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CHAPTER C

WASTE ANALYSIS PLAN

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WASTE ANALYSIS PLAN
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CHAPTER C
WASTE ANALYSIS PLAN

Introduction

This waste analysis plan (WAP) has been prepared for disposal activities to be conducted at the Waste Isolation Pilot Plant (WIPP) facility to meet requirements set forth in Title 20 of the New Mexico Administrative Code, Chapter 4, Part I (20 NMAC 4.1), Subpart V, §264.13. Guidance in the most recent U.S. Environmental Protection Agency (EPA) manual on waste analysis has been incorporated into the preparation of this WAP (EPA, 1994). Accordingly, this chapter includes a facility description; information on the waste to be managed; a discussion of parameters, rationale, and test methods; details of planned waste sampling and analysis; a description of the waste shipment screening and verification process; and a description of the quality assurance (QA)/quality control (QC) program.

When using this WAP, the term "WIPP," when used in the context of requiring a duty or responsibility, means the U.S. Department of Energy (DOE) as the facility owner and operator and the Westinghouse Waste Isolation Division (WID) as the co-operator, as set forth in the WIPP Resource Conservation and Recovery Act (RCRA) Permit Application certification (Chapter M of this permit application). This WAP establishes waste characterization requirements for DOE waste generators at other sites. Waste characterization requirements are implemented in lower-tier documents, including the Transuranic Waste Characterization Quality Assurance Program Plan (QAPP)[1] and quality assurance project plans (QAPjP) for individual generator sites and analytical laboratories.

The mission of the WIPP Project, as established by the U.S. Congress in 1979 (Public Law 96-164), is to provide a research and development facility to demonstrate the safe disposal of transuranic (TRU) mixed waste generated as a result of United States defense activities. This permit application and this WAP are for the management of TRU mixed waste to be disposed of at the WIPP facility.

TRU mixed waste contains both TRU radioactive and hazardous components, as defined in 20 NMAC 4.1, Subpart VIII, §268.35(d), and in the Federal Facility Compliance Act, Public Law 102- 386, Title 1, §3021(d). It is designated and separately packaged as either contact-handled (CH) or remote-handled (RH), based on the radiological dose rate at the surface of the waste

[1]The Transuranic Waste Characterization Quality Assurance Program Plan, DOE/CAO 94-1010 (April, 1995), utilizes a performance-based approach to allow individual sites to have the flexibility to employ analytical and examination methods that meet the quality assurance objectives specified in this WAP. The DOE will conduct waste characterization activities at each generator site planning to ship waste to the WIPP facility to obtain the requisite data. TRU mixed waste characterization described in the QAPP includes: 1) radiography, 2) headspace gas sampling and analysis, 3) solidified waste sampling and analysis, and 4) visual examination.

container. Both CH TRU and RH TRU mixed wastes will be received and disposed of at the WIPP facility.

The hazardous components of the TRU mixed waste to be managed at the WIPP facility are designated in the WIPP facility's RCRA Part A permit application. This WAP describes the measures that will be taken to assure that the wastes received at the WIPP facility are within the scope of the RCRA Part A permit application as established by 20 NMAC 4.1, Subpart V, §264.13, and that they comply with unit-specific requirements of 20 NMAC 4.1, Subpart V, Miscellaneous Units.

Both CH TRU and RH TRU mixed waste at the WIPP facility will be managed using containers that meet or exceed the requirements of the U.S. Department of Transportation (DOT) for Type A containers. The use of the term "container" when referring to waste characterization activities refers to a drum, canister, or Standard Waste Box (SWB) unit. Section D-1a(1) provides details regarding the design and use of these waste containers.

The WIPP facility requires TRU waste characterization programs to adhere to the requirements specified in this WAP, and enumerated in the WIPP Waste Acceptance Criteria (WAC), and the Transuranic Waste Characterization QAPP (DOE, 1995a). All waste characterization activities discussed in Section C-4 will be carried out at generator sites in accordance with this WAP. WIPP management will audit site waste characterization programs and activities as described in Section C-5. This WAP describes the relationship of the waste characterization data and information to the regulatory requirements of 20 NMAC 4.1. The waste characterization program for wastes to be received at the WIPP facility for disposal has been designed to utilize sampling and analysis. In addition, acceptable knowledge of waste generation processes may be used for those wastes for which no practical characterization techniques exist (such as debris waste).

Some TRU mixed waste is retrievably stored at the DOE generator sites. Additional waste will be generated and packaged into containers at these sites in the future. TRU mixed waste will be retrieved from storage areas at a DOE site. Retrievably stored waste is defined as waste generated after 1970 and before implementation of the QAPP characterization requirements. Newly generated waste is defined as waste generated after implementation of QAPP characterization requirements. Stored TRU waste will be characterized on an ongoing basis, as the waste is retrieved. Newly generated TRU waste will be characterized as it is generated. Waste characterization requirements for stored and newly generated wastes differ due to the QAPP requirements, as discussed in Sections C-3a and C-3b.

Characterization requirements for individual containers of waste are specified on a waste stream basis. A waste stream is defined as waste material generated from a single process or from an activity that is similar in material, physical form, isotopic make-up, and hazardous constituents. Waste streams are grouped by Waste Matrix Code Groups related to the physical and chemical properties of the waste. Generator/storage sites must use the characterization techniques described in this WAP to assign appropriate Waste Matrix Code Groups for WIPP disposal. The

Waste Matrix Code Groups are solidified inorganics, solidified organics, salt waste, soils, lead/cadmium metal, inorganic nonmetal waste, combustible waste, graphite, filters, heterogeneous debris waste, and uncategorized metal.

Wastes are initially categorized into three broad Summary Category Groups that are related to the final physical form of the wastes. Waste characterization requirements for these groups are specified separately in Section C-2 of this WAP. These groups include Homogeneous Solids (Summary Category S3000), Soil/Gravel (Summary Category S4000), and Debris Wastes (Summary Category S5000).

The WIPP waste characterization program carried out by generators will be controlled under this WAP and implemented by the requirements of the QAPP and the WAC Certification Program (DOE, 1991). Waste characterization activities at the generator sites include the following, although not all these techniques will be used on each container, as discussed in Section C-2:

- Radiography, which is an x-ray technique to determine physical contents of containers
- Visual examination of opened containers as an alternative way to determine their physical contents or to verify Radiography results
- Headspace-gas sampling to determine volatile organic compound (VOC) content of gases in the void volume of the containers
- Sampling and analysis of waste forms that are homogeneous and can be representatively sampled to determine concentrations of hazardous waste constituents and toxicity characteristic contaminants of waste in containers
- Compilation of documented acceptable knowledge into an auditable record

The DOE's objective is to operate and maintain the WIPP facility free of both chemical and radiological contamination. Therefore, as allowed by 20 NMAC 4.1, Subpart V, §264.13, and consistent with joint EPA and U.S. Nuclear Regulatory Commission (NRC) guidance, all waste sampling and analyses will be conducted by the DOE generator sites in accordance with the requirements of this WAP. The WAP specifies required characterization activities that the generator must complete in order to be able to provide the information needed to send TRU waste to the WIPP facility for disposal. In accordance with this WAP, the generator sites will conduct the required waste characterization activities. Once the sufficient waste characterization is complete, the generator will complete a Waste Stream Profile Form documenting the results of their characterization activities (see Section C-1b). Generators will perform specific waste analyses according to the Transuranic Waste Characterization Sampling and Analysis Methods Manual (hereinafter referred to as the Methods Manual), which prescribes appropriate EPA-specified analytical methods modified as needed due to the presence of TRU waste

contaminants (DOE, 1995b). Since the DOE has determined that the waste analysis parameters (Section C-2a) are the same for CH and RH TRU mixed waste, RH TRU waste will be characterized using the same techniques as are used for CH TRU waste, with the exception of visual examination. Most RH TRU waste will be inspected using radiographic examination, but the DOE decided that visual examination will not be used to verify radiographic examination for RH TRU waste due to the added radiological exposure, cost, and waste generation associated with visual examination. The sampling and analytical methods that are used for CH waste characterization will not change except for that they will be performed remotely in shielded facilities for most RH waste characterization. The remote manipulations used for waste characterization (i.e., shaking and pouring) are common and will not require additional operator training. If at some point in time more effective waste characterization methods are developed for CH TRU or RH TRU waste, they will be submitted for inclusion in the Methods Manual per the DOE/Carlsbad Area Office (CAO) procedure discussed in Appendix C7. The data reports and the Waste Stream Profile Forms (see Section C-1b) resulting from waste characterization activities will be transmitted to the WIPP, reviewed for completeness, and screened for acceptance prior to loading any waste into the Transuranic Package Transporter (TRUPACT-II) or RH TRU mixed waste shielded road cask at the generator facility, as described in Section C-5. Only waste that has been characterized in accordance with this WAP and that meets the WAC, will be accepted for disposal at the WIPP facility.

C-1 Facility Description

C-1a Description of Processes and Activities at the WIPP

General descriptions of the WIPP facility waste handling processes are provided below. Detailed process descriptions are provided in Chapter D, Section D-10a(3), of this permit application.

CH TRU Mixed Waste Handling Process Overview

Waste from DOE TRU mixed waste generator/storage sites identified by the DOE as meeting the WAC will be disposed of at the WIPP facility. The ten major generator/storage sites anticipated to send the majority of waste for disposal at the WIPP are:

- Argonne National Laboratories (East)
- Idaho National Engineering Laboratory
- Los Alamos National Laboratory
- Lawrence Livermore National Laboratory
- Mound Facility
- Nevada Test Site
- Oak Ridge National Laboratory
- Richland (Hanford) Site
- Rocky Flats Environmental Technology Site
- Savannah River Site

Figure C-3 shows the geographic location of these sites. There are several small generator/storage sites that will either ship their waste to the WIPP facility for disposal or to one of the major generator/storage sites for waste characterization and certification to the WIPP requirements. Those sites will be identified to the New Mexico Environment Department (NMED) as they are certified and prior to initiating any shipments from these sites to the WIPP facility.

CH TRU mixed waste will arrive at the WIPP facility in a DOT Type B transportation package (i.e., a TRUPACT-II or other approved package). Each TRUPACT-II is capable of carrying up to two DOT Type A SWBs, two seven-packs of DOT Type 7A 55-gallon (gal) drums, or one DOT Type 7A Ten-drum Overpack (TDOP).

When the TRUPACT-IIs arrive at the WIPP facility, radiological surveys, security checks, and shipping documentation reviews will be performed. Upon completion of these checks, the hazardous waste manifest will be signed to release the driver. Should radiological surveys (i.e., surface dose rate, contamination) exceed acceptable levels, the TRUPACT-IIs and transport trailer will be placed outside the Waste Handling Building (WHB) in the parking area container storage unit or in the WHB itself. Factors such as weather conditions, time of receipt, and space availability will determine the actual location for placement of the TRUPACT-IIs and transport trailer. Once the location is established, the appropriate radiological boundaries (i.e., ropes, placards, etc.) will be erected around the affected TRUPACT-IIs and transport trailer. In the event that fixed and/or removable contamination is detected on the external surface of TRUPACT-IIs in excess of WIPP free release limits, Waste Operations, in conjunction with Operational Health Physics, would assess the situation and formulate a plan of recovery to decontaminate the shipping container(s).

The TRUPACT-IIs will be removed from the transport trailer and taken inside the WHB. Inside the WHB, the TRUPACT-IIs will be opened and the waste containers removed. As the containers are being removed, radiological surveys will be conducted. If contamination is detected on the waste containers, a determination will be made as to whether small area "spot" decontamination activities will be performed or to replace the waste containers, reseal the TRUPACT-II, and prepare a new hazardous waste manifest to ship the payload back to the generator/storage facility. Should small area decontamination be conducted, the resulting waste will be managed as "derived" waste. Derived waste management is discussed in detail in Section D-10a(3)(a).

When the containers are removed from the TRUPACT-II, additional checks will be conducted to verify that the waste containers are the same as those described on the hazardous waste manifest and the WIPP Waste Information System (WWIS) database (described in Section C-5a). When all identification checks have been completed, the generator's copy of the manifest will be returned to them (within 30 days of waste receipt). If there are any discrepancies, the generator will be contacted for resolution. Discrepancies that are not resolved within 15 days of waste receipt will be reported to the NMED as required by 20 NMAC 4.1, Subpart V, §264.72. If a resolution is not reached within 30 days of waste receipt, the waste will be returned to the site

which shipped the containers. A more detailed discussion on discrepancy resolution is provided in Section C-5b of this chapter.

The waste containers will be loaded onto a facility pallet, which will be transferred to a conveyance loading car. The conveyance loading car will move the loaded facility pallet into the waste hoist cage, which will be lowered to the underground waste receiving station through the Waste Shaft. At the underground waste receiving station, the pallet will be transferred to an underground waste transporter, which will move the loaded facility pallet to an underground hazardous waste management unit (HWMU). At the HWMU, the waste containers will be removed from the facility pallet and will be emplaced in a waste emplacement room. Bags of backfill material will be placed around and on top of the stacked waste containers. Section D-10a(3)(b) of this permit application provides a more complete description of the facility and the CH waste management activities.

RH TRU Mixed Waste Handling Process Overview

RH TRU mixed waste will arrive at the WIPP facility in a shielded road cask. Upon arrival, radiological surveys, security checks, and shipping documentation reviews will be performed. Upon completion of these checks, the hazardous waste manifest will be signed to release the driver. Should radiological surveys (i.e., surface dose rate, contamination) exceed acceptable levels, the road cask and transport trailer will be placed outside the WHB in the controlled area or in the WHB itself. Factors such as weather conditions, time of receipt, and space availability will determine the actual location for placement of the road cask and transport trailer. Once the location is established, the appropriate radiological boundaries (i.e., ropes, placards, etc.) will be erected around the road cask and transport trailer. In the event that fixed and/or removable contamination is detected on the external surface of the road cask in excess of WIPP free release limits, Waste Operations, in conjunction with Operational Health Physics, would assess the situation and formulate a plan of recovery to decontaminate the road cask.

The RH TRU mixed waste canister will be removed from the shielded road cask in the WHB hot-cell complex, where it will be checked against the identity on the hazardous waste manifest and the WWIS to verify that the canister is suitable for emplacement. The generator's copy of the manifest is then returned to the generator. If there are any discrepancies, the generator will be contacted for resolution. Discrepancies that are not resolved within 15 days of waste receipt will be reported to the NMED, as required by 20 NMAC 4.1, Subpart V, §264.72. If a resolution is not reached within 30 days of receipt of the waste, the canister will be returned to the site that shipped the canister.

The RH canister will be checked for external surface contamination in the hot-cell complex. If an unacceptable condition is identified, the canister will be overpacked. The overpacked canister will then reenter the normal waste management process line. The canister will then be placed into a facility cask for transport to an HWMU. The facility cask will be placed onto the facility

cask transfer car and will be loaded onto the waste hoist and lowered to the underground waste receiving station.

At the underground waste receiving station, the facility cask transfer car will move the facility cask, loaded with the RH TRU mixed waste canister, from the waste hoist cage, and a forklift will transport it to an HWMU. The emplacement machine will be positioned in front of a predrilled horizontal hole bored into the room wall, and the facility cask will be placed on the machine assembly. The emplacement machine will then insert the waste canister into the hole. A shield plug will be inserted into the hole to provide radiation protection.

The amount of RH TRU mixed waste disposed in each panel is limited, based on thermal and geomechanical considerations. A nominal spacing of 8 feet (ft) (2.4 meters [m]) between centers for RH TRU mixed waste canisters is planned. Section D-10a(3)(c) of this permit application provides a more complete description of the facility and the RH waste management activities.

C-1b Identification of TRU Mixed Waste Managed at the WIPP Facility

Waste Stream Identification

Waste destined for disposal at WIPP is characterized on a waste stream basis. A waste stream is defined as waste material generated from a single process or activity that is similar in material, physical form, isotopic make-up, and hazardous constituents. Waste may be generated as either process or process batch waste streams. A process is defined as a system or series of continuous or regularly occurring actions taking place in a predetermined manner over extended periods of time, resulting in waste that is substantially uniform. A process batch is defined as an amount of material subject to a particular unit chemical process, unit physical mixing process, or another short-term operation, resulting in waste that is substantially uniform. Sites delineate waste streams using acceptable knowledge. Acceptable knowledge is fully described in Section C-4b and Appendix C9.

There are various identifiers used for waste streams, all developed for specific purposes. Table C-1 is a cross correlation table that shows the interrelation between all of these identifiers.

The Summary Category Group (Matrix Parameter Summary Category) description is the broadest grouping. The Summary Category Groups are assigned to each waste stream identified by generators to facilitate RCRA waste characterization and reflect the physical form of the waste.

The Waste Matrix Codes (or Matrix Parameter Categories) were developed by the DOE, in response to the Federal Facilities Compliance Act, as a methodology to aid in classifying mixed waste streams within the DOE system. These codes represent different physical and chemical matrices. The Waste Matrix Code Group (or Final Waste Form) is a grouping of the Waste Matrix Codes that have similar physical and chemical properties.

A Waste Stream WIPP Identifier (ID) is assigned to each specific waste stream at a specific generator site. Similarities in the IDs do not necessarily correlate to similarities between waste streams. The Waste Stream Name is linked to the ID.

Waste stream descriptions may also be associated with TRUPACT-II content (TRUCON) codes. TRUCON content codes were originally developed as a type of shorthand representation of the chemical content and physical waste form of generator waste streams for use in the TRUPACT-II transportation safety analysis. Each waste stream was reviewed and a TRUCON code was assigned. Newly identified waste streams eligible for WIPP disposal will be assigned TRUCON codes, which will be approved by the NRC prior to shipment of the waste streams.

The Item Description Code is a site-specific numerical code applied to individual waste streams to identify their source. These codes represent the local identifiers, used by the generator sites to specify the waste stream type and/or generation area of TRU and TRU mixed waste, and are used at most DOE facilities that generate TRU and TRU mixed waste.

The Waste Type is a numerical designator ranging from one to four that indicates if the waste is a solidified inorganic, solid inorganic, solid organic, or solidified organic. This description is used in the shipment of the waste.

Waste Categories are included in Table C-1 for the purposes of linking this information to the compatibility study presented in Appendix C1.

Waste stream information has been provided by the generator/storage sites and is documented in the WIPP Transuranic Waste Baseline Inventory Report (WTWBIR) (see Table C-2). The information provided by the generator/storage sites in the WTWBIR is not the result of waste characterization. It is an estimate of waste stream constituents. Therefore, one WTWBIR waste stream may relate to numerous waste streams for the purpose of waste characterization. The WTWBIR information was compiled in order to estimate waste volumes and properties for long-term performance assessment. All waste characterization activities must still be conducted and each waste stream submitted to the WIPP facility on a Waste Stream Profile Form for approval. Waste stream descriptions will be finalized over the course of waste characterization at the sites. Changes that have been made to the WTWBIR in recent revisions to this document do not affect this permit application.

Currently, the majority of existing retrievably stored waste to be disposed at WIPP is in earthen-covered storage or other storage which is not readily accessible. Because of this, all of the waste within a waste stream may not be available for sampling and analysis at one time. In these instances, sites will divide waste streams into waste stream lots based on staging, transportation, or handling issues. Characterization activities are then undertaken on a waste stream lot basis. Sites initially delineate and describe waste streams using acceptable knowledge. As waste characterization activities proceed, waste stream descriptions may change based on the results of sampling and analysis. Results from waste characterization are used to confirm acceptable knowledge, including the assignment of EPA hazardous waste codes to waste streams, as appropriate.

The quantity of waste reported in the WIPP RCRA Part A application was determined using reported generator information on waste generating processes, and waste constituents and characteristics. If it was suspected, based on knowledge of a waste generating process, that a RCRA-regulated hazardous constituent may be contained in the waste, the waste was assumed to contain that constituent. The waste volume associated with each reported EPA code was assumed to equal the volume of the waste stream. Therefore, it appears that receipt of the total annual waste volumes reported in the Part A application over WIPP's projected 25 year waste-emplacement period would exceed the 6.2 million cubic feet (ft^3) (175,600 cubic meters (m^3)) allowable waste capacity specified in the Land Withdrawal Act of 1992. This is because many waste streams with multiple EPA codes were counted as multiple volumes. A biennial report, in accordance with 20 NMAC 4.1, Subpart V, §264.75, will provide information on actual volume and waste descriptions received for disposal during the time period covered by the report.

Waste Summary Categories Accepted at the WIPP Facility

Once a waste stream has been delineated, sites assign a Waste Matrix Code to the waste stream based on the physical form of the waste. Waste streams are assigned to one of three broad Summary Category Groups; S3000-homogeneous solids, S4000-soils/gravel, and S5000-debris wastes. These Summary Category Groups are used to determine further characterization requirements.

S3000—Homogeneous Solids

Solid process residues are defined as solid materials, excluding soil, that do not meet the NMED criteria for classification as debris (20 NMAC 4.1, Subpart VIII, §268.2[g] and [h]). Included in the series of solid process residues are inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Summary Category Group based on the specific waste stream types and final waste form. Each waste stream designated as a 3000 solid process residue is identified in Table C-2 with the EPA hazardous waste codes that are associated with that waste stream. This Summary Category Group is expected to contain toxic metals and spent solvents. This category includes wastes that are at least 50 percent by volume solid process residues.

S4000—Soils/Gravel

This Summary Category Group includes waste streams that are at least 50 percent by volume soil as identified in Table C-2 with the EPA hazardous waste codes that are associated with that waste stream. This Summary Category Group is expected to contain toxic metals. Soils are further categorized by the amount of debris included in the matrix.

S5000—Debris Wastes

This Summary Category Group includes waste that is at least 50 percent by volume materials that meet the NMAC criteria for classification as debris (20 NMAC 4.1, Subpart VIII, §268.2) as follows:

> Debris means solid material exceeding a 2.36 inch (in.) (60 millimeter) particle size that is intended for disposal and that is:
>
> 1. a manufactured object, or
> 2. plant or animal matter, or
> 3. natural geologic material.
>
> However, the following materials are not debris:
>
> 1. any material for which a specific treatment standard is provided in 20 NMAC 4.1, Subpart VIII, 268 Subpart D;
>
> 2. process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges, or air emission residues; and
>
> 3. intact containers of hazardous waste that are not ruptured and that retain at least 75 percent of their original volume.

