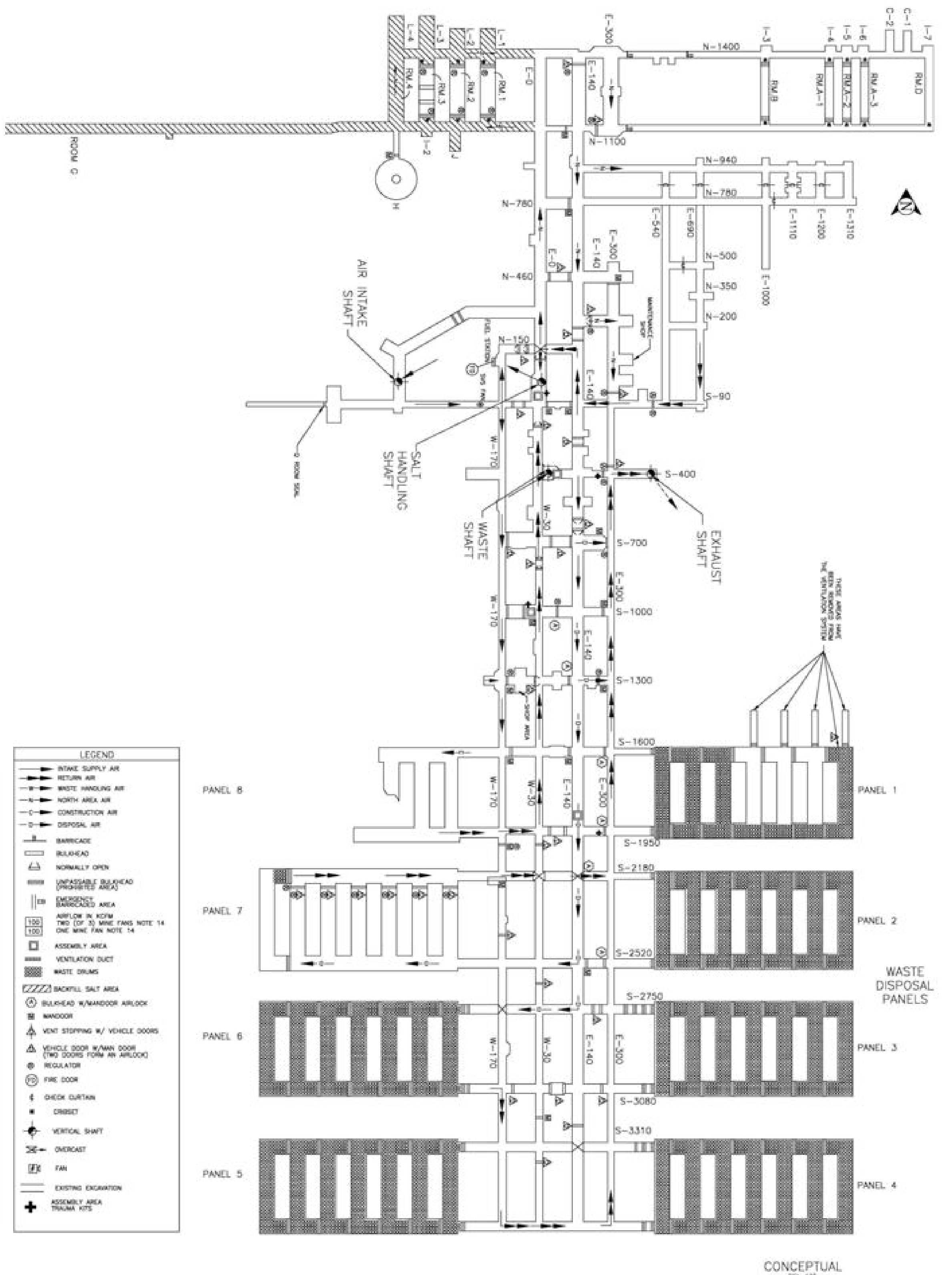


Figure 2.7-10. Underground Ventilation Airflow with Supplemental Ventilation System during Construction Mode