However, for the purposes of this WAP, all heterogeneous materials, or waste materials whose physical form does not lend itself to sampling and analysis, are considered to be in the Summary Category Group regardless of the size of the waste materials. That is, this Summary Category Group includes heterogeneous waste materials that are less than 2.36 in.

A mixture of debris (that has not been treated to the standards provided by 20 NMAC 4.1, Subpart VIII, §268.45), and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume, based on visual inspection (20 NMAC 4.1, Subpart VIII, §268.2[g]). Due to the presence of radioactive contaminants in the waste and the safety hazards involved in opening waste containers, the DOE has opted to use radiography as a form of nondestructive examination of the waste form in place of visual examination of the waste form. For these reasons, radiography will be used on 100 percent of stored waste containers and most RH TRU waste containers to determine the physical composition of debris mixtures. The percentage of debris materials in mixtures in newly generated CH TRU waste will be determined by visual examination during packaging.

"Hazardous debris" means debris that contains a hazardous waste listed in 20 NMAC 4.1, Subpart II, 261 Appendix VIII, or that exhibits a characteristic of hazardous waste identified in 20 NMAC 4.1, Subpart II, §261, Subpart C.

Included in the S5000 series are metal debris, lead containing metal debris, inorganic nonmetal debris, asbestos debris, combustible debris, graphite debris, heterogeneous debris, and composite filters, as well as other minor waste streams, as identified in Table C-2. This Summary Category Group is expected to contain toxic metals and spent solvents. The EPA hazardous waste codes associated with the debris waste streams are included in Table C-2.

Examples of waste that might be included in the S5000 series are asbestos-containing gloves, fire hoses, aprons, flooring tiles, pipe insulation, boiler jackets, and laboratory tabletops. Also included are combustible debris constructed of plastic, rubber, wood, paper, cloth, and graphite and biological materials. Examples of graphite waste that would be included in this series are crucibles, graphite components, and pure graphite.

Chemical Properties of the Waste

This section of the WAP provides an overview of the chemical properties of the waste and the waste source. Hazardous constituents and target analytes for waste to be disposed of at the WIPP facility are shown in Table C-3.

The most common hazardous constituents in the TRU mixed waste to be managed in the WIPP facility consist of the following:

Metals

Some of the TRU mixed waste to be emplaced in the WIPP facility contains metals for which 20 NMAC 4.1, Subpart II, §261.24, toxicity characteristics were established (EPA hazardous waste codes D004 through D011). These materials are known to be present based on acceptable knowledge of waste-generating processes and various analytical results used to verify acceptable knowledge. Cadmium, chromium, lead, mercury, selenium, and silver are present in discarded tools and equipment, solidified sludges, cemented laboratory liquids, and waste from decontamination and decommissioning activities. A large percentage of the waste consists of lead-lined gloveboxes, leaded rubber gloves and aprons, lead bricks and piping, lead tape, and other lead items. Lead, because of its radiation-shielding applications, is the most prevalent toxicity-characteristic metal present.

Halogenated Volatile Organic Compounds

Some of the mixed waste to be emplaced in the WIPP facility contains spent halogenated organic solvents identified in 20 NMAC 4.1, Subpart II, §261.31 (EPA hazardous waste numbers F001 through F005). The presence of these compounds is confirmed by analytical results from headspace gas sampling of TRU mixed waste. Tetrachloroethylene; trichloroethylene; methylene chloride; carbon tetrachloride; 1,1,1-trichloroethane; and 1,1,2-trichloro-1,2,2-trifluoroethane (EPA hazardous waste codes F001 and F002) are the most prevalent halogenated organic compounds identified in TRU mixed waste that may be managed at the WIPP facility during the Disposal Phase. These compounds are commonly used to clean metal surfaces prior to plating, polishing, or fabrication; to dissolve other compounds; or as coolants. Because they are highly volatile, only very small amounts typically remain on equipment after cleaning or, in the case of treated wastewaters, in the sludges after clarification and flocculation.

Nonhalogenated Volatile Organic Compounds

Xylene, methanol, and n-butanol are the most prevalent nonhalogenated VOCs in TRU mixed waste that may be managed at the WIPP facility during the Disposal Phase. These compounds occur in TRU mixed waste materials in much smaller quantities than halogenated VOCs. Like the halogenated VOCs, they are used as degreasers and solvents and are similarly volatile. The same analytical methods that are used for halogenated VOCs are used to detect the presence of nonhalogenated VOCs.

Waste Not Accepted at the WIPP Facility

The DOE has established WIPP WAC to specify the chemical and physical forms of TRU mixed waste that will be accepted at the WIPP facility. These criteria include those required to ensure occupational safety and protection of human health and the environment.

The following waste is unacceptable for management at the WIPP facility:

- Ignitable, reactive, and corrosive waste, as defined under 20 NMAC 4.1, Subpart II, Characteristics of Hazardous Waste
- Liquid wastes, (all waste must meet the WAC criteria regarding liquid content)
- Compressed gases

- Incompatible waste, as defined under 20 NMAC 4.1, Subpart V, Appendix V (waste must be compatible with backfill, seal and panel closure materials, container, cask, and TRUPACT-II materials as well as with other waste)

- Headspace-gas VOC concentrations resulting in average annual emissions not protective of human health and the environment (Table C-5 lists target maximum average headspace concentrations)

- Wastes with EPA codes not listed on RCRA Part A permit application

- Waste with equal to or more than 50 parts per million (ppm) (50 milligrams per liter [L]) polychlorinated biphenyls (PCB)

The WIPP facility will not accept waste that exhibits the characteristics of ignitability, reactivity, or corrosivity. The DOE ensures through administrative and operational procedures at the generator sites that TRU mixed waste received at the WIPP facility does not exhibit these characteristics. These characteristics are generally associated with liquid wastes or specific waste forms that may react violently. This WAP and the WAC, therefore, prohibit liquid waste, explosives, compressed gases, oxidizers, and pyrophorics. The absence of these wastes is confirmed by radiography, visual examination, and headspace analysis.

The TRU mixed waste received at the WIPP facility will not be aqueous or liquid, will not contain WAC-prohibited materials, and will be capable of being handled at standard temperatures and pressures without reaction to oxygen or water (see Table C-4). The WAC specifies that liquid waste is not acceptable at the WIPP. The WIPP facility will not accept containers holding waste that would be considered a liquid waste as defined in 20 NMAC 4.1, Subpart I, §260.10. Every container holding waste with less than 2 L of liquid for a 55-gal drum or 8 L in a SWB must contain as little residual liquid as is reasonably achievable, and all internal containers (e.g., bottles and cans) must contain less than one in. (2.5 centimeters) of liquid at the bottom of the container.

Additionally, TRU mixed waste cannot contain explosives, compressed gases, oxidizers, or nonradionuclide pyrophoric materials. (Waste generators have submitted information on waste streams based on known waste generation processes that indicate certain waste streams may have the potential for reactivity, ignitability, or corrosivity.) These characteristics must be eliminated prior to waste acceptance for disposal at the WIPP.

Before accepting a container holding TRU mixed waste, WIPP personnel will examine the radiography data records to verify that the container holds no unvented compressed gas containers and no greater than one percent by volume of residual liquid. If discrepancies or inconsistencies are detected during the radiography data record review, WIPP personnel may review the radiography video tape to verify that the observed physical form of the waste is consistent with the waste stream description provided by the generator and to ensure that no

WAC-prohibited materials are present in the waste. Section C-5 includes a description of the waste verification process that the DOE intends to conduct prior to receiving a shipment at the WIPP.

The WIPP will manage TRU mixed waste in a manner that mitigates the buildup of explosive or flammable gases within the waste. Containers are vented through individual carbon composite particulate filters, allowing any gases that are generated by radiolytic and microbial processes within a waste container to escape; to prevent over pressurization. Gas generation is discussed in detail in Chapter I, Section I-1e(4).

The WIPP facility is designed to manage only compatible waste. Therefore, a compatibility analysis was performed to identify potential incompatibilities for all defense generated TRU mixed waste reported in the WTWBIR. Wastes were screened for incompatibilities based on their chemical content and physical waste form by comparing information presented in 20 NMAC 4.1, Subpart V, Appendix V, and the EPA document "*A Method for Determining the Compatibility of Hazardous Wastes*," (Hatayama et al., 1980). The compatibility analysis also took into account waste compatibility with various aspects of the repository such as shaft, seal, and panel closure materials, backfill, and fire suppressant materials. Appendix C1 provides additional details and results of this analysis.

To ensure the integrity of the WIPP facility, waste streams identified to contain incompatible materials or materials incompatible with waste containers cannot be shipped to WIPP unless they are treated to remove the incompatibility. Only those waste streams that are compatible or have been treated to remove incompatibilities will be shipped to WIPP.

As described in Chapter D, Section D-9b(4), the potential risks to human health and the environment are due to emissions of VOCs from the waste containers into the air pathway. The most stringent environmental performance standard of 20 NMAC 4.1, Subpart V, §264.601(c) is the acceptable excess risk levels for residential (chronic) exposure to carcinogens (10^{-6} for Class A and B carcinogens and 10^{-5} for Class C carcinogens). In addition, the risk assessment in Chapter D examined occupational exposures and compared them to Occupational Safety and Health Administration risk standards. WAC have been developed to limit the VOC concentrations in the headspace of waste containers to those which when averaged will ensure compliance with the performance standards. These limits are presented in Table C-5 as VOC headspace concentration limits. In reality, these are maximum <u>average</u> headspace concentrations. This means that some containers can exceed these values as long as averages in a disposal room do not. For a generator to ship waste that exceeds any of these values, a WAC exception must be requested at which time WIPP personnel will evaluate the impact on the average concentrations in the disposal room.

The DOE will only allow generators to ship those waste streams with EPA Hazardous Waste Codes listed on Part A of this application. Characterization of all waste streams will be performed as required by this WAP. If during the characterization process, new hazardous

waste codes are identified, those wastes cannot be accepted for disposal at the WIPP facility until a permit modification has been submitted and approved. Similar waste streams at other generator sites will be examined more closely to ensure that the newly identified code does not apply. If other waste streams also require a new hazardous waste code, shipment of these waste streams will also cease until a permit modification has been submitted and approved. Approval will be based on the physical and chemical properties of the waste.

Transformer oils containing PCBs have been identified in a limited number of waste streams included in the Waste Matrix Code corresponding to organic sludges. Because the WIPP facility is not seeking permission to manage PCB waste, these waste streams are required to be screened to assure PCB levels are below 50 ppm.

Control of Waste Acceptance

The waste acceptance program is defined in the WAC (DOE, 1991 or current revision). This document provides a list of criteria that must be met for waste to be shipped to the WIPP facility for management. The WAC requires the generator to prepare a waste certification program that lists the methods and techniques used to determine compliance with the WAC and the QA/QC criteria that are applied to the generator's waste certification program. One of the criteria that the generator is required to meet is compliance with the applicable portions of this WAP. The WAC certification programs result in controlled and consistent waste properties and final packaging.

A Waste Stream Profile Form will describe a CH TRU or RH TRU mixed-waste stream destined for shipment to and disposal at the WIPP facility. The Waste Stream Profile Form summarizes important information about a particular waste stream. Examples of information contained in a Waste Stream Profile Form are:

- The generator's site name
- Original generator of waste stream
- A description of the waste stream
- The date of WAC certification by the DOE/CAO and the certification document title and date
- The Waste Stream WIPP Identification Number
- The designated Summary Category Group
- A listing of acceptable knowledge documentation used to identify the waste stream

- The waste-characterization procedures used and the reference and date of the procedure
- The data packages supporting the characterization
- The EPA hazardous waste codes
- Waste Stream Profile Form Certification statement signed by the manager of the generator site

These data will be provided for each waste stream prior to its acceptance for disposal at the WIPP. The Waste Stream Profile Form data will be transmitted once for each waste stream from a facility.

For waste streams that are continually generated, a Waste Stream Profile Form may be submitted once the waste stream has been characterized per the QAPP based on the variability of the waste stream (as shown in Appendix C6). Characterization activities will continue in order to verify consistency with the initial characterization and Waste Stream Profile Form (Section C-3a). If there are discrepancies, the waste will be redefined to a separate waste stream, and a new Waste Stream Profile Form will be submitted.

The WIPP Waste Operations Manager will be responsible for the review of Waste Stream Profile Forms (see Section C-1c and Figure C-4) and data records to verify compliance with the restrictions on TRU mixed wastes for WIPP disposal. The Waste Stream Profile Form includes a section requiring the waste generator to provide the data and documentation of WAC certification for the TRU mixed waste stream described on the form. The WIPP Waste Operations Manager will also be responsible for the review of shipping records (see Section C-5b) to verify that each container has been prepared under a WAC-certified program and in accordance with this WAP. Waste characterization data must indicate the absence of unacceptable materials.

Generator site waste stream characterization will be subject to the Generator/Storage Site Waste Screening and Certification Audit Program (Appendix C11) for compliance with this WAP. Section C-5 further discusses WIPP facility waste screening activities.

C-1c Waste-Generating Processes

Waste-Generating Processes At DOE Generator Facilities

TRU mixed waste generated at DOE sites results from specific processes and activities that are well-defined and well-controlled, enabling the DOE to characterize waste streams on the basis of knowledge of the process and the raw materials used. Examples of the major types of operations that generate TRU mixed waste include:

- Production of Nuclear Products—Production of nuclear products includes reactor operation, radionuclide separation/finishing, and weapons fabrication and manufacturing. The majority of the TRU mixed waste was generated by weapons fabrication and radionuclide separation/finishing processes. More specifically, wastes consist of residues from chemical processes, air and liquid filtration, casting, machining, cleaning, product quality sampling, analytical activities, and maintenance and refurbishment of equipment and facilities.

- Plutonium Recovery—Plutonium recovery wastes are residues from the recovery of valuable plutonium-contaminated molds, metals, glass, plastics, rags, salts used in electrorefining, precipitates, firebrick, soot, and filters.

- Research and Development (R&D)—R&D projects include a variety of hot cell or glovebox activities that often simulate full-scale operations described above, producing similar TRU mixed wastes. Other types of R&D projects include metallurgical research, actinide separations, process demonstrations, and chemical and physical properties determinations.

- Decontamination and Decommissioning—Facilities and equipment that are no longer needed or usable are decontaminated and decommissioned, resulting in TRU mixed wastes consisting of scrap materials, cleaning agents, tools, piping, filters, Plexiglas™, gloveboxes, concrete rubble, asphalt, cinder blocks, and other building materials. This is expected to be the largest category by volume of TRU mixed waste to be generated in the future.

Waste-Generating Processes at the WIPP Facility

Nonradioactive hazardous waste generated at the WIPP facility is characterized, placed in containers, and temporarily stored, in accordance with 40 CFR §262.34, until it is transported off site for treatment and/or disposal at a permitted facility. This waste generation and accumulation activity, which is performed in compliance with 20 NMAC 4.1, Subpart III, is not subject to RCRA permitting requirements and, as such, is not addressed in this permit application.

Administrative practices that direct normal operations at the WIPP facility will be implemented to minimize the possibility of generating new TRU mixed waste. For this reason, any TRU mixed waste generated through normal waste handling operations will be derived from the waste received from the off-site generator. Throughout this application, site-generated waste that is derived from waste generated at an off-site facility is referred to as *derived waste*. Because derived wastes can contain only those RCRA-regulated materials present in the waste from which they were derived, no additional characterization of the derived waste is proposed for disposal purposes. In other words, the generator's characterization data and knowledge of the

processes at the WIPP facility will be used to identify and characterize containers of derived waste. The management of derived waste is addressed in Section D-10a(3)(a).

Hazardous constituents within the waste containers are known and have been determined to be acceptable for disposal at the WIPP facility. Therefore if a spill, breach, or other type of release of TRU mixed waste from a container occurs, the waste generated during cleanup would be managed as derived waste. Anticipated sources of derived waste during the Disposal Phase include:

- Swipes used to detect external radioactive contamination during receipt inspection and other radiological checks

- Any TRU mixed waste generated through nonroutine events, such as the cleanup of spills

C-1d Description of HWMUs

The underground HWMUs (defined as waste panels) are 2,150 ft (655 m) beneath the surface, in the WIPP underground and are designated as Panels 1 through 10. Each waste panel, designated as Panels 1 through 8, consists of seven parallel rooms and two access drifts. Each room is approximately 300 ft (91 m) long, 33 ft (10 m) wide, and 13 ft (4 m) high. Access drifts connect the rooms and have the same cross section. Panels 9 and 10 are the disposal area access drifts which may be used by the DOE for waste disposal in the future. The DOE intends to operate the WIPP facility in a manner that minimizes the number of underground HWMUs that are open at any one time, as discussed in Section B-1b.

The underground HWMUs provide room for 6.2 million ft^3 (175,600 m^3) of TRU mixed waste, of which no more than 250,000 ft^3 (7,080 m^3) may be for RH TRU mixed waste. The remainder will be for CH TRU mixed waste. RH TRU mixed waste canisters will be inserted into horizontal holes bored into the walls of the HWMUs. The CH TRU mixed waste packages will fill the remaining HWMU space exclusive of the panel closures.

The surface HWMUs are inside the WHB and the parking area south of the WHB. The WHB is the surface facility where waste handling activities will take place (Figure D-1). The WHB has a total area of approximately 84,000 square ft (ft^2) (7,803 square m (m^2) of which 33,175 ft^2 (3,083 m^2) are designated for the waste handling and storage of CH TRU mixed waste and 21,318 ft^2 (1,981 m^2) are designated for the waste handling and storage of RH TRU mixed waste, as shown in Figure D-1. These combined areas are being permitted as a container storage unit. The CH side of the WHB will store up to 2718.2 ft^3 (77.02 m^3) and the RH side up to 377 ft^3 (10.7 m^3), under normal conditions of operations. The concrete floors are sealed with an impermeable coating that has excellent resistance to the chemicals in TRU mixed waste and, consequently, provide secondary containment for TRU mixed waste.

The parking area HWMU (Figure D-2) south of the WHB will be used for storage of waste in sealed shipping containers awaiting unloading, having a surface area of 272,500 ft^2 (25,315 m^2). This area is also being permitted as a container storage unit for 1536 ft^3 (43.5 m^3) of CH and 126 ft^3 (3.6 m^3) of RH waste. The sealed shipping containers provide secondary containment in this HWMU. System descriptions for the WHB HWMU and TRU mixed waste handling systems and a description of the impermeable coating are provided in Sections D-10a(2)(b), D-10a(2)(c), and D-10a(3).

C-2 Waste Parameters

This section discusses the parameters of interest for waste characterization purposes, and the rationale for their selection.

C-2a Selecting Waste Analysis Parameters

The following analytes were selected as parameters of interest:

- Toxicity characteristic contaminants listed in 20 NMAC 4.1, Subpart II, §261.24, Table 1 (excluding pesticides)
- F-listed solvents (F001, F002, F003, F004, F005) found in 20 NMAC 4.1, Subpart I, §261.31, and known to be used at DOE sites
- Hazardous constituents included in 20 NMAC 4.1, Subpart II, §261 Appendix VIII, and reported to be present in waste generated by DOE TRU waste generator/storage sites

Table C-3 summarizes the parameters of interest and the rationale for including each parameter in this WAP. The next sections provide a description of the acceptable methods to evaluate these parameters for each waste Summary Category Group.

C-2b Criteria and Rationale for Parameter Selection

Parameters were selected for characterization based on data needed to address regulatory requirements for accepting TRU mixed waste at the WIPP miscellaneous-unit disposal facility.

Radiography will be used to examine containerized waste to ascertain its physical form. This technique can detect liquid wastes and containerized gases, which are prohibited for WIPP disposal. Prohibiting liquids and containerized gases prevents the shipment of corrosives, ignitable waste, or reactive waste. Radiography will also be able to confirm that the physical form of the waste matches its waste stream description (i.e. Homogeneous Solids, Soil/Gravel, or Debris Waste [including uncategorized metals]). If the physical form does not match the waste stream description, the waste will be designated as another waste stream and assigned

the preliminary hazardous waste codes that are inherent to the new waste stream assignment. If radiography indicates that the waste does not match the waste stream description, a non-conformance report will be completed and the inconsistency will be resolved per Section C8-13 of Appendix C8. The proper waste stream assignment will be determined, the correct hazardous waste codes will be assigned, and the resolution will be documented.

Headspace-gas samples are used to determine the types and concentrations of VOCs in the void volume of waste containers. Averages of measured headspace VOC concentrations in waste containers received at the WIPP site will be compared routinely with those used in this permit application's environmental pathway analysis demonstration to ensure that on an annual basis there are no associated adverse worker or public-health impacts. Average concentrations of VOCs in headspace gas have been used in this permit application's environmental pathway analysis to demonstrate that average annual concentrations of VOCs emitted from containers emplaced at the WIPP will be well below health-based limits (headspace gas analytical data used to determine average concentrations is provided in Appendix C-2).

For wastes that can be representatively sampled (Homogeneous Solids and Soil/Gravel Wastes), the total concentrations of PCBs, VOCs, semivolatile organic compounds (SVOC), and metals will be determined analytically. A representative sample is defined in 20 NMAC 4.1, §260.10 as "a sample of a universe or whole (e.g., waste pile, lagoon, groundwater) which can be expected to exhibit the average properties of the universe or whole."

Data on total concentration will be used to quantify the types and quantities of RCRA-regulated listed hazardous constituents, and to determine whether the waste exhibits a toxicity characteristic under 20 NMAC 4.1, Subpart II. Toxicity characteristic will be determined using total extraction analysis rather than the toxicity characteristic leaching procedure (TCLP), because total concentrations are more useful for repository compliance demonstrations[2] and result in more conservative estimates of toxicity characteristics. (Appendix C3 discusses comparability of the results of these two methods.)

Documented acceptable knowledge will be used to determine the types and quantities of listed and toxicity characteristic waste that cannot be directly sampled for total metals or total organics. Debris waste is heterogeneous, having waste forms that cannot be representatively sampled (e.g. personal protective equipment, leaded rubber gloves, manufactured goods, and natural geologic material). In these types of wastes, acceptable knowledge is used to make a hazardous waste determination. Radiography, visual examination, and headspace gas sampling will be

[2]According to 20 NMAC 4.1, Subpart IX, §270.14(b)(2), the information needed regarding the chemical and physical properties is "...all the information which must be known to treat, store, or dispose of the wastes properly in accordance with Part 264 [Subpart V]." For a mined geological repository such as the WIPP, totals analyses provides such information needed to model the solubility and transport of waste and waste constituents over the long-term. For this reason the DOE has opted to require totals analyses of representative samples of homogeneous waste.

used to verify the acceptable knowledge used. (Appendix C9 details the use of acceptable knowledge).

Table C-6 summarizes the parameters, methods, and rationales for stored and newly generated CH TRU wastes according to their waste forms, and Table C-7 is a parallel table for RH TRU wastes.

C-3 Characterization Techniques and Frequency

Generator/storage sites will characterize waste on a waste stream basis using a variety of techniques. Characterization techniques include: acceptable knowledge, radiography, headspace-gas sampling and analysis, and homogeneous solids and soils/gravel sampling and analysis.

Acceptable knowledge refers to applying knowledge of the hazardous nature of the waste based on the materials or processes used to generate the waste. This may include accompanying records; administrative, procurement and quality controls associated with the processes generating the waste; past sampling and analytical data; material inputs to the waste-generating process; and the time during which the waste was generated (certain waste-generating processes are associated with specific historical time periods). Information required for characterizing waste using acceptable knowledge includes the physical form of the waste and documented changes to the process or material inputs. Appendix C9 outlines the minimum set of requirements which must be met by the generator sites in order to use acceptable knowledge. In addition, verification of acceptable knowledge through sampling and analysis and the generator-site audit program is described in the appendix.

Acceptable knowledge is used in three ways: 1) to delineate waste streams, 2) to make hazardous waste determinations for debris waste, and 3) to determine if homogeneous solids and soil/gravel are RCRA-listed wastes. Used for these purposes, acceptable knowledge balances the requirements for providing definitive chemical and physical characterization of waste streams when it is difficult to obtain a representative sample because of the physical waste form and/or composition of the waste (e.g., metal, glass, and combustibles). This use of acceptable knowledge is outlined in *Waste Analysis: EPA Guidance Manual for Facilities That Generate, Treat, Store and Dispose of Hazardous Waste,* (EPA, 1994), where EPA has specifically referred to the characterization of mixed waste as a situation where the use of acceptable knowledge is appropriate.

Generator sites will use acceptable knowledge to sort waste containers into waste streams for the purposes of grouping waste for further characterization. Since the waste is characterized on a waste stream basis, minimal variability of hazardous constituents between waste containers in a waste stream will provide a more representative characterization of the waste stream. The analyses performed will not differ based on the waste stream, only on the physical form of the waste (i.e., debris waste cannot be sampled for totals analyses). Both stored and newly

generated wastes will be separated in this fashion, though the types of acceptable knowledge used may differ. Section C-4b discusses the use of acceptable knowledge, sampling, and analysis in more detail. Acceptable knowledge is discussed more completely in Appendix C9.

Radiography is used to verify the physical form of retrievably stored CH TRU waste and most RH TRU waste. Based on this physical form (ie, Homogeneous Solids/Soils/Gravel or Debris) it is determined whether a representative sample can be collected and totals analyses performed on the waste. For newly generated waste, physical form will be verified during packaging. Radiography is also used in conjunction with acceptable knowledge to characterize debris wastes. Radiography and the associated information compiled from acceptable knowledge (e.g., age of the waste, generating process) will be used to determine the RCRA-regulated constituents present in the waste.

All waste containers are sampled and analyzed for VOCs in the headspace gas. A statistically selected portion of homogeneous solids and soil/gravel is sampled and analyzed for RCRA-regulated total VOCs, SVOCs, and metals. Sampling and analytical methods used for waste characterization are discussed in Section C-4a.

In the process of performing organic analyses, nontarget compounds may be identified. These compounds will be reported as tentatively identified compounds (TIC). The specific procedures for positive TIC identification are implemented by the QAPP. Positively identified TICs listed in 20 NMAC 4.1, Subpart V, 264, Appendix IX,[3] will be added to the target analyte list if they are detected in 25 percent of all samples from a given waste stream as implemented in the QAPP. The DOE will add these compounds to the list of hazardous constituents for the waste stream (and additional EPA hazardous waste codes, if appropriate), and a permit modification will be submitted adding these constituents, if necessary.

Waste characterization sampling and analysis activities will differ for retrievably stored waste and newly generated waste. The waste characterization data collection design for each type of waste is described in the following sections. Figures C-1 and C-2 summarize the waste characterization data collection design for newly generated and retrievably stored waste, respectively. Table C-8 provides a summary of hazardous waste characterization requirements for all TRU mixed waste by waste characterization parameters.

C-3a Newly Generated Waste

The RCRA-regulated constituents in newly generated wastes will be documented and verified at the time of generation to provide acceptable knowledge for the waste stream. Newly generated mixed waste characterization will begin with verification that processes generating the waste have operated within established written procedures. Waste containers will be classified

[3]Appendix IX of 264 was chosen because analytical methods have been established for all analytes listed.

into waste streams using acceptable knowledge. Verification that the physical form of the waste (Summary Category Group) corresponds to the physical form of the assigned waste stream is accomplished during packaging. This process consists of the operator confirming that the waste is assigned to a waste stream that has the correct Summary Category Group for the waste being packaged. If a confirmation cannot be made, corrective actions will be taken per Section C8-13 of Appendix C8. A second operator, who is equally trained to the requirements of the WAC and QAPP (See Appendix C4, Section C4-3b for training requirements), will provide additional verification by reviewing the contents of the waste container to ensure correct reporting. If the second operator cannot provide concurrence, corrective actions will be taken per Section C8-13 of Appendix C8. The subsequent waste characterization activities depend on the assigned Summary Category Group since waste within the homogeneous solids and soils/gravel summary category groups will be characterized using different techniques than the waste in the debris waste summary category group.

All newly generated waste containers will undergo headspace-gas analysis for VOC concentrations. If the DOE believes the frequency can be reduced in the future based on trends in analytical results, it may provide technical arguments for such a reduction and request a permit modification. The headspace-gas sampling method is provided in Appendix C4, Section C4-1.

Newly generated waste streams of homogeneous solids and soils/gravel wastes will be randomly sampled a minimum of once per year for total VOCs, SVOCs and metals. Sampling frequency of once per year is only allowed if a process has operated within established bounds without any significant process changes or fluctuations. Otherwise, the waste must be considered as process batches. Significant process changes and process fluctuations can be determined using statistical process control charting techniques; these techniques require historical data for determining limits for indicator species and subsequent periodic sampling to assess process behavior relative to historical limits. If the limits are exceeded, the waste stream must be recharacterized, and the characterization must be performed according to procedures required in the QAPP for retrievably stored waste. The process behind this control charting technique is described in Appendix C6, Section C6-5.

Also, as another control of waste generated from a particular process, the bounds for a waste generating process will be established by the specific written procedures for that process. Examples of parameter bounds that could affect a waste generated by a process are volumes of input material, change in the input material, and any other changes that would change the output of that process.

To ensure that the generator site procedures for waste generating processes contain the proper controls of the waste stream, generator site waste generating process procedures must contain sections containing the following information:

- Scope

- Purpose
- Responsible organizations for implementing the requirements of the procedure
- Administrative process controls
- Material inputs
- Waste Streams Generated
- Process controls and range of operation that affect final hazardous waste determinations
- Rate and quantity of hazardous waste generated
- List of applicable operating procedures relevant to the hazardous waste determination
- Nonconformance reporting
- Process knowledge verification sampling
- Reporting and records management

Events where procedurally established bounds are exceeded or any condition of normal operation not being met are events that could trigger an increased sampling frequency of a waste stream. As long as a process does not change within a year, the waste generated by that process will have the same characteristics, and therefore, one sample could verify the lack of variability of that waste stream. Compliance with process procedures and the maintenance of the parameters specified by those procedures will be verified by WIPP during the Generator/Storage Site Waste Screening and Acceptance Audit Program (Appendix C11).

The records generated by the process procedures will be examined for indications of process changes or limits being exceeded that would change the output of that process. If these changes are apparent, WIPP will verify that a follow-up sample of process waste was collected and analyzed. Records of that analysis will be available for examination by the auditors. If records of the analysis are not available, the waste stream will not be acceptable at the WIPP facility for disposal and the site may lose certification authority. If a generator site changes a process but determines that increased sampling is not required because the change will not affect waste generated by that process, the DOE/CAO must be notified in the form of a memorandum to the CAO Waste Characterization Manager. The DOE/CAO must concur with

the decision to not increase the sampling frequency before any additional waste from that process is shipped.

The toxicity characteristics of homogeneous solids and soils/gravel waste streams will be determined using total analysis of toxicity characteristic contaminants, rather than the TCLP. The sampling methods for homogeneous solids and soil/gravel wastes is provided in Appendix C4, Section C4-2.

Acceptable knowledge, examination during packaging, and headspace-gas sampling and analysis are used to characterize debris waste. When waste is being generated by processes that are driven by written procedures, the waste generated by that process can be characterized by acceptable knowledge. Other documentation besides written procedures provide useful information that can be used for acceptable knowledge. Examples of documentation used for waste characterization by acceptable knowledge practices are described in Appendix C9. RCRA-regulated metals present in debris wastes are associated with specific waste materials (i.e., lead in leaded rubber gloves, leaded glass, or lead shielding). Knowledge of the materials and operations that generated these waste streams is used to determine if they contain RCRA-regulated metals. Acceptable knowledge is further explained in Section C-4b and Appendix C9.

C-3b Retrievably Stored Waste

All retrievably stored waste containers will be examined using radiography to confirm the physical waste form (Summary Category Group), to verify the absence of prohibited items, and to determine the waste characterization techniques to be used based on the Summary Category Groups (i.e., S3000, S4000, S5000). Repackaged retrievably stored waste may be handled as newly generated waste to confirm the Summary Category Group. The applicability of Real-Time Radiography (RTR) as an example for this purpose is detailed in Appendix C5.

To confirm the results of radiography, a statistically selected number of the CH waste container population will be visually examined by opening containers to inspect waste contents to verify radiography results. Appendix C6, Section C6-1 contains the approach used to statistically select the number of drums to be visually examined.

All retrievably stored containers will undergo headspace gas analysis for VOC concentrations. The headspace gas sampling method is provided in Appendix C4, Section C4-1.

A statistically selected portion of homogeneous solids and soil/gravel wastes will be sampled and analyzed for total VOCs, SVOCs, and metals. The approach used to statistically select drums for homogeneous solids and soil/gravel wastes is different than the method used to select waste containers for visual examination. This method is also included in Appendix C6, Section C6-2. The sampling methods for these wastes are provided in Appendix C4, Section C4-2.

The toxicity characteristic of homogeneous solids and soil/gravel wastes will be determined using total analysis of toxicity characteristic parameters, rather than the TCLP. Appendix C3 discusses comparability of these analytical results to those of the TCLP method.

Representativeness of containers selected for visual examination and waste subjected to homogeneous solids and soil/gravel sampling and analysis will be validated via examination of documentation that shows that true random samples were collected. (Because representativeness is a quality characteristic that expresses the degree to which a sample or group of samples represent the population being studied, the random sampling of waste streams ensures representativeness.)

Acceptable knowledge, along with radiography and headspace-gas sampling and analysis, is used to characterize debris waste. RCRA-regulated metals present in debris wastes are associated with specific waste materials (i.e., lead in leaded rubber gloves, leaded glass, or lead shielding). Knowledge of the materials and operations that generated these waste streams is used to determine if they contain RCRA-regulated metals. Acceptable knowledge is further explained in Section C-4b and Appendix C9.

Specific waste analysis methods are documented in the Methods Manual. Alternative methods will also be approved by the DOE/CAO Manager and accepted by the NMED. The procedure for this method of submittal and approval is provided in Appendix C7. Appendix C8 discusses required analytical method quality assurance objectives (QAO) and analytical procedures. Site-specific sampling and analysis activities will be documented in the QAPjP prepared by the generator sites, and approved by the WIPP facility personnel.

C-4 Characterization Methods

The characterization techniques used by sites include acceptable knowledge, headspace-gas sampling and analysis, radiography, and solidified waste sampling and analysis. All characterization activities are performed in accordance with the QAPP and the Methods Manual. Table C-8 provides a summary of the characterization requirements for TRU mixed waste.

As part of characterization efforts, waste containers will be tested in testing batches. A testing batch is a suite of waste containers undergoing radiography using the same testing equipment. A testing batch can be up to 20 waste containers without regard to waste matrix. Samples will be collected in sampling batches. A sampling batch is a suite of samples of similar matrix (i.e., gas or solid) collected consecutively, using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which must be collected within 14 days of the first sample in the batch. Samples will be analyzed in analytical batches. An analytical batch is a suite of samples of similar matrix (i.e., gas or solid) processed as a unit, using the same analytical method within a specific time period. An analytical batch can be up to 20 samples (excluding laboratory QC samples), all of which must be received by the laboratory within 14 days of the validated time of sample receipt of the first sample in the batch. For on-line integrated headspace-gas sampling/analytical systems, samples

will be collected and analyzed in on-line batches. An on-line batch is the number of headspace gas samples that are collected and analyzed within a 12-hour period using the same on-line integrated sampling/analysis system.

C-4a Sampling and Analytical Methods

Headspace Gas Sampling and Analysis

All TRU waste will be sampled and analyzed to determine the concentrations of VOCs (presented in Table C-9) in headspace gases. Sampling protocols, equipment, and QA/QC methods for headspace-gas sampling are provided in Appendix C4, Section C4-1. In accordance with EPA convention, identification of compounds detected by gas chromatography/mass spectrometry methods that are not on the list of target analytes must be reported. These compounds are reported as tentatively identified compounds in the waste data package and must be added to the target analyte list if detected in 25 percent of all samples from a given waste stream and if they appear in the 20 NMAC 4.1, Subpart II, 264, Appendix IX list as implemented in the QAPP. The headspace gas analysis method QAOs are specified in Appendix C8.

Homogeneous and Soil/Gravel Sampling and Analysis

The goal of sampling of homogeneous and soil/gravel wastes is to collect a sample that is representative of the waste stream. This is accomplished through core sampling, which is described in Appendix C4, Section C4-2. The waste containers for sampling and analysis are selected randomly from the population of containers for the waste stream. The random selection methodology is specified in Appendix C6.

Totals analyses for VOCs, SVOCs, and RCRA-regulated metals are used instead of the TCLP to determine waste parameters that may be important to the performance within the disposal system (Tables C-10 and C-11). If sample preparation and/or cleanup methods are required, the analyst must use the procedures specified in the Methods Manual. Alternate sample preparation or cleanup methods must be submitted for review and approval in accordance with the DOE/CAO procedure contained in Appendix C7. The generator may use the results from these analyses to determine if a waste exhibits a toxicity characteristic. The mean concentration of toxicity characteristic contaminants are calculated for each waste stream such that it can be reported with an upper 90 percent confidence limit (UCL_{90}). The UCL_{90} values for the mean measured contaminant concentrations in a waste stream will be compared to the specified regulatory levels in 20 NMAC 4.1, Subpart II, expressed as total values, to determine if the waste stream exhibits a toxicity characteristic. A comparison of total analyses and TCLP analyses is presented in Appendix C3, and a discussion of the UCL_{90} is included in Appendix C6, Section C6-3.

Laboratory Selection

The DOE will conduct analyses using laboratories that are qualified through participation in the Performance Demonstration Program (DOE, 1995c, d) and in accordance with the QAPP. These laboratories will use methods presented in SW-846, *"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"*, (EPA, 1986). In the event that the SW-846 method cannot meet program specific QAO due to the properties of TRU waste, an alternate method may be submitted to CAO for approval. Since the original method is not acceptable for use due to inability to meet QAOs, the alternative method would have to be more sensitive and stable. The methods submitted as alternatives would be more restrictive, as far as data acceptability, than SW-846 methods. Appendix C7 contains the DOE/CAO procedure for submittal and approval of alternative analytical methods. The DOE specified analytical protocols and procedures for waste characterization are published in the Methods Manual.[4] The Methods Manual acts as a unified source of information on the sampling and analytical techniques used to comply with the requirements of the QAPP. Many of the procedures found in the Methods Manual are based on analytical methods found in SW-846. In these instances, the analyst is referred directly to the SW-846 method for the requirements of the procedure. Only information unique to the waste characterization program (e.g., target analytes, QAOs, QC requirements) is included in the Methods Manual. The differences between SW-846 methods and the methods contained in the Methods Manual are presented in Appendix C12.

A performance-based approach to analytical method selection also allows individual sites the flexibility to adapt methods to meet the specified analytical method QAOs in Appendix C8. In addition, methods and supporting performance data demonstrating QAO compliance must be submitted to the CAO for review and approval in accordance with Appendix C7. Once approved, the methods will be incorporated into the Methods Manual.

Analytical methods used by the laboratories must: 1) satisfy all of the appropriate QAOs as implemented in the QAPP, and 2) be implemented through laboratory-documented standard operating procedures. These methods fulfill all of the WAP requirements. Alternative methods must demonstrate equivalency, showing that the performance characteristics of the method (e.g., detection limit, accuracy, and precision and completeness for the waste matrix in question) meet or exceed the WAP requirements and objectives. These analytical QAOs are discussed in detail in Appendix C8.

[4]Analytical procedures that have been evaluated by the DOE and shown to produce acceptable results in terms of data quality are implemented by the generator sites.

C-4b Acceptable Knowledge

RCRA regulations codified in 40 CFR Parts 260 through 265, 268, and 270, and New Mexico Hazardous Waste Management Regulations in 20 NMAC 4.1, Subparts I through Subpart VI, Subpart VIII, and Subpart IX, authorize the use of acceptable knowledge as a method which can be used in appropriate circumstances by waste generators, or treatment, storage, or disposal facilities to make hazardous waste determinations. Acceptable knowledge is defined in *Waste Analysis: EPA Guidance Manual for Facilities That Generate, Treat, Store and Dispose of Hazardous Waste* (EPA 1994) to include process knowledge, waste analysis data, and facility records of analysis performed before the effective date of RCRA regulations. Acceptable knowledge, as an alternative to sampling and analysis, can be used to meet all or part of the waste characterization requirements under RCRA (EPA 1994).

Acceptable knowledge is one of a number of techniques used to characterize TRU waste. It is used in conjunction with radiography, headspace gas sampling and analysis, and solidified waste sampling and analysis to meet the requirements of the WAP. Acceptable knowledge is used in TRU waste characterization activities in three ways:

- To delineate TRU waste streams
- To determine if TRU debris wastes exhibit a toxicity characteristic (40 CFR §261.24)
- To determine if TRU wastes are listed (40 CFR §261.31)

Acceptable knowledge is discussed in detail in Appendix C9, which outlines the minimum set of requirements which must be met by the generator sites in order to use acceptable knowledge. In addition, this appendix describes the verification of acceptable knowledge through sampling and analysis and the Generator/Storage Site Waste Screening and Acceptance Audit Program.

C-4c Radiography

Radiography is a nondestructive qualitative and quantitative technique that involves X-ray scanning of waste containers to identify and verify waste container contents. Since the system required for conducting radiography examination is fairly expensive, smaller generator sites reserve the right to conduct visual examination of waste containers in lieu of radiography. For sites that choose to use visual examination in lieu of radiography, the detection of liquid waste in non-transparent inner containers, detected from shaking the container, will be handled by assuming that any liquid that is detected is over WAC limits and the item will be rejected and/or repackaged to exclude the unacceptable characteristic. When radiography is used, or visual examination of transparent containers is performed, the same assumption will be used if the volume of liquid in inner containers is questionable. Radiography, or the equivalent, will be used on the existing/stored waste containers to verify the physical characteristics of the TRU mixed

waste correspond with its waste-stream identification/waste-stream Waste Matrix Code. This is used to determine that the sampling parameter and analysis requirements for that waste form are met. The results of radiography are verified through visual examination of a statistically selected subpopulation of CH TRU waste containers in each CH TRU waste stream. Radiographic examination protocols and QA/QC methods are provided in Appendix C4, Section C4-3.

The applicability of RTR is presented as an example of radiography in Appendix C5. However, the DOE is exploring other methods for the radiographic examination of TRU waste like digital radiography and computer tomography, which have the potential to increase the resolution of radiometric images and increase the discrimination of various waste items. These methods are being developed by DOE and private industry. Several prototype systems exist that are in the process of being validated as qualified radiographic examination methods. When these systems are completely operational and approved, per the procedure outlined in Appendix C7, they will be included in future revisions of the Methods Manual. The quality assurance, quality control and training requirements established for radiography will also apply to newly developed radiographic methods.

C-4d Quality Assurance Sampling and Analysis Requirements

The WIPP facility will assure adequate waste characterization by generator sites sending TRU mixed waste to the WIPP for disposal through appropriate data validation and usability and reporting controls. These steps will be taken at three program levels: 1) the data generation level, 2) the site project level, and 3) the WIPP facility level. These levels are shown in Figure C-5 and the validation process at each level is described in Appendix C8, Sections C8-10 and C8-11. These controls are implemented by the QAPP, by the site-prepared QAPjPs, and by site-specific SOPs. The sampling and analysis program data validation and compliance to data quality objectives (DQO) and QAOs make up the first level of control. The following general requirements must be met by the generator characterization programs:

- Raw data must be reported accurately in a pre-approved format, must be maintained in permanent files, and must be traceable.
- All data must receive a technical review by another qualified analyst, the technical supervisor, and the laboratory QA officer.
- All raw data must have the signatures of a technical supervisor and a QA officer before release.

Generator sites will be responsible for data validation and verification of waste characterization for each container and the data must be documented by release signatures from the Site Project Manager, Site Data Validation Officer, and the Site Data QA Officer. This is the second level of verification.

The DOE operates a QA/QC program to ensure and maintain the integrity of data, documents, and information associated with the management of TRU mixed waste. The following waste characterization activities are described within this subsection: QA/QC control procedures, DQOs, QAOs, data generation, data transmittal, data verification, and records management.