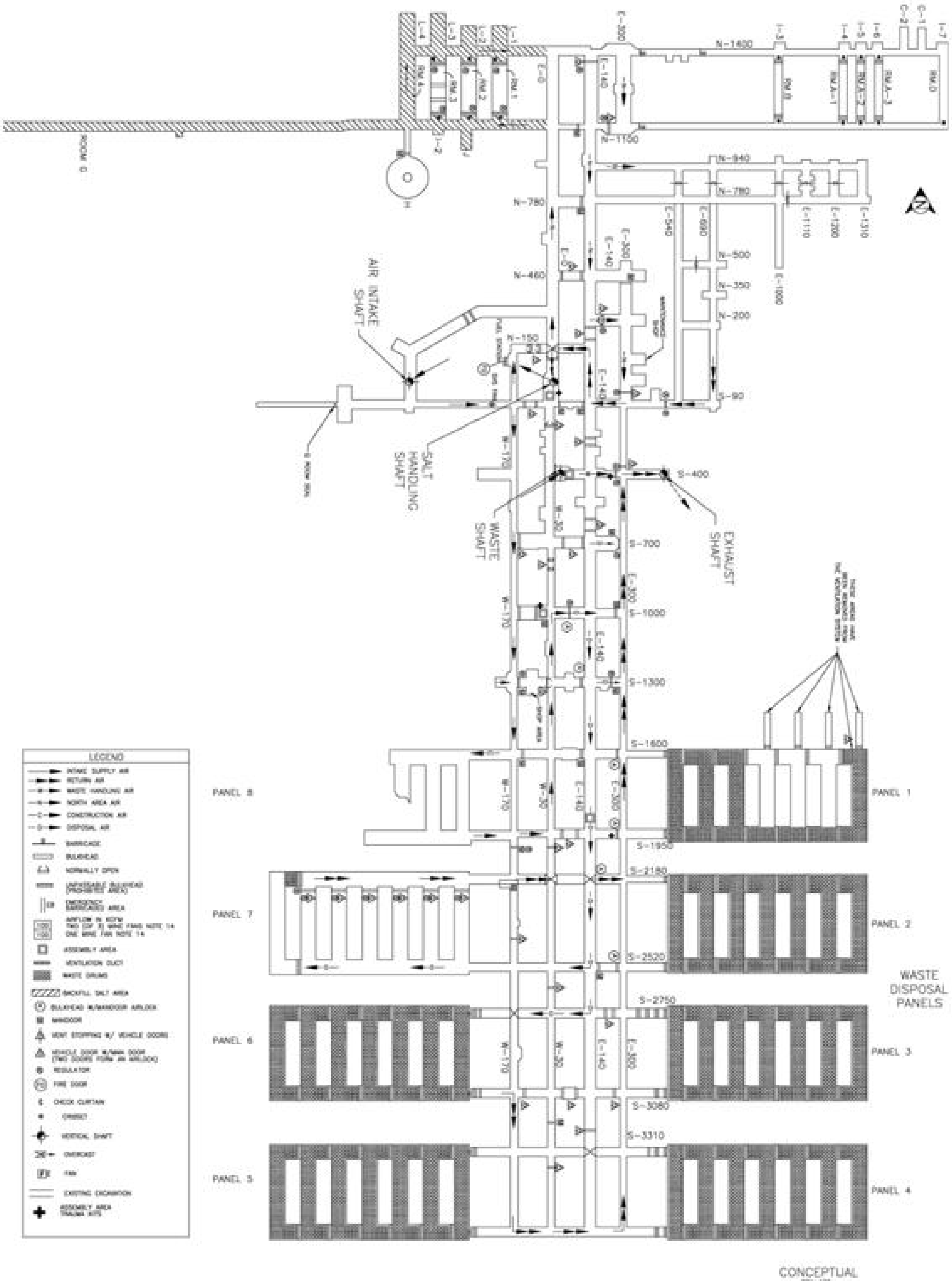


Figure 2.7-11. Underground Ventilation Airflow with Supplemental Ventilation System during Waste Handling Mode

2.8 SAFETY SUPPORT SYSTEMS

2.8.1 Radiation Monitoring System

The radiation monitoring system includes the plant vacuum system, Fixed Air Samplers (FASs), CAMs, Area Radiation Monitors, the Radiological Effluent Monitoring System (REMS), and portable radiation monitoring equipment.

The plant vacuum system provides a centrally located vacuum source that is used to draw air through filters that collect potentially radioactive particulates. The system supplies the vacuum source for CAMs and FASs located in the CH and RH Waste Handling areas of the WHB and Support Building. The vacuum system operating pumps and parameters are displayed in the CMR. The CAM and FAS units not connected to the plant vacuum system are equipped with their own vacuum pumps.

FASs are located in the WHB, the EFB, the Support Building, the TMF, the UG at S-400, the intake to the active panel and the exhaust of the active panel, and other places as deemed necessary based on site operations. These samplers provide an indication of airborne radioactivity. Some FASs are connected to the plant vacuum system and those that are not connected to the plant vacuum system have their own vacuum pumps. In the WHB, FASs are located at the TRUDOCKs, in Room 108, in the Hot Cell Complex Operating Gallery, in the RH Bay, and in the Transfer Cell Service Room. CAMs are installed at each operating station on the TRUDOCKS in the CH Bay and at the Payload Transfer Station in Room 108, and are in service during Waste Handling activities. CAMs are installed in the UG disposal area to sample along radiological area boundaries and the exhaust of active waste emplacement panels. The CAMs, when operating, collect and measure airborne particulates by pulling air through a filter in proximity to an alpha/beta detector. CAMs also provide real-time monitoring at Panel 6 and Panel 7, Room 7 isolation bulkheads that annunciate locally and communicate with the CMR.

CAMs that support RH Waste Handling Operations are located at the cask preparation station, in the CUR, in the Transfer Cell, and in the FCLR. The CAMs are positioned to detect airborne radioactive material at locations where the shipping container lids are removed or Waste Containers are removed from the shipping container. The CAMs at the cask preparation station and in the FCLR have an integrated gamma detector that functions as an Area Radiation Monitor. The integrated gamma detector alerts workers to changes in shielding. The integrated gamma detector in the FCLR alerts the operator should the telescoping port shield be improperly positioned or change position during transfer of an RH Waste Canister from the Transfer Cell to the RH Waste Cask. The CH and RH CAMs annunciate locally and in the CMR. An additional CAM has been added at Station B. One of the REMS skids has been dedicated to providing air for monitoring to this CAM.

The Area Radiation Monitor in the CUR is interlocked with the CUR shield door such that the CUR shield door cannot be opened upon a high radiation signal in the CUR. The Area Radiation Monitor also provides a local warning light, annunciation at the personnel access door to the CUR, and an alarm in the CMR if the personnel access door to the CUR is opened.

The REMS consists of effluent samplers installed on the WHB and UG exhaust. The REMS sampling equipment includes a pump, flow controller, sample holder, and delivery piping. The effluent sampler for the WHB exhaust is at Station C, which is located on the second floor of the WHB. Station C samples the WHB exhaust downstream of the HEPA filters associated with the RH and CH portion of the building. The effluent samples for the UVS exhaust are located upstream (Station A) and downstream (Station B) of the UVS HEPA filters. As noted above, one of the Station B skids has been dedicated to supporting the CAM by providing airflow samples.

Station A is located over the UG ventilation exhaust elbow at the surface and samples using probes that extend 21 feet below the elbow in the Exhaust Shaft. Station B samples from a point downstream from the UVS fans and HEPA filters. Station A contains three sampling skids, each splitting the sample and directing the air into three air samplers per skid. Station B contains two sampling skids. One Station B skid splits the sample and directs the air into three air samplers. The second Station B skid directs the sample to the CAM. The effluent samplers continuously collect particulate samples from the total volume of air being discharged for periodic confirmatory sampling requirements. The samplers consist of a sample delivery system, a filter holder, and a vacuum supply. Sample locations may have multiple filters to allow parallel sampling for outside agencies. The analysis data from effluent samplers are used for quantifying total airborne particulate radioactivity discharged. This is done to demonstrate compliance with the mandated regulatory requirements contained in “Environmental Standards for Management and Storage” (40 CFR 191, Subpart A) and “National Emission Standards for Hazardous Air Pollutants” (40 CFR 61), Subpart H, “National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities.” The counting equipment used to analyze FAS filters provides indication of releases at much lower levels than general area samples or CAMs.

Effluent sampler Station D is located in the UG in E-300 before the disposal exhaust joins the exhaust from other areas of the UG. In addition to the permanently installed equipment, portable CAMs and portable air samplers similar to those installed in Waste Handling areas are used at the WIPP. Portable samplers are used for sampling routine/non-routine operations, for emergency air sampling, or to temporarily replace inoperable equipment. The CAMs are calibrated periodically and after repairs, using standards that are traceable to the National Institute for Standards and Technology. The source and detector geometry during calibration are the same as the sample and detector geometry in actual use.

The radiation monitoring system is further discussed in the Radiation Monitoring System SDD (SDD RM00, *Radiation Monitoring (RM00) System Design Description (SDD)*).

2.8.2 Fire Protection System

The WIPP Fire Protection System is designed to ensure personnel safety, mission continuity, and property conservation. Building designs incorporate features for fire prevention. The plant design meets the improved risk level of protection defined in DOE Order 420.1C, and satisfies applicable sections of the National Fire Protection Association (NFPA) codes, DOE orders, and federal codes described in the *Fire Hazard Analysis for the Waste Isolation Pilot Plant* (FHA) (WIPP-023).

The WIPP Fire Protection System design incorporates the following features:

- Most buildings and their support structures are protected by fixed, automatic FSSs designed to the individual hazards of each area.
- Noncombustible construction, fireproof masonry construction, and fire-resistant materials are considered for use, whenever possible, in buildings and structures.
- Fire separations are installed where required because of different occupancies per the Uniform Building Code®.
- In multistory buildings, vertical openings are protected by enclosing stairways, elevators, pipeways, electrical penetrations, etc., to prevent fire from spreading to upper floors. The Waste Hoist Tower is an exception and has an open path from the Waste Hoist Tower to the bottom of the Waste Shaft to accommodate the hoist ropes.

- A combustible loading control program is in place to minimize the accumulation of combustibles in the WHB, the area between the Support Building and the WHB, the Waste Transport Path in the UG, and the active waste Disposal Room(s).
- WIPP is implementing an “Only Essential Combustibles” policy for the UG and a more detailed procedure with provisions for permits signed by the Fire Marshall and a Fire Protection Engineer (FPE) restricts and regulates combustibles in the UG.
- The area within the PPA security fence is either paved or graveled. A gravel road parallels the PPA perimeter security fence, which acts as a firebreak in the event of a wildland fire. As described in the *WIPP Fire Hazard Analysis*, Appendix A, WIPP is considered a “low” wildland fire risk. Therefore, this design feature (DF) is only credited as “defense-in-depth.”

The WHB and UG exhaust ventilation systems are designed to remove hot fire gases, toxic contaminants, explosive gases, and smoke. In the UG, automatic FSSs are installed on selected vehicles/equipment and in areas normally containing significant combustible material.

Adequate provisions for the safe exit of personnel are available for all potential fire occurrences, with evacuation alarm signals provided throughout occupied areas. Building evacuation plans help ensure the safe evacuation of building occupants during emergency conditions. UG evacuation is performed in accordance with the Underground Escape and Evacuation Plan. This plan identifies the evacuation routes, assembly areas, and self-contained self-rescuer caches. Additionally, firefighting support is available from the Hobbs and Carlsbad, New Mexico, fire departments.

The WIPP Fire Protection System, as described in the *Fire Protection System (FP00) System Design Description (SDD)* (SDD FP00), consists of four subsystems:

- Fire water supply and distribution system.
- Fire detection and alarm system.
- FSS.
- Radio fire alarm reporter system.