The WIPP will also institute QA/QC control over the waste characterization program through the Generator/Storage Site Waste Screening and Acceptance Audit Program. This audit program is discussed in Section C-5 of this chapter and Appendix C11.

QA/QC Control Practices

Waste characterization QA/QC ensures that the characterization data obtained at generator sites are suitable for regulatory compliance purposes. The WIPP facility implements stringent QA/QC over the generation, transmittal, and verification of data from waste characterization determinations. In addition, the WIPP facility extends QA/QC practices to the management of all records associated with waste shipment screening determinations.

Data Quality Objectives

As previously described, the waste characterization data obtained through this WAP implementation will be used to ensure that the WIPP facility meets regulatory requirements with regard to both regulatory compliance and to ensure that all wastes are properly managed during the Disposal Phase. The DQOs established for this plan are implemented by the QAPP. They are designed to address the specific waste characterization parameters that will be evaluated. To satisfy the RCRA regulatory compliance requirements, the following DQOs are established by this WAP and have been incorporated into the QAPP (DOE, 1995a):

- Headspace-Gas Sampling and Analysis
  - To quantify the concentrations of VOC constituents in the total waste inventory to ensure compliance with the environmental performance standards of 20 NMAC 4.1, Subpart V, §264.601(b).
- Total Analysis of Homogeneous solids and soil/gravel
  - To compare UCL_{90} values for the mean measured contaminant concentrations in a waste stream with specified toxicity characteristic levels in 20 NMAC 4.1.
  - To report the average concentration of hazardous constituents in a waste stream, as specified in 20 NMAC 2.1, Subpart II, 261, Appendix VIII, with a 90 percent confidence interval.

- Radiography
  - To verify the TRU waste streams by Waste Matrix Code for purposes of physical waste form identification and determination of sampling and analytical requirements.
- Visual Examination
  - To verify the TRU waste streams by Waste Matrix Code for purposes of physical waste form identification and determination of sampling and analytical requirements.
  - To provide a process check on a sample basis by verifying the information determined by radiography.

Reconciliation of these DQOs by the Generator/Storage Site Project Manager is addressed in Appendix C8, Section C8-11.

Quality Assurance Objectives

Each characterization method described in the QAPP has a corresponding set of QAOs that are intended to provide assurance that the data generated by that method is of known quality. The generator sites must demonstrate compliance with each QAO associated with the various characterization methods as described in the QAPP. Site Project Managers are further required to perform a reconciliation at the project level of the data sets submitted by the various organizations at the site with the DQOs established in this WAP and implemented in the QAPP. The Site Project Manager must determine that all of the DQOs have been met for the characterization of the waste stream prior to submitting a Waste Stream Profile Form to WIPP for approval (Appendix C8, Section C8-11). The following QAO elements must be considered for each technique as a minimum:

- Precision
  - Precision is a measure of the mutual agreement among multiple measurements.
- Accuracy
  - Accuracy is the degree of agreement between a measurement result and the true or known value.

- Completeness

  - Completeness is a measure of the amount of valid data obtained from a method compared to the total amount of data obtained that is expressed as a percentage.

- Comparability

  - Comparability is the degree to which one data set can be compared to another.

A more detailed discussion of the QAOs, including a mathematical representation, where appropriate, can be found in Appendix C8, which describes the QAOs associated with each method of analysis.

Sample Control

The sites will implement a sample handling and control program that will include the maintenance of field documentation records, proper labeling, and a chain of custody (COC) record. The site QAPjP will document this program and include COC forms to control the sample from the point of origin to the final analysis result reporting. WIPP will review and approve the QAPjP, including the determination that the sample control program is adequate. Details of this sample control program are provided in Appendix C4 and are summarized below to include:

- Field Documentation of samples including: point of origin, date of sample, container ID, sample type, analysis requested, and COC number.

- Proper Labeling and/or tagging including: proper sample numbering, sample ID, sample date, sampling conditions, and analysis requested.

- Chain-of-Custody control including: name of sample relinquisher, sample receiver, and the date and time of the sample transfer.

- Proper sample handling and preservation.

Data Generation

The DOE's waste characterization program implements the programmatic QA requirements in Chapter 1.0 of SW-846 (EPA, 1986), and the DOE/CAO verifies these requirements through QAPjP review and approval. The generator site QAPjPs are controlled by the QAPP. The QAPP identifies the specific requirements for all QAPjPs including: DQOs; QAOs; sampling procedures; sample custody procedures; calibration procedures and frequencies; analytical procedures; data reduction, validation, and reporting requirements; internal QC checks and frequencies;

performance and system audits and frequencies; preventive maintenance; procedures for assessing data quality; and procedures for corrective actions.

A pre-approved format will be used by each generator site for reporting waste characterization data. This form will be defined by the generator site QAPjP. The data reporting format will include all of the elements required by this WAP and implemented through the QAPP for data reports (Appendix C8, Section C8-12). The generator site must prepare data packages to meet the requirements of QAPjPs. All generator site QAPjPs are reviewed and approved by the DOE/CAO (See Appendix C10).

The DOE/CAO will perform audits of the generator site waste characterization programs to verify that site sampling, data collection, data validation, and reporting practices, as implemented by the site QAPjPs, will meet DQOs in this WAP (Generator/Storage Site Waste Screening and Acceptance Audit Program). The primary functions of these audits are to review data packages prepared by the generator sites that demonstrate adherence to the requirements of this WAP and assure adherence to the written, approved characterization program (as required by their QAPjPs). These audits ensure that implementation of the QAPjPs are consistent with the intent of the requirements of this WAP as implemented by the QAPP. Section C-5 and Appendix C11 provide additional information on the audits of the generator sites performed by the DOE/CAO.

The DOE/CAO further requires all analytical laboratories analyzing WIPP waste characterization samples for the generator sites to have established, documented QA/QC programs. The DOE/CAO annually evaluates these laboratories and their QA/QC programs as part of their participation in the laboratory performance program. The audits cover the requirements of the lab's QA/QC program as well as compliance with the method parameters specified in the Methods Manual, this WAP, and the QAPP. Continued compliance with these parameters will be verified by ongoing CAO audits. The laboratory's QA/QC program must include the following:

- Facility organization
- A list of equipment/instrumentation
- Operating Procedures
- Laboratory QA/QC Procedures
- Quality Assurance Review
- Laboratory Records Management

Data Transmittal

The DOE/CAO, through the QAPP and generator site QAPjPs, controls aspects of the waste-characterization data transmittal process. Data reports document the analytical results from the required characterization analyses and contain the characterization data plus documentation of required QA/QC activities associated with the sampling and analyses. The QAPP implements the WAP requirements for maintaining the integrity of the data in data reports by requiring data validation at both the data-generation level and the generator-site project level before the data are transmitted to the WIPP facility. Section C8-10 of Appendix C8 discusses the data validation process in more detail.

Data will be transmitted by hard copy from the data generation level to the generator site TRU mixed waste characterization project level. Transmitted data will include testing, sampling, and analytical data reports and data review checklists on forms approved under the generator sites QAPjP. Testing, sampling, and analytical data will be reported for each waste container. These data will also be input electronically into the WWIS. Data will be entered into the WWIS in the exact format required by the database (see Section C-5a for WWIS data requirements and Appendix C13 for the WWIS data dictionary). Summarized characterization information will be reported on a waste stream basis and transmitted by hard copy to the WIPP Waste Operations when requested. Hard copy data packages will include site name, program identification, waste container numbers, release signatures from the generator Site Project Manager and Site Project QA Officer, and a concise narrative summarizing the results of the site project-level review. Section C8-12 of Appendix C8 provides the format requirements for generator/storage site data reports; both hard copy and electronic. The report will briefly describe any problems or noteworthy observations (e.g., nonconformance reports, operational variances).

Once a waste stream is fully characterized, the site project manager will also submit to the WIPP facility a summary of the waste stream information and reconciliation with DQOs (Section C8-11 of Appendix C8). Based on this summary, the generator site project manager will complete a Waste Stream Profile Form (Figure C-4). This will be used as the basis for acceptance of waste characterization information on wastes to be disposed of at the WIPP.

Data Verification

The first level of data verification by the generator site will confirm that the waste characterization data are properly reported for the characterized waste containers that will be shipped to the WIPP. Data review, validation, and verification procedures used by the generator sites are required by the QAPP to assure that 100 percent of the data reported has received an independent technical review to assure that data generation and reduction were conducted in a technically correct manner, calculations have been verified correct, and all variances from accepted analytical methods (appropriate to the waste type being analyzed) have been documented and approved. Data packages will be reviewed for completeness to verify that they include field sampling records, raw analytical data, calculation records, COC documentation,

calibration records, QA sample results, and that sample holding times and preservation methods were met or exceptions documented. Completed data must be signed by the technical supervisor. At the second level of verification, the Site Project Manager, the Site Data Validation Officer, and the Site Data QA Officer will also ensure that a repeat of this review is performed for at least one randomly chosen container quarterly. Finally, a check for the data package elements required by the QAPP will be performed by the WIPP Waste Operations section as the third level of verification for data packages to assure that data packages are complete. Figure C-5 shows the components of each level of data verification. Data verification is discussed in more detail in Appendix C8, Section C8-10.

Records Management

Records related to waste characterization sampling and analysis activities at the generator sites will be maintained in the testing, sampling, or analytical facility files or site project files for those facilities located on sites. Contract waste analytical facilities will forward testing, sampling, and analytical QA documentation along with testing, sampling, and analytical batch data reports to the site project office for inclusion in site central files.

An appropriate records inventory and disposition schedule (RIDS) shall be prepared and approved by appropriate site personnel. All records relevant to an enforcement action, regardless of disposition, shall be maintained at the generator site until they are no longer needed for enforcement action, and then dispositioned per the approved RIDS. All waste characterization data and related QA/QC records in the site project files for waste to be shipped to the WIPP facility are designated according to NQA-1, Supplement 17S-1, as either Lifetime Records or Non-Permanent Records. Records that are designated as Lifetime Records shall be maintained for the life of the waste characterization program at a participating site plus six years, then offered to the DOE/CAO or transferred to the appropriate Federal Records Center (FRC). Waste characterization records designated as Non-Permanent Records shall be maintained for ten years from the date of (record) generation and then dispositioned according to their approved RIDS. If a site ceases to operate, all records shall be transferred before closeout. Table C-13 provides a listing of records designated as Lifetime Records and Non-Permanent Records.

All waste characterization data shall be maintained by DOE/CAO or WID for the active life of the WIPP facility plus two years. The active life of the WIPP facility is defined as the Disposal Phase and the Decommissioning Phase. After their active life, the records shall be retired to the FRC and maintained for 30 years. These records will then be offered to the National Archives. However, this disposition requirement does not preclude the inclusion of these records in the permanent marker system or other requirements for institutional control.

Raw data obtained by testing, sampling, and analyzing TRU waste in support of this WAP will be identifiable, legible, and provide documentary evidence of quality. The reporting requirements

are different for each technique used, but the forms for data reporting will be pre-approved forms, provided in site-specific documentation

C-5 Verification for TRU Mixed Waste

The third level of data verification, which is performed at the WIPP facility, involves screening and verification of waste stream data and waste shipments. Documentation on waste streams will be screened and verified to ensure that the waste is acceptable for disposal at the WIPP facility according to applicable RCRA requirements. Quality controls related to waste labeling, identification, transport, and screening will ensure that the waste packages arriving at the WIPP facility are the same as those transported from the generator sites and are correctly identified on the EPA Hazardous Waste Manifest.

WIPP waste screening is a two-phased process. Phase I will occur prior to transporting the waste to the WIPP facility. Phase II will occur after the waste shipment arrives but before it is emplaced. Figure C-6 presents the waste shipment screening process.

C-5a Phase I Waste Stream Screening and Verification

The first phase of the waste screening and verification process will occur before waste is shipped to the WIPP site. Before WIPP will begin the process of accepting waste from a generator site, an initial audit of that site will be conducted as part of the Generator/Storage Site Waste Screening and Acceptance Audit Program (Appendix C11). The RCRA portion of the generator site audit program will provide on-site verification of characterization procedures, data package preparation, and recordkeeping. The secondary verification step is the waste-characterization data package completeness/accuracy review and acceptance by the WIPP as part of the Waste Stream Profile Form approval process. At the WIPP facility, screening includes verification that all of the required elements of a data package are present (Appendix C8, Section C8-12) and that the waste characterization data meet acceptance criteria required for compliance with the WAP.

Once a generator site has prepared a QAPjP in accordance with the QAPP, it is submitted to the DOE/CAO for review and approval (See Appendix C10). The generator site will implement the specific parameters of the QAPjP once it is approved. The initial site RCRA audit will be performed at some point after this implementation has taken place and before a Waste Stream Profile Form has been submitted to the WIPP for approval. The checklists used in this audit will be based on each site's QAPjP. Additional audits, focusing on results of waste characterization, will be performed at least annually. The WIPP has the right to conduct unannounced audits and to examine any records that are related to the scope of the audit. More detail about this audit program is provided later in this section and in Appendix C11.

When the required waste stream characterization data have been collected by a generator and the initial site audit has been successfully completed, the generator Site Project Manager can

verify that waste stream characterization meets the WAP requirements as a part of the Level 2 data verification required by the QAPP (Appendix C8, Section C8-11). If the waste characterization does not meet the requirements of the WAP, the waste stream cannot be sent to the WIPP until those requirements are met. The generator will complete a Waste Stream Profile Form and submit it to Waste Operations, along with the accompanying waste characterization documentation for that waste stream. This provides notification that the generator considers that the waste stream (identified by the waste stream identification number) has been adequately characterized for disposal according to the WIPP facility approved QAPjP and QAPP DQOs.

The Waste Stream Profile Form is provided as Figure C-4. It includes information on the generator site name and EPA identification number, the technical contact for information on that waste stream, the WIPP ID, Summary Category Group, listing of acceptable knowledge documentation used, and waste characterization data package identification numbers associated with that waste stream. The form also requires the date of the WAC certification for that waste stream, procedures used for characterization, and EPA Hazardous Waste Code designations. Upon WIPP facility approval of the waste stream for disposal through the use of the Waste Stream Profile Form, the generator may begin shipping waste containers from that waste stream.

As part of the waste characterization data submittal, the generator site will also transmit the data on a container basis via the WWIS database. This data submittal can occur at any time as the data are being collected. The system will conduct internal limit checks as the data are entered, and the data will be available to WIPP personnel for review as supporting information for Waste Stream Profile Form review.

If discrepancies arise as a result of this review, the generator sites will be contacted by WIPP Waste Operations and required to provide the necessary additional information to resolve the discrepancy before that waste stream is approved for disposal at the WIPP facility. If the discrepancy is not resolved, the waste stream will not be approved.

WIPP WWIS Description

The WWIS is an electronic database that contains information and data related to the characterization, certification, and the shipment of waste destined for WIPP. The database design contains different modules for waste characterization data (as required by the QAPP and RCRA), waste certification data (as required by the WAC), and transportation data (as required by the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC). The database contains edit, limit, and other data check functions to ensure that data supplied meet the requirements and the limits of the QAPP, RCRA, the WAC, and the TRAMPAC. All TRU waste sites planning to ship waste to WIPP will supply the required data to the WWIS. The WWIS will verify that all of the supplied data meet the edit and limit checks prior to the shipment of any waste to WIPP. The WWIS database will notify the generator site if any of the supplied data fails to meet the requirements of the edit and limit checks via an appropriate error message. The generator site

will be required to correct the discrepancy with the waste or the waste data and re-transmit the corrected data prior to acceptance of the data by the WWIS. WIPP facility personnel will review data reported for each container of each shipment prior to providing notification to the shipping site that the shipment is acceptable. Table C-12 gives a partial listing of the data fields contained in the WWIS.

The WWIS will generate the following:

- Container Emplacement Report

  This report will be added to the operating record as an indication of the quantities of waste, date of emplacement, and location in the repository. This report will be generated on a shipment basis. Reports that are included as part of the operating record will be retained at the site, for the life of the facility.

- Shipment Summary Report

  This report will contain the container IDs of every container in the shipment, listed by TRUPACT-II number and by assembly number (for seven packs), for every assembly in the TRUPACT-II. This report is used by Waste Operations to verify containers in a shipment and will be generated on a shipment basis.

- Characterization Data Report

  This report will be generated on a waste stream basis and will be used by the WIPP in the Waste Stream Profile Form review and approval process. This report will contain the data listed in the Waste Characterization Data Module on Table C-12. This report will be generated and attached to the Waste Stream Profile Form for inclusion in the facility operating record and will be kept for the life of the facility.

- Reports of Change Log

  This will consist of a short report that lists the user ID and the fields changed. The report will also include a reason for the change. A longer report will list the information provided on the short report and include a before and after image of the record for each change, a before-record for each deletion, and the new information for added records. These reports provide an auditable trail for the data in the database.

Access to the WWIS will be controlled by a Data Administrator (DA) of the Waste Operations section who will control the WWIS users based on approval from management personnel. Integrity of the WWIS data will be maintained by strict access control to the database. The WWIS system is located in a limited access area within the WIPP site. Access to the computer room area where the WWIS system will reside is controlled through a cipher lock door system whose combination is only granted to authorized personnel. This computer room also houses the systems that provide the WIPP local and wide area networks, and is staffed by experienced computer operators on a 24 hour basis.

The WWIS will be included in the contingency planning performed by the Information Technology Resources (ITR) Section at the WIPP site. This section operates the computer room. This planning includes dual storage (other than the computer room) of software backup tapes that will permit rapid restart of the system.

The computer room is provided with power by a uninterruptible power supply system that can provide clean, harmonic filtered power for 30 minutes after the loss of the primary power supply. This will provide for an orderly shutdown of the database.

Nightly backups of the WWIS system will occur as part of the overall backup program for all of the systems. The database can be restarted, if for whatever reason, a catastrophic failure occurs using the previous day's backup copy. In addition to the nightly backup procedure, the database will be archived quarterly and annually. The archived copies will be included in the operating record and retained for the life of the facility.

The WWIS system hardware and application software is constructed using client-server architecture. The client software will provide the user interface and communication to the server. This limits user access only to those database functions approved by the WIPP, such as allowing the small quantity generator sites to populate a defined data structure established on the system for them by the WIPP. Onsite terminals are located within controlled access areas designated for use by authorized WWIS users. Offsite access will be by direct log in through multi-layer password/user ID methodology. The first layer of control will provide authorized access to the WIPP network, the second layer will provide authorized users access to the WWIS system, and the third layer defines the specific functions of the WWIS that each user has been assigned. Access to the various WWIS functions is controlled by the WWIS DA. All access attempts will be logged by the system. Waste Operations and ITR personnel will routinely review the logs for the purpose of identifying and investigating unauthorized access attempts.

The TRU waste generator sites will only have access to data that they have supplied, and only until the data have been formally accepted by the WIPP. After the data have been accepted, the data will be protected from indiscriminate change and can only be changed by a qualified DA.

The database has a Data Change Log that will require a reason for the change from the DA prior to accepting the change. The data change information, the user ID of the qualified DA making the change, and the date of the change will be recorded in the data change log automatically. The data change log cannot be revised by any user, including the DA. The data change log will be subject to internal and external audits and will provide an auditable trail for all changes made to previously approved data.

Examination of the Waste Stream Profile Form

Members of the Waste Operations section will be responsible for the verification of completeness and accuracy of the Waste Stream Profile Form. This verification will consist of a review of the Waste Stream Profile Form by the Environmental Compliance and Support section and the Quality Assurance department. These groups will review the Waste Stream Profile Form based on their area of responsibility. Of particular importance are the assignment of the waste-stream description, Waste Matrix Code Group, and Summary Category Groups, the results of waste analyses, the acceptable knowledge documentation, the methods used for characterization, the WAC certification, and appropriate designation of EPA hazardous waste code(s). If the waste stream profile form is considered to be inaccurate, efforts will be made to resolve discrepancies by contacting the generator site. If discrepancies in the waste stream are detected at the generator site, the QAPP requires the site to implement a non-conformance program to identify, document, and report discrepancies (Appendix C8, Section C8-13). The QAPP requires that site management at all levels shall foster a "no fault" attitude to encourage the earliest identification of discrepancies and/or deviations from protocols. The Waste Stream Profile Form must pass all verification checks at the WIPP facility in order for the waste stream to be approved for shipment to the WIPP facility.

The identified EPA hazardous waste codes for the wastes that appear on the Waste Stream Profile Form will be compared to those in the WIPP RCRA Part A to ensure that only wastes that contain constituents contained in the Part A are approved for shipment to the WIPP. The analytical data package summaries will be reviewed to verify that the waste has been classified correctly. The analytical method used will be compared to those listed in Tables C-9, C-10, and C-11 to assure that only approved analytical methods were used for analysis of the waste. Waste Operations will verify that WAC certification has been granted to the generator.

Environmental Compliance and Support will verify three different types of data related to WAC on every container holding TRU mixed waste before a shipment leaves the generator site for the WIPP facility. The three verifications will be performed on data from the following determinations: 1) an assignment of the waste stream's waste description (by waste matrix codes) and Waste Matrix Code Group; 2) a determination of ignitability, reactivity, and corrosivity; and 3) a determination of compatibility. The verification of waste stream description will be performed by reviewing the waste characterization data package for consistency in the waste stream description. The data package will also indicate if the waste has been checked for the characteristics of ignitability, corrosivity, and reactivity. The final verification of waste

compatibility will be performed using Appendix C1, the compatibility study. Since the Part A does not include hazardous waste codes that are not consistent with the WAC, a consistency check between the hazardous waste codes listed in the data package for the waste stream and the hazardous waste codes listed on the Part A will verify that the waste stream is not ignitable, corrosive, or reactive, and that it is compatible with the other waste to be disposed of at the WIPP facility.