2.8.2.1 Fire Water Supply and Distribution System

The fire water supply and distribution system consists of two fire pumps and a pressure maintenance (jockey) pump located in the water pump house and a compound-loop yard distribution system. One fire pump is electric-motor driven and the other pump is diesel-engine driven. Both pumps are rated for 1,500 gallons per minute (gpm) at 125 psi. The system’s maximum design flow rate is to provide fire water at a rate of 1,500 gpm for two hours, for a total of 180,000 gallons. All major components of the fire water supply and distribution system are listed by Underwriters’ Laboratories Inc. and/or approved by Factory Mutual Engineering Corporation.

The fire water supply system receives its water supply from one onsite 180,000-gallon ground-level storage tank, which is part of the water distribution system.

Operation of the two fire pumps and the jockey pump is controlled by distribution-system pressure changes. The pumps are arranged for sequential operation. Under normal conditions, the jockey pump operates to maintain the designed system static pressure. Should there be a demand for fire water that exceeds the capacity of the jockey pump, the fire water demand will cause the system pressure to drop, which automatically starts the electric fire pump. If the jockey and electric fire pumps cannot maintain system pressure, the diesel pump automatically starts.

The yard compound-loop distribution system serves all areas of the site by supplying fire water to all facilities containing a sprinkler system and to the fire hydrants, located at approximately 300-foot intervals throughout the site. The system contains numerous sectionalizing and control valves that are locked open and visually checked monthly.

2.8.2.2 Fire Detection and Alarm System

The fire detection and alarm system consists of multiple systems, each using most or all of the following components:

- Heat sensing fire detectors.
- Smoke detectors.
- Sprinkler system water flow alarm devices.
- Manual fire alarm systems.
- Control panels.
- Audible and visual warning devices.

Each building has a separate alarm system reporting to the CMR. Selected buildings have an alarm system reporting to the CMR via the radio fire alarm reporter system. A complete description of the type of FSS and fire detection system provided at each of the WIPP surface structures and the UG is provided in the FHA (WIPP-023) and the Fire Protection System SDD (SDD FP00).

2.8.2.3 Fire Suppression System

The FSS consists of several different FSSs or equipment that services the surface buildings, facilities, and the UG areas. These may include any one or more of the following fire suppression capabilities:

- Automatic wet-pipe sprinkler system.
- Automatic dry and wet chemical extinguishing systems.
- Portable fire extinguishers.

The automatic wet-pipe sprinkler system is the primary FSS for the WIPP surface structures. Each building has a separate fire sprinkler system supplied from the fire water distribution system, except for the TMF and one other building which are supplied from neighboring building sprinkler systems.

Sprinkler systems are maintained full of pressurized water. When a fire occurs, the heat produced will cause one or more sprinkler heads in the area to actuate, causing water to flow. The sprinklers will continue to flow until manually shut off.

Each sprinkler system installed in a permanent building includes the following features:

- A main drain.
- Instrumentation.

- An alarm valve.
- A water flow detection device.
- A water motor gong.
- An isolation valve.
- A fire department connection (except the water pumphouse).
- Distribution piping with installed fusible sprinklers.
- Valving.
- An inspector’s test connection.

The availability of fire water at each sprinkler system is routinely checked as part of the inspection requirement for each system. Should the fire water distribution system become unavailable, adequate measures (e.g., not permitting any fire initiating activities at the affected buildings or implementing fire watches) are taken to provide a reduced risk of a large fire. The sprinkler systems are operable in the absence of electric power due to the diesel-driven fire pump. The sprinkler systems and the fire water supply and distribution system are not designed to withstand the effects of a DBE or DBT.

The WHB is protected by three independent sprinkler systems. The three sprinkler system risers are located in Room 108, in the RH Bay, and in the CH Bay. A water supply extension is installed between the Room 108 riser and the CH Bay riser can be used to supply either sprinkler system in the event one system loses its primary fire water supply. The WHB hose stations are disabled and not used.

Selected diesel-powered equipment in the UG is protected with dry chemical automatic FSSs. The automatic FSS is activated on detection of high temperatures associated with the fire. The system operates by directing a flow of fire suppressant into the engine compartment and affected fire hazards while simultaneously shutting down the fuel flow and the engine. Diesel powered equipment in the UG with engines in excess of 150 horsepower or having a turbocharger installed is protected with an automatic FSS discharging a wet chemical FSS in addition to an automatic FSS discharging dry chemical. Areas of combustible concentrations in the UG are protected by installed automatic dry chemical systems or aerosol based FSSs such as StatX which is Underwriters Laboratories (UL) listed for the application. Other types of automatic FSSs may be employed. The emphasis in UG fire suppression is to address rapidly growing fires with automatic FSSs to address fire in the incipient stage. Other FSSs, away from waste disposal areas, are designed to provide incipient fire suppression to assist in protecting life safety while at the same time reducing smoke emission.

2.8.2.4 Radio Fire Alarm Reporter System

The radio fire alarm reporter system provides fire alarm and system trouble annunciations in the CMR for structures not connected to the CMS local processing units. This system consists of radio transmitters that transmit alarm and trouble signals via a Factory Mutual Engineering Corporation signal to a central base station/receiver.