Generator/Storage Site Waste Screening and Acceptance Audit Program

An important part of the WIPP's verification process is the Generator/Storage Site Waste Screening and Acceptance Audit Program implemented by representatives of the DOE/CAO and WID. The focus of this audit program is compliance with the QAPP, site QAPjPs, this WAP, and the RCRA. The RCRA compliance portion of the audits will be performed by the Environmental Compliance and Support section. This audit program addresses all waste sampling and analysis activities, from waste-stream classification assignment through final loading of the TRUPACT-II or shielded road cask, and ensures that SOPs are being followed and the QAPjPs are fully implemented. Audits will assure that containers and their associated documentation are adequately tracked throughout the waste handling process. Operator qualifications will be verified, and QA/QC procedures will be surveyed. Results of all generator site audits will be kept in the WIPP facility operating record until closure of the facility.

An initial audit will be performed at each generator site performing waste characterization activities prior to the formal acceptance of the Waste Stream Profile Forms and/or any waste characterization data supplied by the sites. Audits will be performed at least annually thereafter, including the possibility of unannounced audits (this means not a regularly scheduled audit). These audits will verify that the generator site has implemented a QA program for the characterization of waste. The accuracy of physical waste description and waste stream assignment provided by the generator site will be verified by review of the radiography results, and visual examination of data records and radiography videotapes (as necessary) during audits. More detail on this audit process is provided in Appendix C11.

C-5b Phase II Waste Shipment Screening and Verification

Phase II of the waste shipment screening and verification process includes examination of a waste shipment after the waste shipment has arrived. The second-phase determinations are: 1) a determination of the completeness and accuracy of the EPA Hazardous Waste Manifest; 2) a determination of waste shipment completeness; 3) a determination of land disposal restriction notice completeness; and 4) an identification and resolution of waste shipment irregularities. Only those waste containers that pass all Phase II waste-screening determinations will be emplaced at the WIPP. For each container shipped, the generator site must provide the following information:

Typical Hazardous Waste Manifest Information:

- Generator site name and EPA ID
- Generator site contact name and phone number
- Quantity of waste
- List of the hazardous waste codes in the shipment
- Listing of all container IDs
- Signature of authorized generator representative

Typical Land Disposal Restriction Notice Information:

- EPA Hazardous Waste Number(s)
- Applicable treatment standards for F001-F005 wastes (D001-D003 wastes prohibited by the WAC)
- Supporting analyses and/or references to previously supplied analytical data (Such as Characterization Reports and data submitted to the WWIS)

Specific Container information:

- Waste Stream Identification Number
- List of Hazardous Codes per Container
- Certification Data (Nuclide info, etc.)
- Shipping Data (Assembly numbers, ship date, shipping category, etc.)

This information must also be supplied electronically to the WWIS and may be provided to the WWIS as part of the Phase I Screening or may be supplied at the time of shipment.

Waste Operations personnel will verify that all this information is provided for each container received. The ID will be compared with a list of those approved for disposal at the WIPP.

Examination of the EPA Uniform Hazardous Waste Manifest and Associated Waste Tracking Information

Upon receipt of a waste shipment, Waste Operations will make a determination of EPA Uniform Hazardous Waste Manifest completeness and sign the manifest to allow the driver to depart. Waste Operations will make a determination of waste shipment completeness by checking the unique, bar-coded identification number found on each container holding TRU mixed waste after opening the TRUPACT-II or shielded road cask. The bar-coded identification number(s) will be noted and checked against the WWIS database. The RH waste canister has a unique identification number stamped into it which will be verified in the Hot Cell during transfer to the facility cask. The WWIS computer database will maintain waste container receipt and emplacement information provided by the WIPP site. It will include, among other items, the following information associated with each container of TRU mixed waste:

- Package (container) receipt date
- Overpack identification number (if appropriate)
- Package (container) emplacement date
- Package (container) emplacement location (panel/room)

The WWIS links the bar-coded identification numbers of all containers in a specific waste shipment to the waste assembly (for 7-packs) and to the shipment identification number, which is also written on the EPA Hazardous Waste Manifest. Generators electronically transmit the waste shipment information to the WWIS before the waste shipment is transported. Once a waste shipment arrives, WIPP facility personnel can verify the identity of each container using the data already in the WWIS.

If there are discrepancies on the manifest, the generator will be contacted for resolution. A manifest discrepancy is a difference between the quantity or type of hazardous waste designated on the manifest and the quantity or type of hazardous waste a facility actually receives. Manifest discrepancy resolution is accomplished by contacting the generator site technical contact (as listed on the manifest). If the discrepancy is identified prior to the containers being removed from the TRUPACT-II, the waste will be retained in the parking area. If the discrepancy is identified after the waste containers are removed from the TRUPACT-II, the waste will be retained in the WHB. Errors on the manifest can be corrected by the accepting facility with a verbal concurrence by the generator. Discrepancies not resolved within 15 days of receiving the waste will be reported to the NMED. Notifications to the NMED will consist of a letter describing the discrepancies, attempts to reconcile the discrepancies, and a copy of the manifest. If the waste containers reside in the TRUPACT-II and the manifest discrepancies have not been resolved within 30 days of waste receipt, the shipment will be returned to the generator/storage facility. If it becomes necessary to return waste containers to the generator site, a new EPA Uniform Hazardous Waste Manifest will be prepared.

Documentation of the returned containers will be covered by Waste Operations protocols and the WWIS. Changes will be made to the WWIS data to indicate the current status of the container(s), and a reason will be required to change the data. This reason, plus the record of the WWIS data change will be maintained in the change log of the WWIS and will provide an auditable record of the returned shipment.

The Waste Operations section will be responsible for resolution of discrepancies, notification of the NMED, as well as returning the original copy of the manifest to the generator. The manifest will be returned within 30 days of delivery of the waste.

Examination of the Land Disposal Restriction (LDR) Notice

Unless TRU mixed waste is otherwise exempted from the LDRs, the DOE intends to petition the EPA for a variance from the prohibition on land disposal of untreated TRU mixed waste at the WIPP facility. If successful, the WIPP facility may dispose of the restricted waste. With each waste shipment of LDR waste, the generator must provide the WIPP facility with a LDR determination and a notice that the waste is not prohibited from land disposal because the waste is covered by a no-migration determination (NMD). (This assumes that a Disposal-Phase NMD will be made by the EPA. Wastes will be in conformance with conditions of the NMD.) WIPP facility personnel will review this notice for accuracy and completeness. The generator will prepare this notice in accordance with the requirements of 20 NMAC 4.1, §268.7(a)(3).

Verification

Waste Operations will make a determination of waste shipment irregularities. The following items will be noted for each waste shipment arriving at the WIPP facility:

- The number and type of containers holding TRU mixed waste match the information in the WWIS
- Container defects

Waste Operations will verify that the containers (as identified by their container ID numbers) are the containers for which accepted data already exists in the WWIS. A check will be performed by Waste Operations comparing the data on the WWIS Shipment Summary Report for the shipment to the actual shipping papers (including the EPA Hazardous Waste Manifest). This check also verifies that the containers included in the shipment are those for which approved shipping data already exist in the WWIS Transportation Data Module (Table C-12). For SWBs and TDOPs, this check will include comparing the barcode on the container with the shipping papers and the data on the WWIS Shipment Summary Report. For 7-pack assemblies, one of the seven container barcodes will be read by the barcode reader and compared to the assembly information for this container on the WWIS Shipment Summary Report. This will automatically identify the remaining six containers in the assembly. This process enables Waste Operations

to identify all of the containers in the assembly with minimum exposure. If all of the container IDs and the information on the shipping papers agree with the WWIS Shipment Summary Report, the operator is assured that the containers have been approved for disposal at the WIPP facility.

Waste Shipment Screening QA/QC

Waste shipment screening QA/QC ensures that waste received is that which has been approved for shipment during the Phase I screening. This is accomplished by maintaining stringent QA/QC control of the waste shipment screening process. The screening process will be controlled by administrative processes which will generate records documenting waste receipt that will become part of the waste receipt record. The waste receipt record documents that container identifications correspond to shipping information and approved waste streams. The WIPP extends QA/QC practices to the management of all records associated with waste shipment screening determinations.

Records Management

As part of the WIPP facility's operating record, data and documents associated with waste characterization data are managed in accordance with standard records management practices. The storage of WIPP's copy of the manifest, LDR information, waste characterization data, waste stream profile forms, and other related records will be identified on the appropriate records inventory and disposition schedule for Waste Operations.

Waste characterization data and documents related to waste characterization that are part of the WIPP facility operating record are managed in accordance with the following guidelines:

General Requirements

- Records must be legible
- Corrections must be made with a single line through the incorrect information, and a date and initial of the person making the correction
- Records must be paginated indicating the total number of pages that make up the record
- Black ink is encouraged, unless a copy test has been conducted to ensure the other color ink will copy
- Use of highlighters on records is discouraged
- Records must be reviewed for completeness
- Records must be validated by the cognizant manager

Records Storage

- Active records must be stored when not in use

- Quality records must be kept in a one-hour (certified) fire-rated container or a copy of a record must be stored separately (sufficiently remote from the original) in order to prevent destruction of both copies as a result of a single event such as fire or natural disaster
- Unauthorized access to the records is controlled by locking the storage container or controlling personnel access to the storage area

The following records will be maintained for waste characterization purposes as part of the WIPP facility operating record:

- Completed WIPP Waste Stream Profile Forms and accompanying documentation
- Completed Waste Receipt Checklists
- WIPP WWIS Container Emplacement Report
- Audit reports and corrective action reports from Generator/Storage Site Waste Screening and Acceptance Audit Program audits

These records will be maintained for each TRU mixed waste container managed at the WIPP facility.

Records at the WIPP facility will be managed in accordance with the CAO Quality Assurance Program Description (QAPD) record management requirements. The QAPD provides for generation of QA records; QA guidelines; indexing of QA records; classification of QA records; receipt of QA records; storage, preservation, and disposition of QA records; and retrieval of QA records.

Waste Shipment Tracking QA/QC

The Transportation Tracking and Communications System is a unique waste shipment monitoring system that will provide 24-hour-per-day feedback to the WIPP facility via satellite on the location and status of each waste shipment during transport.

C-6 List of References

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TABLES

TABLE C-1
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Homogeneous Solids—S3000	Solidified Inorganics	1000	AL-W005	Solidified Aqueous Liquids/Slurries				
	Solidified Inorganics	3150	IN-W157	Solidified Process Residues	ID 213	004	4	Solidified Liquid
	Solidified Inorganics	3150	IN-W166	Solidified Process Residues	ID 114	114	1	Inorganic Process Solids and Soils
	Solidified Inorganics	3150	IN-W177	Solidified Process Residues		835		
	Solidified Inorganics	3150	IN-W179	Solidified Process Residues	MD 111A	836	1	
	Solidified Inorganics	3150	IN-W181	Solidified Process Residues	ID 211A	978	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3150	IN-W188	Solidified Process Residues	ID 211A	976	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3150	IN-W216	Solidified Process Residues	ID 211A	001	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3150	IN-W220	Solidified Process Residues	ID 111	111	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3113	IN-W221	Absorbed Aqueous Liquids	ID 113	113	4	Solidified Liquid
	Solidified Inorganics	3150	IN-W222	Solidified Process Residues	ID NYD	292		
	Solidified Inorganics	3121	IN-W228	Solidified Wastewater Treatment Sludges	ID 211A	002	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3150	IN-W332	Solidified Process Residues		204		
	Solidified Inorganics	3113	IN-W347	Absorbed Aqueous Liquids		102		

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Homogeneous Solids—S3000	Solidified Inorganics	---	LA-W002	Solidified Aqueous Waste	LA 111A; 211A	002	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	---	LA-W003	Dewatered Sludge	LA 111B; 211B	003	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	---	LA-W006	Cemented Process Residues	LA 114A	006	1	Inorganic Process Solids and Soil
	Solidified Inorganics	---	LL-W019	Solidified Waste	LL 111	002	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3150	MD-W002	Absorbed Aqueous Liquids				
	Solidified Inorganics	3120	OR-W042	Inactive Storage Tank Contents—MTRU Sludge				
	Solidified Inorganics	1220	PA-W014	Solidified TRU Waste Liquids				
	Solidified Inorganics	3129	PA-W015	TRU Solid				
	Solidified Inorganics	1190	PA-W015A	TRU and Technetium Waste				
	Solidified Inorganics	3150	RF-M001	Solidified Process/TRM	RF 114	806	1	Inorganic Process Solids and Soils
	Solidified Inorganics	3150	RF-W010	Solidified Aqueous Sludge/ TRM	RF 111	800 803 807	1	Inorganic Waste Water Treatment Sludge
	Solidified Inorganics	3121	RF-W038	Solidified Laboratory Waste/TRM	RF 113	802	4	Solidified Liquid

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Homogeneous Solids—S3000	Solidified Inorganics	3111	RF-W040	Incinerator Ash/TRM		419 420 421 425 428		
	Solidified Inorganics	3119	RF-W059	Sand, Slag, and Crucible/ TRM		387 392 390 393 395 394 396 399 391		
	Solidified Inorganics	1190	RF-W063	Miscellaneous TRM		070 503 400 508 401 527 500 541		
	Solidified Inorganics	6290	RF-W065	Calcium Metal/TRM		333		
	Solidified Inorganics	3129	RF-W068	Particulate Sludge/TRM		292 299 372 823		
	Solidified Inorganics	3119	RF-W076	Process Residues/TRM		289 372 292 422 299 423 340		
	Solidified Inorganics	---	RL-M005	TRU Mixed Homogeneous Solids with Mercury				
	Solidified Inorganics	---	RL-M032	TRU Mixed Inorganic Homogeneous Solids				

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Homogeneous Solids—S3000	Solidified Inorganics	3111	SR-W053	Ash				
	Solidified Inorganics	3129	IN-W146	Uncategorized Inorganic Sludges				
	Solidifed Inorganics	3000	OR-W046	Solidified Liquid Low Level Waste Tanks - Sludge				
	Solidified Organics	3150	IN-W167	Solidified Process Residues	ID 112	112	4	Organic Liquid and Sludge
	Solidified Organics	3113	IN-W174	Absorbed Aqueous Liquids		834		
	Solidified Organics	3114	IN-W309	Organic Setups	ID 212	003	4	Organic Liquid and Sludge
	Solidified Organics	3222	RF-W013	Solidified Organics/TRM	RF 112	801	4	Organic Liquid and Sludge
	Solidified Organics	3212	RF-W069	Organic Resins/TRM	RF 126	430 431 809	3	Cation and Anion Exchange Resins
	Solidified Organics	---	RL-M017	TRU Mixed Organic Labpacks				
	Solidified Organics	---	RL-M018	TRU Mixed Organic Labpacks (State only)				
	Solidified Organics	---	RL-M024	TRU Mixed Organic Labpacks with polychlorinated biphenyls (PCB)				
	Solidified Organics	2000	SR-W006	Organic TRU				
	Salt Waste	3140	IN-W311	Salt Waste		409		
	Salt Waste	3140	IN-W312	Salt Waste	ID 124	124	2	Pyrochemical Salt
	Salt Waste	3140	IN-W314	Salt Waste		409		

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Homogeneous Solids—S3000	Salt Waste	3141	RF-W058	Miscellaneous Pu Recovery By-products/TRM	RF 124	365 414 404 415 405 418 406 427 407 429 408 433 409 434 410 435 411 473 412 654 413	2	Pyrochemical Salt
	Salt Waste	---	IN-M001	Electrorefiner Stripped Salts—Barium (Ba) & Cadmium (Cd)				
Soils/Gravel—S4000	Soils	4200	IN-W263	Contaminated Soils/Debris	MD 111B	842	1	
	Soils	---	RL-M007	TRU Mixed Soils without Mercury				
Debris Waste—S5000	Combustible	5310	IN-W198	Plastic/Rubber Debris	ID 216C	337	3	Combustibles
	Combustible	5320	IN-W202	Wood Debris	ID 216A	970	3	Combustibles
	Combustible	5300	IN-W205	Combustible Debris	ID 216B	900	3	Combustibles
	Combustible	5311	IN-W250	Leaded Gloves/Aprons Debris	ID 123	123	3	Leaded Rubber
	Combustible	5311	IN-W252	Leaded Gloves/Aprons Debris	ID 123; 223A	339	3	Leaded Rubber
	Combustible	5311	IN-W254	Leaded Gloves/Aprons Debris	ID 223A	463	3	Leaded Rubber
	Combustible	5311	IN-W256	Leaded Gloves/Aprons Debris		802		

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Combustible	5300	IN-W325	Unknown Solids		815		
	Combustible	5300	IN-W327	Combustible Debris		847		
	Combustible	5310	IN-W330	Plastic/Rubber Debris		801		
	Combustible	5300	IN-W336	Combustible Debris		202		
	Combustible	---	LA-W004	Combustible Waste	LA 116A	004	3	
	Combustible	---	LL-M001	Research and Development Glovebox Waste	LL 116	001	3	
	Combustible	---	RL-M009	TRU Mixed Organic Debris with Corrosives				
	Combustible	---	RL-M010	TRU Mixed Organic Debris with Mercury				
	Combustible	---	RL-M011	TRU Mixed Organic Debris without Mercury				
	Combustible	---	RL-M012	TRU Mixed Organic Debris/ Contaminated without Organics				
	Combustible	---	RL-M013	TRU Mixed Organic Debris/ Contaminated with Organics				
	Combustible	---	RL-M014	TRU Mixed Leaded Gloves/ Aprons with Mercury				
	Combustible	---	RL-M015	TRU Mixed Leaded Gloves/ Aprons Metals without Mercury				

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Combustible	---	RL-M016	TRU Mixed Leaded Gloves/ Aprons Metals/Organics without Mercury				
	Combustible	---	RL-M022	TRU Mixed Leaded Gloves/ Aprons PCBs with Mercury				
	Combustible	---	RL-M023	TRU Mixed Resource Conservation and Recovery Act (RCRA) Organic Debris with PCBs				
	Filter	5410	IN-W214	Composite Filters		813		
	Filter	5410	RF-W066	Filters & Media/TRM	RF 119	328 376 331 490 335 491 342	3	Filters
	Filter	5410	RF-W067	Cemented Filters/TRM	RF 119	376 338	3	Filters
	Filter	5410	AW-M003	TRU Waste Used Pre-filters				
	Graphite	5000	IN-W272	Debris Waste	ID 115	312	2	Graphite
	Graphite	5000	IN-W275	Debris Waste		301		
	Graphite	5000	IN-W276	Debris Waste	ID 215A	300	2	Graphite
	Graphite	3119	RF-W060	Coarse Graphite/TRM	RF 115	303 312	2	Graphite
	Heterogeneous	5440	IN-W169	Predominantly Combustible Debris	ID 216C	330	3	Combustibles

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Heterogeneous	5440	IN-W170	Predominantly Combustible Debris	AE 116A AE 116B	120		Combustibles
	Heterogeneous	5440	IN-W171	Predominantly Combustible Debris	AE 116A AE 116B	110		Combustibles
	Heterogeneous	5440	IN-W172	Predominantly Combustible Debris		010		
	Heterogeneous	5440	IN-W186	Predominantly Combustible Debris	ID 116	116	3	Combustibles
	Heterogeneous	5440	IN-W189	Predominantly Combustible Debris	ID 221A	464	3	Benelex® and Plexiglas®
	Heterogeneous	5440	IN-W197	Predominantly Combustible Debris	ID 216A	336	3	Combustibles
	Heterogeneous	5440	IN-W203	Predominantly Combustible Debris		826		
	Heterogeneous	5440	IN-W204	Predominately Combustible Debris	MD 116A	827	3	
	Heterogeneous	5440	IN-W225	Predominantly Combustible Debris	ID 221A	302	3	Benelex® and Plexiglas®
	Heterogeneous	5400	IN-W259	Heterogeneous Debris		104		
	Heterogeneous	5430	IN-W265	Predominately Inorganic Nonmetal Debris	ID 121	374	3	Benelex® and Plexiglas®
	Heterogeneous	5000	IN-W269A	Debris Waste		150		
	Heterogeneous	3190	IN-W271	Uncategorized Inorganic Process Residues		814		

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Heterogeneous	5400	IN-W281	Heterogeneous Debris	MD 117A	824		
	Heterogeneous	5400	IN-W283	Heterogeneous Debris	ID 225A	241	3	Combustibles and Noncombustibles
	Heterogeneous	5400	IN-W285	Heterogeneous Debris		201		
	Heterogeneous	8200	IN-W289	Unknown Solids	AE 116A	121		
	Heterogeneous	5000	IN-W291	Debris Waste		100		
	Heterogeneous	8200	IN-W302	Unknown Solids		020		
	Heterogeneous	5400	IN-W329	Heterogeneous Debris		848		
	Heterogeneous	5000	IN-W334	Debris Waste		203		
	Heterogeneous	5000	IN-W345	Debris Waste		155		
	Heterogeneous	5000	IN-W351	Debris Waste		105		
	Heterogeneous	5490	NT-W001	Heterogeneous Debris, Uncategorized	NT 111; 116; 211; 225		1 & 3	
	Heterogeneous	5400	OR-W044	CH TRU Heterogeneous Debris	OR 125A; 125B		3	
	Heterogeneous	8000	OR-W045	CH TRU Uncategorized				
	Heterogeneous	5400	OR-W047	CH TRU Heterogeneous Debris				
	Heterogeneous	5330	RF-M002	Supercompacted Combustibles/TRM	RF 116C	2116	3	Combustibles

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Heterogeneous	5900	RF-W008	Soil & Cleanup Debris/TRM	RF 121	374	3	Benelex® and Plexiglas®
	Heterogeneous	5330	RF-W012	Combustibles/TRM	RF 116	330 831 336 832 337 833	3	Combustibles
	Heterogeneous	3119	RF-W036	Firebrick, Pulverized or Fines/ TRM	RF 122	377 378	2	Firebrick and Ceramic Crucibles
	Heterogeneous	---	RL-M004	TRU Mixed Heterogeneous Debris (State only)				
	Heterogeneous	---	RL-M006	TRU Mixed Inorganic Homogeneous Solids without Mercury				
	Heterogeneous	---	RL-M031	TRU Mixed Heterogeneous Debris (State only)				
	Heterogeneous	8900	SA-W134	TRU Waste at Hot Cell Facility				
	Heterogeneous	5400	SR-W026	Heterogeneous Debris				
	Heterogeneous	5400	SR-W027	Heterogeneous Debris				
	Heterogeneous	5400	AW-W020	TRU-Cd-Hot Cell Waste				
	Heterogeneous	---	IN-M002	TRU-Cd-Hot Cell Waste				
	Heterogeneous	---	IN-W139	TRU Contaminated Lead Debris				
	Heterogeneous	---	IN-W269B	Debris Waste		150		
	Heterogeneous	5440	IN-W323	Predominantly Combustible Debris		153		