2.8.2.5 Fire Protection System Design, Installation, Testing, and Maintenance

The following NFPA standards apply at the WIPP:

- The fire water supply and distribution system is designed, installed, tested, and maintained in accordance with the following:

  - *Standard for the Installation of Stationary Pumps for Fire Protection* (NFPA 20).
  - *Standard for the Installation of Private Fire Service Mains and Their Appurtenances* (NFPA 24).
  - *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* (NFPA 25).
- The automatic wet-pipe sprinkler systems are designed, installed, tested, and maintained in accordance with the following:
  - *Standard for the Installation of Sprinkler Systems* (NFPA 13).
  - *Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems* (NFPA 25).
- The chemical FSSs are designed, installed, tested, and maintained in accordance with the following:
  - *Standard for Dry Chemical Extinguishing Systems* (NFPA 17).
  - *Standard for Wet Chemical Extinguishing Systems* (NFPA 17A).
  - *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities* (NFPA 122).
- The fire detection and alarm systems are designed, installed, tested, and maintained in accordance with the following:
  - *National Electrical Code* (NFPA 70).
  - *National Fire Alarm Code* (NFPA 72).
- The radio fire alarm reporter system is designed, installed, tested, and maintained in accordance with the following:
  - *National Fire Alarm Code* (NFPA 72).
  - *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems* (NFPA 1221).

All new systems installed for UG equipment and fixed areas of combustible material will follow the appropriate requirements of applicable NFPA codes to the extent applicable. The periodic testing and maintenance of these systems will be captured in procedures addressing NFPA required testing, maintenance, and frequency of activities.

2.9 UTILITY DISTRIBUTION SYSTEMS

2.9.1 Electrical System

The WIPP electrical system is designed to provide normal and backup power, grounding for electrically energized equipment and other plant structures, lightning protection for the plant, and illumination for the WIPP surface and UG.

The WIPP has standard industrial electrical distribution equipment including the following:

- Medium-voltage switchgear and buses.
- Medium-voltage to low-voltage step-down unit substations.
- Motor control centers.
- Small distribution transformers and panels.
- Relay and protection circuitry.
- Station batteries and associated synchronous inverters.
- Two diesel generators.

The electrical system is designed to supply alternating current power at the following approximate bus voltages:

- 13.8-kilovolt (kV), three-phase, three-wire, 60-hertz power supply for the main plant substation, UG switching stations, and surface and UG unit substation transformers.
- 4.16 kV, three-phase, three-wire, 60-hertz power supply for the main exhaust-fan drive motors.
- 2.4 kV, three-phase, 60-hertz power supply for the drive motor for the motor-generator set, which provides the backup supply for the Salt Handling Shaft Hoist drive motor.
- 480/277-volt, three-phase, 60-hertz power supply for motor control centers, the Air Intake Shaft Hoist drive motor, solid-state direct current converter systems for the Salt Handling Shaft Hoist and Waste Hoist, UG filtration fans, lighting, and power distribution transformers.
- 120/208-volt, three-phase, 60-hertz power supply for lighting, instrumentation, communications, control systems, and small motor-driven equipment.
- 120/208-volt, three-phase, 60-hertz UPS for control and instrumentation, which must be continuously energized under all Plant Operating Modes.

2.9.1.1 Normal Power Source

The WIPP site normal power is from a public utility company, which supplies electrical power from their 115-kV Potash/Kerrmac Junction transmission line from the north and Whitten/Jal substation line from the south. The north line is approximately 9 miles long, while the south line is approximately 19 miles long. The Potash Junction and Whitten substations each have two feeders from multiple generating stations, and loss of one generating source does not interrupt power to the WIPP site.

The utility substation at the WIPP site is located east of the PPA. Area substations are located at the various surface facilities. Underground conduits, cable duct banks, and buried cables connect the plant substation with the area substations.

2.9.1.2 Backup Power Source

In case of a loss of utility power, backup power to selected loads can be supplied by either of the two onsite 1,100-kilowatt diesel generators. The generators provide 480 volts of alternating current power to the loadings listed in Table 2.9-1. Each of the diesel generators can furnish power for preselected loads, to operate the Air Intake Shaft Conveyance for UG personnel evacuation, and other selected backup loads in accordance with procedures in the WP 04-ED series of facility operations procedures. Generators are conservatively estimated to be running at load within 60 minutes. The onsite total fuel storage capacity is sufficient for the operation of one diesel generator at full load for one day, and additional fuel supplies are readily available within a few hours by tank truck, allowing online refueling and continued operation.

Facility Operations personnel start the diesel generators. The diesel generators can be started from the control panel on each diesel generator or from the CMR. Monitoring of the diesel generators and associated breakers is possible at the CMR, thus providing the ability to energize selected loads from the backup power source in sequence and without exceeding generator capacity.

Table 2.9-1. Diesel Generator Loadings

Loadings
UPS, CMS, WHB, CAMs
CMR HVAC system utilities
Communications systems
Air Intake Shaft Conveyance(if necessary for UG evacuation)
WHB lighting
WHB cranes
WHB vacuum pumps
Main air compressors
UG exhaust fans
WHB fans

2.9.1.3 Uninterruptible Power Supply

The central UPS, located in the Support Building, provides transient free, reliable 120/208 volts of alternating current power to the essential loads, listed in Table 2.9-2. This ensures continuous power to the radiation detection system for airborne contamination and area radiation monitoring, local processing units, computer room, and CMR even during the interval between the loss of offsite power and initiation of backup diesel generator power. Additional UPSs provide transient free power to strategically located local processing units for the radiation monitoring system on the surface, in selected areas in the Exhaust Shaft, and in UG passages and waste disposal areas. In case of loss of alternating current power input to the UPSs, the dedicated batteries can supply power to a fully loaded UPS for 30 minutes.

Table 2.9-2. Uninterruptible Power Supply Loads

Load on Central UPS
Radiological Monitoring System (Area Radiation Monitor and CAM)
CMS equipment in the Support Building and WHB
Communication system in Support Building and WHB
Seismic trip in WHB
Network computers and equipment in the Support Building computer room

Loads on Individual UPS Units
CMS equipment in facilities other than Support Building and WHB
Selected surface and UG radiological monitoring units
Emergency Operations Center, Safety Building, Guard and Security Building
Safety communication and alarm system in facilities other than Support Building and WHB

2.9.1.4 Lightning Protection and Grounding

The WIPP lightning protection system uses the plant ground system and consists of lightning arresters located at select substations and a lightning dissipation system. The lightning dissipation system uses arrays that encircle the WIPP fenced area and umbrella arrays, which are mounted on top of select facilities and hoist head frames. Dissipation arrays are installed over the hoist head frames and the WHB. Hemisphere arrays are installed over the EFB and also over the Salt Handling Shaft and Air Intake Shaft head frames. A conical array is installed over the Waste Hoist Tower. Roof arrays are located along the outer rim of the WHB and between supports on the site-perimeter lamp poles. The arrays between site-perimeter lamp poles provide protection to the CH and RH shipping containers in the parking area. The arrays associated with the WHB and Waste Hoist Tower not only protect personnel but also the Waste Containers from lightning strikes.

The WIPP grounding system uses a resistive grounded electrical system and consists of grounding resistors, a direct buried surface site ground grid, bare copper UG facility ground, facility ground rings, facility ground conductors, ground buses, equipment grounding conductors, and bonding, and grounding electrodes. The grounding associated with the utility switchyard is separate from the WIPP site plant grounding. The lightning protection and grounding systems are discussed in SDD ED00, *Electrical System (ED00) System Design Description (SDD).*

2.9.1.5 Safety Considerations and Controls

Failure of the normal distribution system or any of its components will not affect safe conditions of the WIPP facilities. Site utilities are not required to place the site in a safe configuration. Personnel may suspend Waste Handling Operations and leave the area without site utilities.

2.9.2 Compressed Air System

The compressed air system is diverse in the types and sizes of compressors used and redundancy is provided for the main plant air compressors, Salt Handling Shaft Hoist house, and the UG. All are electrically driven except for the diesel-powered backup compressor in the UG.

Air dryers are provided for both the plant air system and the instrument air system. Instrument air is supplied to selected doors in the WHB, used to operate dampers and control systems for the UVS, and supplied to HVAC systems in the EFB.

2.9.3 Plant Monitoring and Communications Systems

The plant monitoring and communications systems include onsite and plant-to-offsite coverage and are designed to provide immediate instructions to ensure personnel safety, facility safety and security, and efficient operations under normal and emergency conditions. Plant monitoring and communications systems include the following:

- CMS.
- Plant communications:
  - Touch-tone phones and/ or cell phones.
  - Mine pager phones.
  - Plant public address system including alarms and the site notification system.
  - UG evacuation signal system.
  - Radio.

2.9.3.1 Central Monitoring System

The CMS collects and monitors real-time site data, automatically and manually, during normal and emergency conditions. The UG and surface data monitored by the CMS are gathered, processed, stored, logged, and displayed. The data are collected continuously from approximately 1,500 remote sensors.

The CMS is a computer-based monitoring and control system. It is used for real-time site data acquisition, display, storage, alarm, and logging, and for the control of site components. The CMS monitors selected components from the following systems:

- Radiation monitoring equipment and effluent sampling stations.
- Electrical power distribution status, including backup diesel operation.
- Fire detection and alarm system.
- Ventilation system, including UG exhaust fan, mining damper position, fan status, flow measurement, and filter differential pressure.
- Meteorological data, including wind speed and direction, temperature, and barometric pressure.
- Facility systems, including air compressors, vacuum pumps, and water storage tank levels.

The CMS has five operator workstations, which display alarms, status, trends, graphics, and interactive operations. There are two operator workstations and an engineer's workstation located in the CMR, two operator workstations in the computer room, and a CMS backup operator workstation located in the security operations center. The CMS electronic data storage devices are in the computer room adjacent to the CMR. The CMS sources of backup electrical power include a UPS and the diesel generators.

2.9.3.2 Plant Communications

The phone system is a private automatic branch exchange network providing conventional onsite and offsite telephone services.

The mine pager phone system is an independent, hard-wired, battery-operated system for communications throughout the UG and between the surface and the UG. Mine pager phones are located throughout the UG and in surface structures to support daily operations and emergencies.

The plant public address and alarm systems provide for the initiation of surface and UG evacuation alarms and public address announcements from the CMR and local stations. The public address system master control console is located in the CMR, with paging stations in the following locations:

- Support Building.
- WHB.
- Water Pump House.
- Guard and Security Building.
- Salt Shaft Hoist House and Headframe.
- EFB.
- Safety Building.
- Engineering Building.
- Warehouse.
- Shops.
- UG.

The UG evacuation signal is separate from the public address system and includes strobe lights. A UG evacuation signal is initiated automatically by a UG fire alarm signal via the CMS, manually by the CMR operator, or from pushbuttons in the Salt Handling Shaft Hoist House and Waste Hoist Control Room.