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Heterogeneous	5000	KA-W016	TRU Debris				
	Heterogeneous	5400	OR-W040	RH TRU Heterogeneous Debris				
	Heterogeneous	5400	RL-M201	Projected RH-MTRU Waste				
	Inorganic Nonmetal	5230	IN-W161	Ceramic/Brick Debris	ID 122; 222B	371	2	Firebrick and Ceramic Crucibles
	Inorganic Nonmetal	5200	IN-W230	Inorganic Nonmetal Debris	ID 122	122	2	Firebrick and Ceramic Crucibles
	Inorganic Nonmetal	5220	IN-W240	Glass Debris	ID 118	118	2	Glass
	Inorganic Nonmetal	5220	IN-W243	Glass Debris	ID 218B	440	2	Glass
	Inorganic Nonmetal	8900	IN-W245	Uncategorized Unknown	ID 225B	441	3	Combustibles and Noncombustibles
	Inorganic Nonmetal	8900	IN-W247	Uncategorized Unknown	ID 218A	442	2	Glass
	Inorganic Nonmetal	8900	IN-W249	Uncategorized Unknown		810		
	Inorganic Nonmetal	5250	MD-M001	Asbestos Debris				
	Inorganic Nonmetal	3114	RF-W026	Used Absorbents/TRM	RF 122	375	2	Firebrick and Ceramic Crucibles
	Inorganic Nonmetal	3119	RF-W032	Ground Glass/TRM	RF 118	444	2	Glass
	Inorganic Nonmetal	5122	RF-W052	Glass/TRM	RF 118	440 442 441 856	2	Glass

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Inorganic Nonmetal	5123	RF-W056	Magnesium (Mg) Oxide Crucibles/TRM	RF 118	370 368 655	2	Glass
	Inorganic Nonmetal	5129	RF-W057	Insulation/TRM	RF 122	438	2	Firebrick and Ceramic Crucibles
	Lead/Cadmium Metal Waste	5400	AW-M001	ALHC Upgrade Decon Debris				
	Lead/Cadmium Metal Waste	5311	AW-M002	Lead/Cadmium Metal Waste				
	Lead/Cadmium Metal Waste	---	ET-M001	Hot Laboratory & Pu Facility D&D				
	Lead/Cadmium Metal Waste	5311	RF-W029	Leaded Gloves/TRM	RF 123	339	3	Leaded Rubber
	Lead/Cadmium Metal Waste	5311	RF-W041	Leaded Gloves-Acid Contaminated/TRM		341		
	Lead/Cadmium Metal Waste	---	RL-M019	TRU Mixed Elemental Hazardous Metals with Mercury				
	Lead/Cadmium Metal Waste	---	RL-M020	TRU Mixed Elemental Hazardous Metals without Mercury				
	Lead/Cadmium Metal Waste	3190	AW-W016	Electrorefiner Stripped Cadmium				
	Lead/Cadmium Metal Waste	3150	AW-W022	Electrorefiner Insolubles with Cadmium				

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Lead/Cadmium Metal Waste	---	IN-M004	Electrorefiner Stripped Cadmium				
	Lead/Cadmium Metal Waste	---	IN-M005	Electrorefiner Insolubles with Cadmium				
	Uncategorized Metal	3100	IN-W260A	Inorganic Process Residues		040		
	Uncategorized Metal	5100	IN-W280	Metal Debris		803	1	
	Uncategorized Metal	5100	IN-W287	Metal Debris		101		
	Uncategorized Metal	5100	IN-W294	Metal Debris	ID 217C	481	2	Metal
	Uncategorized Metal	5100	IN-W296	Metal Debris	ID 217C	480	2	Metal
	Uncategorized Metal	5100	IN-W298	Metal Debris	ID 117	320	2	Metal
	Uncategorized Metal	5100	IN-W300	Metal Debris	ID 117	117	2	Metal
	Uncategorized Metal	---	LA-W001	Mixed Metal Scrap and Incidental Combustibles	LA 125A	001	3	
	Uncategorized Metal	---	LA-W005	Noncombustible Scrap	LA 117A; 118A	005 006	2	
	Uncategorized Metal	---	LA-W009	Metal Waste from Gloveboxes and Equipment				
	Uncategorized Metal	---	LL-W018	Combined Metal Scrap and Incidental Combustibles	LL 125	003	3	
	Uncategorized Metal	5112	RF-W011	Metal/TRM	RF 117	480 481	2	Metal
	Uncategorized Metal	5190	RF-W037	Heavy Metal (non-SS)/TRU	RF 117	320	2	Metal

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

Summary Category Group	Waste Matrix Code Group	Waste Matrix Code	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	IDC	Type	Waste Category
Debris Waste—S5000	Uncategorized Metal	---	RL-M001	TRU Mixed Inorganic Debris with Mercury				
	Uncategorized Metal	---	RL-M002	TRU Mixed Inorganic Debris Metals without Mercury				
	Uncategorized Metal	---	RL-M003	TRU Mixed Inorganic Debris Metal with Corrosives				
	Uncategorized Metal	---	RL-M008	TRU Mixed Inorganic Debris Metals without Mercury				
	Uncategorized Metal	---	RL-M021	TRU Mixed Inorganic Debris PCBs with Mercury				
	Uncategorized Metal	6200	AW-W018	Sodium-TRU				
	Uncategorized Metal	6200	AW-W019	Sodium Potassium-(NaK)-TRU				
	Uncategorized Metal	5100	AW-W021	Metal Debris				
	Uncategorized Metal	---	IN-M003	Element Hardware FCF Waste				
	Uncategorized Metal	3100	IN-W260B	Inorganic Process Residues		040		
	Uncategorized Metal	5190	IN-W322	Sample Fuel		154		
	Uncategorized Metal	---	LA-WR01	Mixed Metal Scrap and Incidental Combustibles				
	Uncategorized Metal	---	LA-WR05	Noncombustible Scrap				

TABLE C-1 *(Continued)*
WASTE IDENTIFIERS CROSS-CORRELATION

[a] Waste stream unique identifications (ID) are taken from the U.S. Department of Energy (DOE), 1995, "Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report," CAO-94-1005, Rev. 1, U.S. Department of Energy, Albuquerque, New Mexico.

[b] TRUCON = TRUPACT-II Content

TABLE C-2
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	AL-W005	Solidified Aqueous Liquids/Slurries[c]		This waste stream will be generated during the remediation of a glovebox that has been used for plutonium (Pu) and other transuranic research. The glovebox continues to be used for transuranic research. Some of the contents of the glovebox will become mixed transuranic (MTRU) waste. It has not yet been determined what volume will be MTRU and what will be TRU. Isotopes that are known to be in the glovebox are: Pu-239, Pu-240, Pu-242, Np-237, Pa-233, U-235, U-236, and U-238. Concentrations of the TRU components range from 1 part per million (ppm) to 2,300 ppm in various concentrations of nitric acid. Uranium concentrations range from 0.1 ppb to 407,770 ppm. Note: This stream may contain Toxic Substance Control Act (TSCA) waste at unknown levels.	d D004 D005 D006 D007 D008 D010 D011
	Solidified Inorganics	IN-W157	Solidified Process Residues	ID 213	This waste comes from the Rocky Flats Plant (RFP). It contains alcohols and organic acids such as ethylene diamine tetra acetic acid (Versenes) set in portland and magnesia cements.	d D006 D008 F001 F002 F003
	Solidified Inorganics	IN-W166	Solidified Process Residues	ID 114	Solid inorganic process solution waste consists of cemented inorganic particulates of sludge-like (not chemically precipitated) wastes from Pu recovery operations.	D008 F001 F002 F003
	Solidified Inorganics	IN-W177	Solidified Process Residues		This waste comes from Mound Laboratory. It consists of caustic waste and neutralized waste liquids, adsorbed onto a clay called Florco®.	d

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	IN-W179	Solidified Process Residues		This waste comes from Mound Laboratory. The waste consists of shower water, decontamination water, cooling water, and some acids and caustics that have been solidified in portland cement.	d D006 D007 D008 D009 D010 D011 F001 F003 P015
	Solidified Inorganics	IN-W181	Solidified Process Residues	ID 211A	This waste is from RFP. The waste consists of sludge from laundry operations that have been cemented in portland. The cement is described as a poor grade.	d D006 D007 D008 D009 F001 F002 F003 P015
	Solidified Inorganics	IN-W188	Solidified Process Residues	ID 211A	This waste is from RFP. The waste consists of sludge from floor drains in a Pu process facility that have been cemented in portland cement, described as poor grade.	d D006 D007 D008 D009 D022 D028 F001 F002 F003 P015

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	IN-W216	Solidified Process Residues	ID 211A	The waste stream generated at RFP, consists of first- and second-stage sludges. Sludges were combined starting in 1979 to reduce the radiation levels of first stage sludge. Portland cement was added to absorb free liquids.	d D005 D006 D007 D008 D009 D011 D022 D028 F001 F002 F003 P015
	Solidified Inorganics	IN-W220	Solidified Process Residues	ID 111	This waste includes waste generated at Argonne National Laboratory-East (ANL-E) and solid wet sludge from RFP. The ANL-E waste is derived from research activities performed in a laboratory environment. The waste includes concrete and laboratory apparatus. The RFP solid wet sludge is cemented or dewatered sludge precipitated from aqueous waste treatment processes. Soils that are not contaminated with or by chemicals are also included.	d D004 D005 D006 D007 D008 D009 F001 F002 F003 P015
	Solidified Inorganics	IN-W221	Absorbed Aqueous Liquids	ID 113	Solid laboratory waste consists of cemented or absorbed neutralized aqueous laboratory waste.	d F003

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	IN-W222	Solidified Process Residues	ID NYD	This waste stream, generated at RFP, consists of sludge from the incinerator off-gas system, recovery building filter plenums, pumps, etc. Portland cement is added to absorb free liquids. The sludge may contain a limited number of surgical gloves.	d D006 D008 F001 F002 F003
	Solidified Inorganics	IN-W228	Solidified Wastewater Treatment Sludges	ID 211A	This waste stream, generated at RFP, consists of wet sludge from treatment of all other plant radioactive and/or chemical contaminated wastes and further treatment of the first stage effluent. Some pre-1973 wastes may include nonsludge wastes such as electric motors, mercury and lithium batteries, bottles of liquid chemicals, and small amounts of mercury in pint bottles. Portland cement was added to absorb the residual liquids.	d D005 D006 D007 D008 D009 D011 D022 D028 F001 F002 F003 P015
	Solidified Inorganics	IN-W332	Solidified Process Residues		This waste comes from the Battelle Columbus Laboratories. It is a turco soap decontamination solution (used to decontaminate glove boxes from a Pu laboratory) that is solidified in a plaster-of-paris.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	IN-W347	Absorbed Aqueous Liquids		This waste comes from ANL-E. It consists of liquids adjusted to pH 10 using NaOH, which are then absorbed in vermiculite.	e
	Solidified Inorganics	LA-W002	Solidified Aqueous Waste,	LA 111A; 211A	Solidified aqueous waste, cemented sludge.	d
	Solidified Inorganics	LA-W003	Dewatered Sludge.	LA 111B; 211B	Dewatered sludge from Pu recovery operations.	D004
	Solidified Inorganics	LA-W006	Cemented Process Residues	LA 114A	Cemented process residues derived from decontamination activities.	D007
	Solidified Inorganics	LL-W019	Solidified Waste	LL 111	50 to 90% of this waste matrix consists of liquids solidified in 1- to 5-gallon (gal) plastic containers using portland cement or Aquaset® for the water-based liquids and Envirostone® or Petroset® for the oil-based liquids. The remainder consists of glovebox waste.	D040 F002
	Solidified Inorganics	MD-W002	Absorbed Aqueous Liquids[c]		TRU waste from PP-113, R-140, R-149. Note: This stream may contain TSCA waste at unknown levels.	e
	Solidified Inorganics	OR-W042	Inactive Storage Tank Contents—MTRU Sludge[c]		The waste stream is comprised of MTRU sludge that has settled and separated from wastewater that has been stored in large underground storage tanks. The waste is a product of past operations at Oak Ridge National Laboratories (ORNL) involving various nuclear research and radioisotope fabrication processes. Note: This stream may contain TSCA waste at unknown levels.	D006 D007 D008 D009
	Solidified Inorganics	PA-W014	Solidified TRU Waste Liquids		Aqueous Slurries—Basic. This stream is generated from the shutdown of the neptunium/technetium recovery system.	d

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	PA-W015	TRU Solid		Other inorganic sludges generated from the shutdown of the neptunium/technetium recovery system	D007
	Solidified Inorganics	PA-W015A	TRU and Technetium Waste		Other wastewaters. This stream is generated from the shutdown of the neptunium/technetium recovery system.	e
	Solidified Inorganics	RF-M001	Solidified Process/TRM	RF 114	This waste stream represents the solidified final form of all particulate and sludge-type materials. Particulates and sludge-type materials are immobilized with portland cement. The cemented wastes are cast into 1-gal molds and allowed to cure prior to packaging. This is the final waste form for Firebrick, Pulverized or Fines/TRM, Incinerator Ash/TRM, Particulate Sludge/TRM, and Sand, Slag, and Crucible/TRM.	d D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D035 D040 F001 F002 F003 F005

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	RF-W010	Solidified Aqueous Sludge/ TRM	RF 111	This waste stream consists of aqueous sludge from wastewater treatment mixed with 30% portland cement. The waste is generated as a result of process wastewater treatment in Building 374 and 774. Aqueous sludge is produced by vacuum filtration of precipitated solids from pretreated aqueous waste slurry. Untrapped solids are skimmed off the surface of the filter medium of the rotating drum as wet sludge. The precipitated solids are chiefly hydroxides with pH of 10 to 12. The final waste form is obtained by mixing the wet sludge with approximately 30% portland cement. RFP has several drums of aqueous sludge that were returned by Idaho National Engineering Laboratory (INEL). These old drums were packaged by alternating the layers of cement and wet sludge or by adding cement to the top and bottom of a drum containing wet sludge.	D006 D008 F001 F002 F005
	Solidified Inorganics	RF-W038	Solidified Laboratory Waste/TRM	RF 113	This waste stream is liquid waste solidified with portland cement. This waste consists of waste liquids from the analytical laboratories, research and development laboratories, and maintenance shops that are packaged and sent to Building 774 for immobilization with portland cement and absorbent cement. These are wastes which are incompatible with the process collection system and the liquid waste treatment plant. Acidic wastes are neutralized before immobilization. Immobilization is done in 55-gal drums. Approximately 21 gal of waste are added to each drum prior to storage.	D007

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	RF-W040	Incinerator Ash/TRM		This waste stream was previously named "fluidized bed incinerator ash (TRU)-mixed." Ash is generated from operation of a fluidized bed incinerator in Building 776 or an incinerator in RFP Building 771. The incinerator was used to burn office trash, combustible waste generated in process areas, combustible oils from refrigeration units, diesel fuel, and crank case oils. The oil had been accumulated as a low-level mixed waste. Fluid bed incinerator ash was packaged in 55-gal drums lined with a rigid polyethylene liner and one bag liner. It is a portion of the waste stream entitled "fluidized bed incinerator ash/LLW mixed" in the inventory report. The ash normally assays as low-level waste (LLW) but this portion was found to be TRU.	D004 D005 D006 D007 D008 D009 D010 D011 F001 F002 F005
	Solidified Inorganics	RF-W059	Sand, Slag, and Crucible/ TRM		This waste includes unpulverized slag, unpulverized sand and crucible, unpulverized sand, slag and crucible, sand slag and crucible heel, sand from button breakout, pulverized sand slag and crucible, and pulverized slag and crucible. This waste is generated during the reduction of Pu tetrafluoride to Pu metal. Its composition includes magnesium oxide sand, crucible, calcium metal, and stainless steel (SS).	d D007
	Solidified Inorganics	RF-W063	Miscellaneous TRM		As result of the shutdown of Pu operations at RFP in November 1989, several hundred plastic bottles and several tanks of process liquids remained in storage in Buildings 371, 559, 771, and 779.	d D007
	Solidified Inorganics	RF-W065	Calcium Metal/TRM		This material is elemental calcium used in Pu reduction operations. Calcium metal pellets are mixed with Pu tetrafluoride during the reduction process as a pyrotechnic initiator.	d

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	RF-W068	Particulate Sludge/TRM		This waste stream was previously named "Particulate-Sludge/TRU Mixed (2)." This waste was generated from Pu recovery operations in RFP Building 771. The waste consists of incineration sludge, miscellaneous sludge, sludge from size reduction area, grit, and cemented miscellaneous sludge. Spent ion exchange resin waste is not included in this data. The waste is packaged in 55-gal drums with multiple bag liners. This waste consists of a variety of organically contaminated sludges with particulate fines of heavy metals that are TRU contaminated.	d D006 D007 D008 F001 F002 F005
	Solidified Inorganics	RF-W076	Process Residues/TRM		This waste stream was previously named "Particulate-Sludge/TRU Mixed (2)." This waste was generated from Pu recovery operations in RFP Building 771. The waste consists of low-purity oxide heel, incineration sludge, miscellaneous sludge, sludge from size reduction area, grit, soot, and soot heel. The waste is packaged in 55-gal drums with multiple bag liners.	d D006 D007 D008 F001 F002 F005
	Solidified Inorganics	RL-M005	TRU Mixed Homogeneous Solids with Mercury[c]		This waste stream consists primarily of homogeneous solids. Some of the containers contain organic debris (plastic, cellulosics). Note: This stream may contain TSCA waste at unknown levels.	d D009
	Solidified Inorganics	RL-M032	TRU Mixed Inorganic Homogeneous Solids		This waste stream consists primarily of inorganic homogeneous solids (absorbents).	d D007 F003
	Solidified Inorganics	SR-W053	Ash		Ash from the RFP incinerator was sent to the Savannah River Site (SRS) for Pu recovery research purposes. It is stored in a satellite area in 235-F. The sample material was sent to SRS to investigate possible flow sheets for the recovery of Pu. The ash was classified as waste by the Colorado Court System, and the flow-sheet experiments were cancelled.	D004 D005 D006 D007 D008 D009 D010 D011 F001 F002 F005

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Organics	IN-W167	Solidified Process Residues	ID 112	TRU solid organic waste consisting of cemented or absorbed organic liquids from production or laboratory processes.	D022 F001 F003
	Solidified Organics	IN-W174	Absorbed Aqueous Liquids		This waste comes from Mound Laboratory. It consists of acid liquids, mainly nitric, absorbed onto a clay called Florco®.	d
	Solidified Organics	IN-W309	Organic Setups[c]	ID 212	This waste stream contains liquid organic wastes generated at RFP. About 47% of the organic waste stream is lathe coolant, which is 60% Texaco Regal oil and 40% carbon tetrachloride. About 10% of the organic waste stream is trichloroethane. The remainder is other organic wastes. These liquid wastes were mixed with calcium silicate to form a grease or paste-like material. Note: This stream may contain TSCA waste at unknown levels.	D005 D011 F001 F002 F004 P015
	Solidified Organics	RF-W013	Solidified Organics/TRM	RF 112	This waste stream includes waste TRU organic fluids that are transferred to RFP Building 774 for cementation from Buildings 707, 776, and 777. The liquids are mixed with gypsum cement within 55-gal drums. The drum is lined with one or two bag liners with a rigid polyethylene liner. This waste stream includes cemented solids and organic sludges/particulates.	F001 F002
	Solidified Organics	RF-W069	Organic Resins/TRM	RF 126	This waste stream was previously named "Particulate-Sludge/TRU Mixed (2)." This waste was generated from Pu recovery operations in Building 771. It consists of unleached resin and leached resin. The waste is packaged in 5-gal drums with multiple bag liners. Final waste form for this waste stream is cemented resin.	d D006 D007 D008 F001 F002 F005
	Solidified Organics	RL-M017	TRU Mixed Organic Labpacks		This waste stream consists primarily of organic labpacks. Some of the containers contain inorganic debris (metals), organic debris (plastic, cellulosics).	d F003
	Solidified Organics	RL-M018	TRU Mixed Organic Labpacks (State only)		This waste stream consists primarily of organic labpacks. Some of the containers contain organic debris (plastic, cellulosics).	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Organics	RL-M024	TRU Mixed Organic Labpacks with polychlorinated biphenyls (PCB)[c]		This waste stream consists primarily of organic labpacks. Some of the containers contain organic debris (plastic, rubber, cellulosics), and PCBs.	d
	Solidified Organics	SR-W006	Organic TRU		Laboratory waste from Pu extractions generated in the Savannah River Technology Center (SRTC) 773-A Facility. Homogeneous, liquid, flammable, xylene-based chelating agent. TTA - Thenoyl trifluoroacetone.	d
	Salt Waste	IN-W311	Salt Waste		This waste was generated at the RFP.	D028 F001
	Salt Waste	IN-W312	Salt Waste	ID 124	Pyrochemical salt consists of used chloride salts from pyrochemical processes such as electrorefining, molten salt extraction or direct oxide reduction.	d
	Salt Waste	IN-W314	Salt Waste		This waste, generated at the RFP, consists of chunks of salt and ceramic.	F001
	Salt Waste	RF-W058	Miscellaneous Pu Recovery By-products/TRM	RF 124	This waste is generated during Pu recovery operations such as direct oxide reduction molten salt extraction, electrorefining, and salt scrub. Its composition includes mixed salts, a probable presence of magnesium, sodium and potassium metals and chromium. This waste consists of reactive molten and electrorefining (ER) salt residues from Pu purification and direct oxide reduction.	d D007