Radio includes two-way and paging onsite and offsite radio systems with base stations in the CMR and the security operations center.

The plant communication systems are not designed to withstand the effects of a DBE or DBT.

2.10 AUXILIARY SYSTEMS AND SUPPORT FACILITIES

2.10.1 Water Distribution System

The water distribution system is designed to receive water from a commercial water department, provide storage for fire and domestic water, chlorinate and store domestic water, and distribute domestic water. The Water Pump House contains the fire pumps, the domestic water pumps, and the water chlorination equipment.

2.10.2 Sewage Treatment System

The sewage treatment facility is a zero-discharge facility consisting of two primary settling ponds, two polishing ponds, and three evaporation basins. The entire facility is lined with synthetic liners and is designed to dispose of domestic sewage as well as site-generated brine waters from observation wells and from dewatering of site shafts.

2.10.3 Meteorological Tower

The WIPP site meteorological monitoring tower is located approximately 1,970 feet northeast of the WHB. Instrumentation on the tower measures and records wind speed, wind direction, and temperature at elevations of 2, 10, and 50 meters. The data are displayed in the CMR and in the Emergency Operations Center. The meteorological data are used for development of the air dispersion coefficient used in the consequence analysis discussed in Chapter 3.0, “Hazard and Accident Analysis, and Control Selection.”

2.10.4 Central Monitoring Room

The CMR provides a continuously manned central location furnished with CMS operator and engineer stations; plant communications system dial phones, mine pager phones, the plant public address and alarms system master control console; a two-way radio base station; a satellite weather monitor; a commercial television station weather monitor; and space, communications, and furnishings for the Operations Assistance Team.

The primary functions of the CMR are as follows: monitoring parameters associated with required plant operating conditions and weather conditions; providing a central communications center; reporting of occurrences by all employees; providing site conditions to the Emergency Operations Center; and providing accommodation for an assembly of advisors to monitor an abnormal condition and provide operational assistance.

The CMR includes the operator stations to control selected site components such as UG ventilation fans, bulkhead doors and dampers, backup diesel generator operation, and site power distribution breaker operation.

The CMS is a supervisory control and data acquisition system consisting of a mix of functional units communicating on a redundant network throughout the facility on the surface and in the UG. The network is made up of optical fiber and the associated fiber distribution units, switches, etc. The CMS is used for real-time site data acquisition, display, storage, alarming and for the control of site components. The CMS monitors process, environmental, electrical, mechanical, radiation, and fire protection systems and provides manual and automatic control of UG ventilation, backup power, UG evacuation alarm, and electrical distribution. The CMS consists of local processing units, operator and engineer workstations server PCs, printers, and UPSs.

2.11 REFERENCES

10 CFR 71, “Packaging and Transportation of Radioactive Material,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

10 CFR 71, “Packaging and Transportation of Radioactive Material,” Section 71.17, “General License: NRC-Approved Package,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

10 CFR 71, “Packaging and Transportation of Radioactive Material,” Section 71.63, “Special Requirement for Plutonium Shipments,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

10 CFR 830, “Nuclear Safety Management,” Section 830.203, “Unreviewed Safety Question Process,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

10 CFR 835, “Occupational Radiation Protection,” Appendix D, “Surface Contamination Values,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

30 CFR 57, “Safety and Health Standards – Underground Metal and Nonmetal Mines,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

30 CFR 57, “Safety and Health Standards – Underground Metal and Nonmetal Mines,” Subpart B, “Ground Control,” *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

30 CFR 57, "Safety and Health Standards – Underground Metal and Nonmetal Mines," Subpart R, "Personnel Hoisting," *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Wastes," Subpart A, "Environmental Standards for Management and Storage," *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

40 CFR 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," Section 191.14, "Assurance Requirements," Paragraph (d), *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

40 CFR 194, "Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with The 40 CFR Part 191 Disposal Regulations," Section 194.44, "Engineered Barriers," *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

49 CFR 178.350, "Specifications for Packagings," Section 178.350, "Specification 7A; General Packaging, Type A," *Code of Federal Regulations*. U.S. Government Printing Office, Washington, DC.

19.6.5 NMAC, "New Mexico Mine Safety Code for All Mines Including Open-Cut and Open-Pit," *New Mexico Administrative Code*, as amended.

Administrative Order Under the New Mexico Hazardous Waste Act 74-4-13, February 28, 2014.

ANSI/ASME N510-1989, *Testing of Nuclear Air-Treatment Systems,* American National Standards Institute, New York, NY.

CH-TRAMPAC, *Contact-Handled Transuranic Waste Authorized Methods for Payload Control* (current revision), U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE/CBFO-11-3470, *A Management Proposal for Salt Disposal Investigations with a Field Scale Heater Test at WIPP*, Revision 0, June 2011, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM.

DOE/EIS-0026-S-2, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, September 1997, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM.

DOE Guide 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide,* March 28, 2000, U.S. Department of Energy, Washington, DC.

DOE Guide 420.1-1A, *Nonreactor Nuclear Safety Design Criteria for use with DOE O 420.1C, Facility Safety*, December 4, 2012, U.S. Department of Energy, Washington, DC.

DOE Guide 424.1-1B, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*, April 8, 2010, U.S. Department of Energy, Washington, DC.

DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*, November 2003, U.S. Department of Energy, Washington, DC.