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Soils/Gravel—S4000	Soils	IN-W263	Contaminated Soils/Debris		This waste, generated at Mound Laboratory, consists of soils, including small rocks and pebbles, generated from cleanup of a leak. All soil waste was dry when packaged. A few waste boxes also include picks, shovels, metal cans, rubber gloves, booties, respirators, plastic, and possibly an air hammer and chisel.	d D006 D007 D008 D009 D010 D011
	Soils	RL-M007	TRU Mixed Soils without Mercury		This waste stream consist primarily of soils. Some of the containers contain organic debris (rubber, cellulosics, plastic) and inorganic debris (metal).	D007 D010
Debris Waste - S5000	Combustible	IN-W198	Plastic/Rubber Debris	ID 216C	The waste stream is from the RFP and consists of various types of plastics such as polyethylene (PE), polyvinyl chloride (PVC), teflon (TFE), and nonleaded rubber items. The waste may be bags, vials, bottles, sheeting, and surgical gloves. Some other combustible wastes such as respirator facemasks and paper may be included. Some small amounts of noncombustible wastes may also be present.	D008 D022 D029 F001 F002 F003 F005
	Combustible	IN-W202	Wood Debris	ID 216A	This waste stream is from the RFP and primarily consists of wood in the form of lumber, plywood, filter frames, and possibly ladders. Some of the items such as plastic sheeting, Kimwipes®, and other combustibles are also present. Plastic sheeting may have some paint coatings. Limited noncombustibles such as nails and sheetrock may also be included.	D008 F001 F002 F003
	Combustible	IN-W205	Combustible Debris	ID 216B	This waste stream from the RFP primarily consists of line- and nonline-generated combustible materials such as plastics, paper, empty PE bottles, booties, paper, plastic sheeting, and surgical gloves. The waste may be dry or damp. Limited amounts of noncombustibles may also be present.	D008 F001 F002 F003
	Combustible	IN-W250	Leaded Gloves/Aprons Debris	ID 123	Discarded leaded glovebox gloves and leaded aprons.	D008

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Combustible	IN-W252	Leaded Gloves/Aprons Debris	ID 123; 223A	This waste comes from RFP. It consists of leaded rubber gloves and aprons. A limited amount of unleaded gloves, lead bricks, and lead sheeting may also be present.	D008 D022 D028 D029 F001 F002 F003 F005
	Combustible	IN-W254	Leaded Gloves/Aprons Debris	ID 223A	This waste comes from RFP. It consists of leaded rubber gloves and aprons. A limited amount of unleaded gloves, lead bricks, and lead sheeting may also be present.	D008 F001 F002
	Combustible	IN-W256	Leaded Gloves/Aprons Debris		This waste stream is generated at the Mound Laboratory. The waste consists of neoprene dry box (glovebox) gloves, neoprene, O-rings, and lead-lined gloves.	D008
	Combustible	IN-W325	Unknown Solids[e]		This waste stream was generated at Mound Laboratory and consists of classified parts.	e
	Combustible	IN-W327	Combustible Debris		This waste stream is from Mound Laboratory and consists of nonline generated combustible wastes such as plastic sheeting, paper, reagents, gloves (rubber and cloth), plastic bottles, wood, paper suits, and shoe covers. About 75% of the waste is compacted. The waste may be either dry or damp.	e
	Combustible	IN-W330	Plastic/Rubber Debris		This waste stream, generated at Mound Laboratory, consists of various types of plastics (PVC, PE, Tygon®, etc.) in the form of tubing, piping, sample vials, gaskets, manipulator boots, etc. Limited amounts of other combustible wastes may also be included. One drum contains liquid mercury. The wastes are primarily from decommissioning and decontamination (D&D) activities at the Pu processing and research buildings. Limited amounts of waste may be damp.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Combustible	IN-W336	Combustible Debris		This waste stream, generated at Battelle Columbus Laboratories, contains such combustible items as wood, plastic suits, nylon reinforced plastic tent structures, shoe covers, rubber gloves, and air hose. The waste is from decontamination and deactivation of the Pu laboratory.	e
	Combustible	LA-W004	Combustible Waste	LA 116A	Combustible waste - paper, rags, plastic, rubber, etc.	D005
	Combustible	LL-M001	Research and Development Glovebox Waste	LL 116	The waste consists mostly of untreated dry solids such as tissues, paper, assorted plastics, glassware, ceramics, and metals. Portland cement or Aquaset® is used to solidify small amounts of water-based liquids; Envirostone® or Petroset® is used to solidify small amounts of solvents and oil-based liquids. The composition varies considerably, but it is predominantly organics (> 90% by weight).	d D006 D008 D009 D040
	Combustible	RL-M009	TRU Mixed Organic Debris with Corrosives		This waste stream consists primarily of organic debris. Some of the containers contain inorganic debris (metals) and soils.	d
	Combustible	RL-M010	TRU Mixed Organic Debris with Mercury		This waste stream consists primarily of organic debris. Some of the containers contain inorganic debris (metals, including mercury) and soils.	d D006 D009
	Combustible	RL-M011	TRU Mixed Organic Debris without Mercury		This waste stream consists primarily of organic debris. Some of the containers contain inorganic debris (metals) and soils.	d D007 D008
	Combustible	RL-M012	TRU Mixed Organic Debris/ Contaminated without Organics		This waste stream consists primarily of organic debris. Some of the containers contain inorganic debris (metals) and soils.	D019

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
	Combustible	RL-M013	TRU Mixed Organic Debris/ Contaminated with Organics		This waste stream consists primarily of organic debris. Some of the containers with organics contain inorganic debris (metals) and soils.	D019 F001 F002 F003 F004 F005
Debris Waste - S5000	Combustible	RL-M014	TRU Mixed Leaded Gloves/ Aprons with Mercury		This waste stream consists primarily of leaded gloves/aprons. Some of the containers contain inorganic debris (metals, including mercury), organic debris (plastic, rubber, cellulosics), and soils.	d D005 D006 D007 D008 D009
	Combustible	RL-M015	TRU Mixed Leaded Gloves/ Aprons Metals without Mercury		This waste stream consists primarily of leaded gloves/aprons. Some of containers contain inorganic debris metals, without mercury), organic debris plastic, rubber, cellulosics), and soils.	d D005 D006 D007 D008
	Combustible	RL-M016	TRU Mixed Leaded Gloves/ Aprons Metals/Organics without Mercury		This waste stream consists primarily of leaded gloves/aprons. Some of the containers contain inorganic debris metals), organic debris (plastic, rubber, cellulosics), and soils.	D007 D008 D019
	Combustible	RL-M022	TRU Mixed Leaded Gloves/ Aprons PCBs with Mercury[c]		This waste stream consists primarily of leaded gloves/aprons. Some of the containers contain inorganic debris (metal), organic debris (plastic) and hazardous constituents including PCBs and mercury. Note: This waste stream may contain TSCA waste at unknown levels.	D006 D008 D009
	Combustible	RL-M023	TRU Mixed Resource Conservation and Recovery Act (RCRA) Organic Debris with PCBs[c]		This waste stream consists primarily of organic debris contaminated with PCBs. Note: This waste may contain TSCA waste at unknown levels.	d

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
	Filter	IN-W214	Composite Filters		This waste stream, generated at the Mound Laboratory, consists primarily of spun glass filters and fiberglass glovebox prefilters. The waste may include limited amounts of other noncombustibles.	d D009
Debris Waste - S5000	Filter	RF-W066	Filters & Media/TRM	RF 119	This waste stream was previously named "Filter Waste/TRU." Filter waste is generated from process operations throughout the RFP site. This waste consists of Ful-flo filters from the Building 771 incinerator, Ful-flo filters from nonincineration operations, absolute glovebox filters from nonacid contaminated operations, acid contaminated absolute glovebox filters, acid contaminated high-efficiency particulate air (HEPA) filters, nonacid contaminated HEPA filters, plenum prefilters, filter media, and processed filter media. Processed filter media is material which has been treated using portland cement to absorb moisture and neutralize acid contamination. Filter waste is packaged in 55-gal drums and metal standard waste boxes.	d D004 D006 D007 D008 D009 D010 D011 F001 F002 F005
	Filter	RF-W067	Cemented Filters/TRM	RF 119	This waste stream was previously named "Filter Waste/TRU." Filter waste is generated from process operations throughout the RFP site. Processed filter media is material that has been treated using portland cement to absorb moisture and neutralize acid contamination. Filter waste is packaged in 55-gal drums and metal standard waste boxes. Hazardous constituents originate in liquid and gaseous effluents from processing operations.	d D005 D006 D007 D008 D009 F001 F002 F003
	Graphite	IN-W272	Debris Waste	ID 115	Coarse graphite chunks.	F001 F002
	Graphite	IN-W275	Debris Waste		This waste stream, generated at the RFP, is similar to graphite molds. A graphite core is part of the shaped graphite mold to cast Pu metal. The graphite has broken into pieces, and some of the graphite has been scarfed or wire brushed to remove any above-discard deposits of Pu.	F001

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Graphite	IN-W276	Debris Waste	ID 215A	This waste stream, generated at the RFP, consists of graphite molds used in casting Pu metal. The waste may also include small amounts of surgical gloves. The graphite is in the form of broken mold pieces. Some of the graphite has been scarfed or wire-brushed to remove above-discard deposits of Pu.	D022 D028 F001 F002 F003 F005
	Graphite	RF-W060	Coarse Graphite/TRM	RF 115	This waste form includes scarfed graphite chunks and coarse graphite. This waste is a result of broken graphite molds from the classified weapons shape casting process.	D006
	Heterogeneous	IN-W169	Predominantly Combustible Debris	ID 216C	The waste stream is from RFP and primarily consists of line- and nonline-generated dry combustible materials such as paper, rags, plastics, surgical gloves, cloth overalls and booties, cardboard, wood, wood filters frames, and laundry lint. Some combustibles may be damp or moist. Limited amounts of noncombustibles such as glass, concrete, cement, lead glovebox gloves, batteries, and metal scrap may also be present.	D008 D022 D029 F001 F002 F003 F005
	Heterogeneous	IN-W170	Predominantly Combustible Debris		This waste is generated at ANL-E. The waste is derived from decontamination and disposal of facilities and ancillary systems (e.g., gloveboxes).	D004 D006 D008 F003
	Heterogeneous	IN-W171	Predominantly Combustible Debris		This waste is generated at ANL-E. The waste is derived from research activities performed in a research environment. The waste includes soft plastics, cardboard, rags, paper, and cloth from various processes. The waste is packaged in 55-gal drums or in standard waste boxes.	D004 D006 D008 F003

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W172	Predominantly Combustible Debris		This waste stream, generated at Bettis Atomic Power Laboratory, consists primarily of rags, gloves, plastic, paper, carbo-wax, filters, oil-contaminated absorbent (diatomaceous earth), and rubber. The waste stream may also contain noncombustible items.	F001 F002
	Heterogeneous	IN-W186	Predominantly Combustible Debris	ID 116	Combustible waste consists of cellulosic, plastic or cloth waste from various processes.	D008 F001 F002
	Heterogeneous	IN-W189	Predominantly Combustible Debris	ID 221A	This waste, generated at RFP, contains mainly Benelex® which is a dense, laminated, lignocellulose hardboard made from wood chips and particles. Benelex® is generally 2 inches (in.) thick. Some of the Benelex® has lead shielding attached to it. Metal hinges and angle iron strongbacks are also present. Plexiglas™ is the other major constituent in the waste. The Plexiglas™ thickness ranges from 2 to 4 in. Both the Benelex® and the Plexiglas™ are combustible.	D008 F001
	Heterogeneous	IN-W197	Predominantly Combustible Debris	ID 216A	The waste stream is from the RFP and primarily consists of damp or wet line- and nonline-generated dry combustible materials such as paper, rags, plastics, surgical gloves, canvas, cardboard, wood, and rubber. Some combustibles may be damp or moist. Moisture content may range from damp to wet, and may include water, soaps, nitric acid, or caustic solutions. Limited amounts of noncombustibles such as glass, concrete, cement, leaded glovebox gloves, and metal scrap may also be present. These wastes are mostly from decontamination and cleanup work, and may be from any Pu area.	d D008 D022 F001 F002 F003 F005

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W203	Predominantly Combustible Debris		This waste stream, generated at Mound Laboratory, includes two different types waste depending on when the waste was generated. Prior to 1980 waste consisted of glovebox floor sweepings and rust. After 1980, waste may consist of large combustible waste such as plastic tanks, Plexiglas™ shielding and windows, wood, and fiberglass conveyor glovebox sections. Limited amounts of small combustibles such as shoe covers and surgical gloves are also included.	D009
	Heterogeneous	IN-W204	Predominately Combustible Debris		This waste stream is smaller combustible items from Mound Laboratory that fit into drums.	D008 D009
	Heterogeneous	IN-W225	Predominantly Combustible Debris	ID 221A	The waste, generated at RFP, contains mainly Benelex® which is a dense, laminated, lignocellulose hardboard made from wood chips and particles. Benelex® is generally 2 in. thick. Some of the Benelex® has lead shielding attached to it. Metal hinges, and angle iron strongbacks are also present. Plexiglas™ is the other major constituent in the waste. The Plexiglas™ thickness ranges from 2 to 4 in. Both the Benelex® and the Plexiglas™ are combustible.	D008 F001
	Heterogeneous	IN-W259	Heterogeneous Debris		This waste stream, generated at ANL-E, contains alpha hot cell waste. Noncombustible and combustible waste are segregated. Combustible wastes include: paper, plastic and PVC containers, rubber O-rings and gloves, rags, and Q-tips. Noncombustible wastes include: laboratory equipment, tools, fixtures, glassware, pipe, tubing, fitting, fasteners, firebrick, ferrous and nonferrous metal scraps and parts, and small electric motors. Sodium in the waste is reacted with ethyl alcohol, mixed with pelletized clay, and dried. Nitrates and oxidizing agents are neutralized or reduced, mixed with pelletized clay.	D008

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W265	Predominately Inorganic Nonmetal Debris	ID 121	This waste contains blacktop, concrete, reinforced concrete, cinder blocks, bricks, dirt and sand. Limited amounts of waste may be damp. A limited amount may contain combustibles such as coveralls and gloves. The waste is generated from cleanup of spills and leaks, process changes, maintenance, and D&D operations. Portland cement is added to containers that contain wet or damp waste.	F001 F002 F003 F004
	Heterogeneous	IN-W269A	Debris Waste		This waste stream, generated at INEL, contains laboratory waste from ANL-W including fluxwire, fission counters, analytical samples dissolved and absorbed on Oil-Dri, glassware, vials, miscellaneous waste from gloveboxes, dissolved pellets absorbed on Oil-Dri, enriched and normal U308 pellets, aluminum foil and capsules, TREAT® waste capsules, chlorinated ion exchange resins, Pu sources. Laboratory waste includes Kimwipes®, trash, glassware, dissolved samples absorbed in Oil-Dri, analytical samples, gloves, etc.	e
	Heterogeneous	IN-W271	Uncategorized Inorganic Process Residues[e]		This waste stream was generated at Mound Laboratory. The records at Mound Laboratory and at INEL do not agree on the content. The waste most likely is graphite crucibles and electrodes, with some containers of mercury.	D009
	Heterogeneous	IN-W281	Heterogeneous Debris		This waste stream, generated at the Mound Laboratory, consists of large, noncombustible wastes such as tanks (SS and tantalum), piping, ducts, conduit, electric motors, pumps, metallurgical presses, lathes, dissolvers, evaporators, furnaces, ladders, vacuum sweepers, 24- x 24- x 12-in. HEPA filters, fume hoods, gloveboxes, Plexiglas™ glovebox windows, and floor tile. Limited amounts of combustible wastes (plastic tanks, fiberglass gloveboxes, plastic contamination control tents, etc.) are also included.	D005 D006 D007 D008 D009 D010 D011

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W283	Heterogeneous Debris	ID 225A	This waste stream, generated at the RFP, consists of piping, flanges, valves, tools, equipment, PVC piping, glassware (flasks, broken ion exchange columns, etc.), glass filters, leaded glovebox gloves, paper, and plastics. Wastes from renovations of the americium recovery line were shipped only in 1972 and 1973. Some of the containers are lead-lined.	d D008 F002 F003
	Heterogeneous	IN-W285	Heterogeneous Debris		This waste stream, generated at Battelle Columbus Laboratories, contains noncombustible items such as tools, crucibles, piping, valves, pieces of equipment, lead bricks, Plexiglas™, and filters.	D008
	Heterogeneous	IN-W289	Unknown Solids[e]		This waste is generated at ANL-E and RFP. The waste is derived from decontamination and disposal of facilities and ancillary systems.	D004 D005 D006 D007 D008 D009 F001 F002 P015
	Heterogeneous	IN-W291	Debris Waste		This waste stream, generated at ANL-E, contains combustible and noncombustible items such as paper, rags, rubber gloves, plastic bottles, glassware, small tools, balances, and empty metal cans. The waste is usually separated into combustible and noncombustible streams.	d F003

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W302	Unknown Solids[e]		This waste stream, generated at Bettis Atomic Power Laboratory, contains noncompressible and noncombustible items such as absolute filters, solidified chemical waste, contaminated metal equipment, furnace brick, and highly contaminated glovebox equipment. Metal scrap could include bars, sheet, fixtures, small equipment tools, etc. made of carbon steel, SS, inconnel, aluminum, copper, brass and zirconium. Chemical wastes include spent chemical solutions and associated solids from the isotope and isotopic dilution analysis of nuclear fuel specimens. The residues were neutralized before being either mixed with absorbent material solidified.	d F001 F002
	Heterogeneous	IN-W329	Heterogeneous Debris		This waste stream, generated at Mound Laboratory, consists of nonline generated noncombustible wastes such as tools, pipe, equipment, metal, glass, concrete, plaster, bricks, and dirt. Limited amounts of combustible wastes such as paper, rags, etc. are also included.	e
	Heterogeneous	IN-W334	Debris Waste		This waste stream, generated at Battelle Columbus Laboratories, contains a mixture of combustible and noncombustible items in roughly equal proportions. Combustible items include paper and paper products. Noncombustibles are primarily metal and some glass.	e
	Heterogeneous	IN-W345	Debris Waste		This waste stream, generated at INEL, consists of a plastic glovebox, a hydraulic pump containing oil, vacuum pump, centrifuges, tools, and experimental fuel capsules. The presence of hazardous materials is not known, but some absorbed oil is likely.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W351	Debris Waste		This waste stream, generated at ANL-E, consists of glass bottles used to transport liquid wastes.	e
	Heterogeneous	NT-W001	Heterogeneous Debris, Uncategorized	NT 111; 116; 211;225	This waste stream consists of glovebox parts, laboratory trash, contaminated equipment, and solidified sludges. Real-time radiography has been performed on the waste to verify there are no free liquids present, with the exception of liquid in aerosol cans. Most of the waste is contact handled (CH) TRU waste; one and 3 drums are remote-handled (RH). The waste stream was generated at Lawrence Livermore National Laboratory, Livermore, CA (LLNL) and shipped to the Nevada Test Site (NTS) from 1974 until 1990. The waste was declared as potentially mixed TRU waste by the generator in April 1991.	d D006 D007 D008 D011 F001 F002 F003 P015
	Heterogeneous	OR-W044	CH TRU Heterogeneous Debris[c]	OR 125A; 125B	This waste stream consists of CH TRU waste which is classified as contaminated equipment, decontamination debris or dry solids. The physical form is solid. These wastes do not contain free or containerized liquids. Note: This stream may contain TSCA waste at unknown levels.	D006 D008 D009 D011
	Heterogeneous	OR-W045	CH TRU Uncategorized[c,e]		This waste stream consists of CH TRU waste which is not classified. The physical form is either solid, liquid, mixed (both solid and liquid), or unknown. Note: This stream may contain TSCA waste at unknown levels.	D006 D008 D009 D011
	Heterogeneous	OR-W047	CH TRU Heterogeneous Debris[c]		This waste stream consists of CH TRU waste which is classified as contamination equipment, decontaminated debris, or dry solids. The physical form is solid. Note: This stream may contain TSCA waste at unknown levels.	D006 D008 D009 D011
	Heterogeneous	RF-M002	Supercompacted Combustibles/TRM	RF-116C	This waste consists of cloth and paper products from cleanup of gloveboxes and spills, which has been supercompacted for volume reduction.	F001 F002 F005

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	RF-W008	Soil & Cleanup Debris/TRM	RF 121	This waste stream is construction rubble generated during D&D activities. The waste consists of blacktop/concrete/dirt/sand. The waste is generated from construction/demolition within the Pu process buildings. The waste is usually packed in 55-gal drums with multiple bag liners, a fiberboard liner, and a rigid polyethylene liner. Also, the waste can be packaged in DOT 7A, Type A metal boxes which are lined with a fiberboard and PVC liner. Metals are considered to be potentially present in the rubble from demolition and cleanup activities. Solvents are potentially present from the materials used during decontamination.	D006 D007 D008 F001 F002 F005
	Heterogeneous	RF-W012	Combustibles/TRM	RF 116	The waste consists mainly of cloth and paper products from cleanup of gloveboxes and spills, involving hazardous solvents. The bulk of these wastes are packaged in 55-gal drums with one rigid polyethylene liner and several bag liners. In addition the waste may be repackaged into DOT 7A, Type A metal boxes which are lined with a fiberboard and PVC liner.	F001 F002 F005
	Heterogeneous	RF-W036	Firebrick, Pulverized or Fines/TRM	RF 122	This waste stream was previously named "Firebrick - Pulverized or Fines." This waste is generated from replacement of fire brick in the Pu recovery incinerator in RFP Building 771. The fire brick must be replaced periodically because of the Pu buildup. The fire brick is pulverized to facilitate Pu recovery. Material which assays below the economic discard limit is discarded as pulverized fire brick waste. The waste is packaged in 55-gal drums lined with a rigid polyethylene liner.	D004 D006 D007 D008 F001 F002 F005
	Heterogeneous	RL-M004	TRU Mixed Heterogeneous Debris (State only)		This waste stream consists primarily of heterogeneous debris (filters). Some of the containers contain organic debris (plastic).	e
	Heterogeneous	RL-M006	TRU Mixed Inorganic Homogeneous Solids without Mercury		This waste stream consists primarily of inorganic homogeneous solids. Some of the containers contain organic debris (rubber, cellulosics).	d D019 F003