DOE/NTP 96-1204, *National TRU Waste Management Plan*, Revision 3, July 2002, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE Order 420.1C, Change 1, *Facility Safety*, February 27, 2015, U.S. Department of Energy, Washington, DC.

DOE Order 430.1B, Change 2, *Real Property Asset Management*, April 25, 2011, U.S. Department of Energy, Washington, DC.

DOE Order 458.1, Change 2, 2011, *Radiation Protection of the Public and the Environment*, June 6, 2011, U.S. Department of Energy, Washington, DC.

DOE Order 6430, *General Design Criteria Manual for Department of Energy Facilities*, Draft (superseded), June 10, 1981, U.S. Department of Energy, Washington, DC.

DOE-STD-1066-99, *Fire Protection Design Criteria*, July 1999, U.S. Department of Energy, Washington, DC.

DOE/WIPP 02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (current revision), U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE/WIPP 02-3212, *Ground Control Annual Plan for the Waste Isolation Pilot Plant*, Revision 6, April 2008, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE/WIPP 11-3177, *Geotechnical Analysis Report for July 2009–June 2010*, U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

DOE/WIPP 86-010, *Waste Isolation Pilot Plant Design Validation Final Report*, October 1986, U.S. Department of Energy, Washington, DC.

ECO 11611, *Evaluation for Hot Cell Structural Degradation*, Engineering Change Order 11611, August 24, 2006, Washington TRU Solutions, LLC, Carlsbad, NM.

ECO 11676, *13-Ton CH Forklift Fire Evaluation*, Engineering Change Order 11676, November 2006, Washington TRU Solutions, LLC, Carlsbad, NM, Carlsbad, NM.

Golder, Personal Communication by Letter from Golder Associates Inc. to Nuclear Waste Partnership LLC, "Early Time Generation of Methane and Hydrogen in Filled Panel at the WIPP," November 30, 2006.

HWFP, *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*, NM4890139088-TSDF (current revision), New Mexico Environment Department, Santa Fe, NM.

Memorandum of Understanding between the U.S. Department of Energy (DOE) and the Mine Safety and Health Administration, U.S. Department of Labor, Formalizing a Working Relationship between DOE and MSHA. October 7, 2014.

New Mexico State Mining Law 69-8-16.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2007 Edition, National Fire Protection Association, Quincy, MA.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 2002 Edition, National Fire Protection Association, Quincy, MA.

NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*, 2002 Edition, National Fire Protection Association, Quincy, MA.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2007 Edition, National Fire Protection Association, Quincy, MA.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2007 Edition, National Fire Protection Association, Quincy, MA.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2008 Edition, National Fire Protection Association, Quincy, MA.

NFPA 70®, *National Electrical Code®*, 2008 Edition, National Fire Protection Association, Quincy, MA.

NFPA 72®, *National Fire Alarm Code®*, 2007 Edition, National Fire Protection Association, Quincy, MA.

NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*, 2015 Edition, National Fire Protection Association, Quincy, MA.

NFPA 220, *Standard on Types of Building Construction*, 2006 Edition, National Fire Protection Association, Quincy, MA.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2007 Edition, National Fire Protection Association, Quincy, MA.

NRC, 2010, *10-160B Certificate of Compliance*, Docket No. 71-9204 (current revision), U.S. Nuclear Regulatory Commission, Washington, DC.

NRC, 2011, *RH-TRU 72-B Certificate of Compliance*, Docket No. 71-9212 (current revision), U.S. Nuclear Regulatory Commission, Washington, DC.

NS-05-001, 2005, *WIPP Contact Handled (CH) Documented Safety Analysis (DSA) Revision 10 Source Term, Dose Consequence and Supporting Information*, March 2005, Washington TRU Solutions, LLC, Carlsbad, NM.

Public Law 102-579, et seq., 1992 (1996), *Waste Isolation Pilot Plant Land Withdrawal Act of 1992*, October 30, 1992 (as amended by Public Law 104-201, September 23, 1996).

SDD CF00-GC00, *Plant Buildings, Facilities, and Miscellaneous Equipment System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD ED00, *Electrical System (ED00) System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD FP00, *Fire Protection System (FP00) System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD GPDD, *General Plant Design Description (GPDD) System Design Description (SDD)*, (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD HV00, *Heating, Ventilation and Air Conditioning System System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD RM00, *Radiation Monitoring (RM00) System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD UH00, *Underground Hoisting System Design Description* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

SDD WH00, *Waste Handling System (WH00) System Design Description (SDD)* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

Waste Isolation Pilot Plant Recovery Plan (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

WIPP-023, *Fire Hazard Analysis for the Waste Isolation Pilot Plant* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

WP 04-ED, *WIPP Electrical Distribution Surface Series of Technical Procedures* (current revisions), Nuclear Waste Partnership LLC, Carlsbad, NM.

WP 09-CN3005, *Graded Approach to Application of QA Controls*, Management Control Procedure (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

WP 12-5, *Waste Isolation Pilot Plant Radiation Safety Manual* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

WP 13-1, *Nuclear Waste Partnership LLC Quality Assurance Program Description* (current revision), Nuclear Waste Partnership LLC, Carlsbad, NM.

WTS, Personal Communication by Letter from Washington TRU Solutions, LLC, “Estimation of Hydrogen Generation Rates from Radiolysis in WIPP Panels,” July 2006.

This page intentionally left blank