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	RL-M031	TRU Mixed Heterogeneous Debris (State only)		This waste stream consists primarily of heterogeneous debris. The waste is hazardous by state regulation.	e
	Heterogeneous	SA-W134	TRU Waste at Hot Cell Facility		Predominantly metal laboratory trash including saw blades, copper and brass fittings. Balance of waste is combustible laboratory trash including rubber gloves and Tygon® tubing. There are no liquids.	e
	Heterogeneous	SR-W026	Heterogeneous Debris		200 Areas (F and H Separations Facilities). This waste is primarily solids consisting of mainly booties, laboratory coats, floor sweepings, rags, labware, and other job control wastes. This waste is generated primarily through separation activities in the course of Pu production, includes small amounts of TRU waste from on-site laboratories.	d D004 D006 D007 D008 D009 D011 D018 D019 D022 D023 D024 D025 D026 P015

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	SR-W027	Heterogeneous Debris		200 Areas (F and H Separations Facilities). This waste is generated primarily through separation activities in the course of Pu production and includes small amounts of TRU waste from on-site laboratories. This waste stream is primarily solids consisting of booties, laboratory coats, floor sweepings, labware, rags, and other job control waste.	d D004 D006 D007 D008 D009 D011 D018 D019 D022 D023 D024 D025 D026 F001 F002 F003 F005 P015
	Inorganic Nonmetal	IN-W161	Ceramic/Brick Debris	ID 122; 222B	This waste contains whole and broken pieces of construction bricks, cinderblocks, and firebrick. Waste generated in the 1971 to 1973 period includes firebrick from the Pu recovery incinerator and related refractory development and from four boilers; cinderblocks and other brick from routine maintenance and from following the RFP fire. Waste generated since 1973 is mostly firebrick from Pu recovery operations. The firebrick generated since 1973 is a high-alumina, high-strength brick manufactured by Plibrico (Plicast 40®). Some of the incinerator firebrick is scarfed to remove surface contamination and then leached with nitric acid to recover Pu.	F001 F002

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Inorganic Nonmetal	IN-W230	Inorganic Nonmetal Debris	ID 122	Insulation, firebrick, and concrete.	F001 F002
	Inorganic Nonmetal	IN-W240	Glass Debris	ID 118	Glass waste consists of discarded labware, windows, containers or raschig rings from various processes.	D008 D009 F001
	Inorganic Nonmetal	IN-W243	Glass Debris	ID 218B	This waste stream, generated at the RFP, consists of glass sample vials, bottles, lead-taped sample vials, ion exchange columns, dissolver pyrex laboratory glassware such as Pyrex™ flasks and beakers, glovebox windows (glass, Plexiglas™, leaded glass), and crushed and ground glass. The waste includes limited amounts of other noncombustibles such as metals, and limited amounts of combustible wastes. No sludges should be present although some glass vials may contain limited amounts of residual liquids.	D008 D029 F001 F002 F003 F005
	Inorganic Nonmetal	IN-W245	Uncategorized Unknown[e]	ID 225B	This waste stream, generated at the RFP, consists of boronated glass rings used to minimize neutron multiplication in liquid storage tanks. Unleached rashig rings was used from 1971–79 as a separate stream and then combined with leached rashig rings. The rings are about 1.75 in. high and 1.5 in. in diameter, with a 0.25 in. wall thickness. The rings are heat and chemical resistant borosilicate glass. Some of the rings, which had above-discard amounts of Pu, were leached with nitric acid to recover the Pu and then rinsed with water, and dried. Some of the rings may be contaminated with small amounts of oil.	d D008 F001

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Inorganic Nonmetal	IN-W247	Uncategorized Unknown[e]	ID 218A	This waste stream, generated at the RFP, consists of boronated glass rings used to minimize neutron multiplication in liquid storage tanks. Unleached rashig rings was used from 1971–79 as a separate stream and then combined leached rashig rings. The rings are about 1.75 in. high and 1.5 in. in diameter, with a 0.25 in. wall thickness. The rings are heat and chemical resistant borosilicate glass. Some of the rings, which had above-discard amounts of Pu, were leached with nitric acid to recover the Pu and then rinsed with water, and dried. Some of the rings may be contaminated with small amounts of oil.	d D008 D028 D029 F001 F002 F003 F005
	Inorganic Nonmetal	IN-W249	Uncategorized Unknown[e]		This waste stream, generated at Mound Laboratory, consists mostly of whole and broken glassware and glass sample vials. The majority of the glass is Pyrex™. Limited amounts of other noncombustibles may be present.	D009
	Inorganic Nonmetal	MD-M001	Asbestos Debris[c]		(24) Asbestos filters, (1) glass filter. Note: This waste may contain TSCA waste at unknown levels.	e
	Inorganic Nonmetal	RF-W026	Used Absorbents/TRM	RF 122	This waste stream was previously named "Spent Absorbent/TRU (Oil Dry)". This waste stream was not specifically identified in the Storage and Inventory Report prepared by RFP in fulfillment of Federal Facility Compliance Act requirements. This waste is the TRU fraction of the waste titled "Oil Dry/LLW Mixed" in the Inventory Report. Normally it is low-level waste (LLW) but occasionally some assays as TRU. Absorbents, usually vermiculite materials, which are used in the absorption, or absorption of any liquids as needed. One of the most commonly used absorbents is Oil Dri®. Spent absorbents are assumed to be radiologically contaminated. The waste is packaged in 55-gal drums lined with two polyethylene bags.	F001

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Inorganic Nonmetal	RF-W032	Ground Glass/TRM	RF 118	This waste stream is crushed fluorescent lights with some leached glass. Glass waste consists of crushed fluorescent lamps that come from the fluorescent lights used throughout the Pu and uranium processing areas, as well as ground leaded glass. Small amounts of leached glass may be mixed with the crushed fluorescent lamp waste. This glass waste is packaged in 55-gal drums that are lined with one fiberboard liner and two polyethylene bags.	D008
	Inorganic Nonmetal	RF-W052	Glass/TRM	RF 118	This waste stream is glass from D&D, labs, etc. This waste stream is made up of glass from analytical laboratories, recovery processes, ceramics, and glovebox windows. This waste stream was previously named "glass." This waste form has been characterized by toxicity characteristic leaching procedure (TCLP) analytical data and process knowledge. Ground glass is characterized by process knowledged and limited analytical data.	D005 D008 F001 F002
	Inorganic Nonmetal	RF-W056	Magnesium (Mg) Oxide Crucibles/TRM	RF 118	This waste stream includes any type or size of ceramic crucibles or liners including LECO crucibles. This waste consists of magnesium oxide crucible, magnesium oxide crucible fragments with reactive salts of calcium, magnesium, sodium, and/or potassium adhering to the surface and containing Pu residue. This waste stream was generated during Pu recovery using pyrochemical and electro-chemical processing. Waste is placed in 4-liter poly bottles and double plastic bagged or placed in 1 gal or 1 quart paint cans, then placed into 55-gal drums.	d D006
	Inorganic Nonmetal	RF-W057	Insulation/TRM	RF 122	This waste stream is contaminated insulation. The insulation is generated from construction and demolition on site. This waste was characterized using process knowledge for manifesting purposes in 1987 and 1989 to determine if any reportable quantities per 49 CFR 172 were present. These are spent solvents from degreasing of Pu or other metals.	F001 F002

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Lead/Cadmium Metal Waste	AW-M001	ALHC Upgrade Decon Debris		Waste packaged for WIPP containing: radioactive cadmium debris from CH-ANL-242T, solidified to meet WIPP-WAC requirement for particulate immobilization, and bags of lead-lined gloves were placed in the solidified drums to fill the void space.	D006 D007 D008
	Lead/Cadmium Metal Waste	AW-M002	Lead/Cadmium Metal Waste		This waste is typically lead lined gloves replaced at the Experimental Fuel Laboratory glovebox.	D008
	Lead/Cadmium Metal Waste	ET-M001	Hot Laboratory & Pu Facility D&D		1 lead shielding brick plus additional hot material.	D008
	Lead/Cadmium Metal Waste	RF-W029	Leaded Gloves/TRM	RF 123	This waste stream consists of leaded rubber gloves that are used on gloveboxes to reduce radiation exposure to personnel. Gloves that are damaged or that do not meet safety inspection requirements are replaced with new gloves and discarded as waste. The gloves are packaged in 55-gal drums lined with a rigid polyethylene liner and one bag liner.	D008
	Lead/Cadmium Metal Waste	RF-W041	Leaded Gloves-Acid Contaminated/TRM		This waste stream consists of leaded rubber gloves used in the glovebox system for Pu recovery operations in RFP Buildings 771 and 371. These gloves are contaminated with nitric acid and other acids when replaced and discarded as waste. The gloves are packaged in 55-gal drums lined with a rigid polyethylene liner and a bag liner. Leaded gloves as waste are currently characterized by process knowledge and sample analysis using the Extraction Procedure (EP) Toxicity Test.	D008

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Lead/Cadmium Metal Waste	RL-M019	TRU Mixed Elemental Hazardous Metals with Mercury		This waste stream consists primarily of elemental hazardous metals. Some of the containers contain inorganic debris (metals, including mercury), organic debris (plastic, rubber, cellulosics), and soils.	d D005 D006 D007 D008 D009
	Lead/Cadmium Metal Waste	RL-M020	TRU Mixed Elemental Hazardous Metals without Mercury		This waste stream consists primarily of elemental hazardous metals. Some of the containers contain inorganic debris (metals without mercury), organic debris (plastic, rubber, cellulosics), and soils.	D007 D008
	Uncategorized Metal	IN-W260A	Inorganic Process Residues		This waste stream, generated at Bettis Atomic Power Laboratory, contains solid binary scrap as powder, pellets, or rods. The material is made of ceramic based UO_2 and ThO_2. Some kilorods or fuel rods constructed of fuel pellets within hollow zirconium tubes are also included.	e
	Uncategorized Metal	IN-W280	Metal Debris		This waste comes from Mound Laboratory. It consists of SS, carbon steel, and small amounts of aluminum-metal wastes in the form of valves, piping, wrenches, nuts, bolts, SS tubing, spatulas, pans, hotplates, ringstands, etc. Limited amounts of combustible and noncombustible waste also present from. Most of the waste is metal waste that is primarily from D&D operations. Some of the metals were leached with nitric acid, ultrasonically cleaned and dried to remove above-discard amounts of Pu.	D009
	Uncategorized Metal	IN-W287	Metal Debris		This waste stream, generated at ANL-E, contains glovebox sections and associated equipment from decontamination and decommissioning operations. The waste is predominantly noncombustible.	D008

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Uncategorized Metal	IN-W294	Metal Debris	ID 217C	This waste comes from RFP. It consists of the smaller pieces of the waste that have been washed with water to recover Pu.	D008 D022 F001 F002 F005
	Uncategorized Metal	IN-W296	Metal Debris	ID 217C	The waste comes from RFP. It consists of nonline- and line-generated wastes. The waste may be in the form of gloveboxes, glovebox windows, furnaces, lathes, drill presses, ducting, piping, angle iron, tanks, downdraft tables, part carriers, respirator filters, ultrasonic cleaners, control panels, electronic instrumentation, vacuum sweepers, pumps, motors, railing stairs, metal racks and trays, hotplates, empty metal produce and paint cans, carts, power tools (saws, drills, etc.), hand tools (wrenches, hammers, saws, chisels, gauges, etc.), chairs, desks, tables, typewriters, filing cabinets, crushed 55-gal drums, etc. The waste may also include limited amounts of combustible waste.	D008 D028 D029 F001 F002 F003 F005
	Uncategorized Metal	IN-W298	Metal Debris	ID 117	This waste comes from the RFP. It consists of used tantalum crucibles, funnels, funnel inserts, and pour rods.	D008 F001 F002
	Uncategorized Metal	IN-W300	Metal Debris	ID 117	Discarded metal.	D008 F001 F002 P015
	Uncategorized Metal	LA-W001	Mixed Metal Scrap and Incidental Combustibles	LA 125A	Mixed metal scrap and incidental combustibles.	d

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Uncategorized Metal	LA-W005	Noncombustible Scrap	LA 117A; 118A	Noncombustible scrap—small tools, cans, small equipment items, broken glass, etc.	D006
	Uncategorized Metal	LA-W009	Metal Waste from Gloveboxes and Equipment		Metal waste from gloveboxes and equipment	F001 F002 F005
	Uncategorized Metal	LL-W018	Combined Metal Scrap & Incidental Combustibles	LL 125	The waste consists mostly of metal scrap such as decommissioned gloveboxes, hoods, and other large equipment as well as laboratory trash. Typically, it will contain metal components, glassware, ceramics, plastics, paper, and wood. It will be mostly inorganic material but can vary widely.	D008
	Uncategorized Metal	RF-W011	Metal/TRM	RF 117	This waste includes items such as gloveboxes and machinery and empty containers. Items that are difficult to reduce to a size that would fit in a 55-gal drum are placed in DOT 7A, Type A metal boxes. These drums are lined with a rigid polyethylene liner, fiberboard liner and several bag liners. The boxes are lined with a fiberboard and PVC liner.	D008 F001 F002
	Uncategorized Metal	RF-W037	Heavy Metal (non-SS)/TRU	RF 117	Heavy (non-SS) metal waste is generated at various locations throughout the RFP. Heavy scrap metal is defined at RFP as metal elements above copper (Cu) on the periodic chart. Typically, these scrap metals consist of crucibles, funnels, rods and fixturing from several processes and production operations. Tantalum, tungsten, and platinum are examples of scrap metals at the RFP.	D008
	Uncategorized Metal	RL-M001	TRU Mixed Inorganic Debris with Mercury		This waste stream consists primarily of with mercury inorganic debris. Some of the containers contain organic debris (plastic and cellulosics).	D006 D009
	Uncategorized Metal	RL-M002	TRU Mixed Inorganic Debris Metals without Mercury		This waste stream consists primarily of inorganic metal debris. Some of the containers contain organic debris (plastic, rubber, cellulosics).	D008

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
CONTACT-HANDLED TRANSURANIC WASTE

CH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste—S5000	Uncategorized Metal	RL-M003	TRU Mixed Inorganic Debris Metal with Corrosives		This waste stream consists primarily of inorganic debris. Some of the containers contain organic debris (plastic, cellulosics, rubber).	d
	Uncategorized Metal	RL-M008	TRU Mixed Inorganic Debris Metals without Mercury		This waste stream consist primarily of inorganic debris metals. Some of the containers contain organic debris (plastic, rubber, cellulosics), and soils.	d D006 D007 D008
	Uncategorized Metal	RL-M021	TRU Mixed Inorganic Debris PCBs with Mercury[c]		This waste stream consists primarily of inorganic debris. Some of the containers contain organic debris (plastic, cellulosics). The hazardous constituents include PCBs and mercury. Note: This waste may contain TSCA waste at unknown levels.	D006 D008 D009

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
REMOTE-HANDLED TRANSURANIC WASTE

RH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Homogeneous Solids—S3000	Solidified Inorganics	IN-W146	Uncategorized Inorganic Sludges		Ten drums of TRU mixed waste sludge was generated from cleaning of four catch tanks. Concentrations of radionuclides and hazardous waste vary from drum to drum.	D006 D007 D008 D009 D011
	Solidified Inorganics	OR-W046	Solidified Liquid Low Level Waste Tanks - Sludge[c]		This waste stream is comprised of liquid low-level waste (LLLW) that has been concentrated by evaporation and subsequently stored in large underground storage tanks. The waste is generated as relative dilute low level waste in various nuclear research and radioisotope fabrication processes. These streams are collected centrally and the volumes reduced in an evaporation facility. After the waste has been stored, it separates into phases. The resulting solids (sludge phase) is fairly homogeneous chemically and radiochemically. Because the sludge is a product of solids concentration, it has been classified as a TRU waste. Note: This stream may contain TSCA waste at unknown levels.	D006 D007 D008 D009
	Salt Waste	IN-M001	Electrorefiner Stripped Salts—Barium (Ba) & Cadmium (Cd)		Chloride salts containing residual amounts of Cd and Ba.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
REMOTE-HANDLED TRANSURANIC WASTE

RH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Filter	AW-M003	TRU Waste Used Pre-filters		The waste consists of metal or wood framed pre-filters. Prefilters are 2 x 2 x 0.5 feet (ft). HEPA filters are 2 x 2 x 1 ft. Both types of filters have screen mesh covering high-efficiency filtering media. The concentrations of radioisotopes and RCRA toxic metals vary in each filter. These filters were generated from the decontamination of the analytical hot cell in 1993.	e
	Heterogeneous	AW-W020	TRU-Cd-Hot Cell Waste		This waste stream consists of metallic cadmium, soils, and associated cleanup materials (paper towels and cloth rags). The waste is contaminated with activation and fission products as well as with Pu. This waste stream is generated for Fuel Cycle Facility demonstration support experiments.	D006
	Heterogeneous	IN-M002	TRU-Cd-Hot Cell Waste		Metallic cadmium, salts, and cleanup material such as paper towels and rags.	e
	Heterogeneous	IN-W139	TRU Contaminated Lead Debris		This waste is lead contaminated lead debris from various sources. This debris includes lead pieces, galvanized sheet metal, copper/bronzeware, silicon, impregnated fiberglass, paper, HEPA filters, duct, etc.	D008
	Heterogeneous	IN-W269B	Debris Waste		This waste stream, generated at Idaho National Engineering Laboratory, contains laboratory waste from ANL-W including fluxwire, fission counters, HEDL samples, analytical samples dissolved and absorbed on Oil-Dri, glassware, vials, miscellaneous waste from gloveboxes, dissolved pellets absorbed on Oil-Dri, enriched and normal U-308 pellets, aluminum foil and capsules, TREAT® waste capsules, chlorinated ion exchange resins, Pu sources. Laboratory waste includes Kimwipes®, trash, glassware, dissolved samples absorbed in Oil-Dri, analytical samples, gloves, etc.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
REMOTE-HANDLED TRANSURANIC WASTE

RH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Heterogeneous	IN-W323	Predominantly Combustible Debris		This waste stream was generated at ANL-W and at INEL. Most of the waste is organic and combustible materials including paper, wood, PVC and plastic containers and items, rubber gaskets and gloves, leather, rags, towels, Q-tips, tubing, filter media, abrasive media and metal pieces. Small residuals of moderators and fuel are trapped on the filters. Drums of CH waste are stored at the TRU Storage Area (TSA). Drums of RH waste are stored at the Intermediate Level TRU Storage Facility (ILTSF).	D008
	Heterogeneous	OR-W040	RH TRU Heterogeneous Debris[c]		This waste stream consists of RH TRU waste which is classified as contaminated equipment, decontamination debris or dry solids. The physical form is solid. Note: This stream may contain TSCA waste at unknown levels.	D006 D008 D009 D011
Debris Waste - S5000	Heterogeneous	RL-M201	Projected RH-MTRU Waste		The waste includes failed and obsolete equipment or material, including tanks, pumps, agitators, ovens, heaters, hoods, jumpers, and accessories. Some waste will contain wood, plastics, paper, rubber, and soils.	e
	Lead/Cadmium Metal Waste	AW-W016	Electrorefiner Stripped Cadmium		This waste stream consists of cadmium dispersed in a copper alloy matrix. This waste stream will be generated from the electrorefiner station in the ANL-Fuel Cycle Facility.	D006
	Lead/Cadmium Metal Waste	AW-W022	Electro Refiner Insolubles with Cadmium		This waste stream consists of cadmium metal with other heavy metals and "mable" metals (that is, they are not reactive in the FCF electrorefining process). This waste stream will be generated from the electrorefiner station in the ANL-W Fuel Cycle Facility Integral Fast Reactor demonstration. This waste stream includes inorganic sludges/particulates.	D006
	Lead/Cadmium Metal Waste	IN-M004	Electrorefiner Stripped Cadmium		Encapsulated waste cadmium metal.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
REMOTE-HANDLED TRANSURANIC WASTE

RH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Lead/Cadmium Metal Waste	IN-M005	Electrorefiner Insolubles with Cadmium		Cadmium and other heavy metals.	e
	Uncategorized Metal	AW-W018	Sodium - TRU		Sodium is used as a primary and secondary coolant for the EBR-II Reactor. Waste sodium metal is a hazardous constituent of the TRU waste stored at the ANL-W Radioactive Scrap and Waste Facility (RSWF). Waste at RSWF is RH. This waste is generated during maintenance and operational activities. The sodium typically coats waste metal equipment, experiments and components removed during reactor operations and maintenance activities.	d
	Uncategorized Metal	AW-W019	Sodium Potassium-(NaK) - TRU		Sodium potassium alloy is used as a coolant for some components of the EBR-II reactor. Waste NaK metal is stored at the ANL-W RSWF. The RH NaK waste at the RSWF is contained in SS capsules or tubing and placed inside carbon steel waste cans which are then placed in SS outer cans. The entire package is then stored in RSWF storage liners (carbon steel soil storage vaults). The NaK is generated during maintenance and operational activities. NaK waste is in canisters with TRU waste metal pieces and rods from reactor experiments.	d
	Uncategorized Metal	AW-W021	Metal Debris		This waste stream consists of metal, and of EER N fuel elements. This waste stream will be generated from the "Element Chopper" station in the ANL-W Fuel Cycle Facility demonstration.	D005 D006
Debris Waste - S5000	Uncategorized Metal	IN-M003	Element Hardware FCF Waste		Small pieces of SS from nuclear fuel.	e
	Uncategorized Metal	IN-W260B	Inorganic Process Residues		This waste stream, generated at Bettis Atomic Power Laboratory, contains solid binary scrap as powder, pellets, or rods. The material is made of ceramic based UO_2 and ThO_2. Some kilorods or fuel rods constructed of fuel pellets within hollow zirconium tubes are also included.	e

TABLE C-2 (CONTINUED)
TRU MIXED WASTE CHARACTERIZATION INFORMATION
REMOTE-HANDLED TRANSURANIC WASTE

RH TRU Waste Summary Category Group Description	Waste Matrix Code Group	Waste Stream Unique ID[a]	Waste Stream Name	TRUCON[b] Code	Waste Description (WTWBIR)[a]	EPA Code
Debris Waste - S5000	Uncategorized Metal	IN-W322	Sample Fuel		Waste consists of actinide neutron sources, a tadrum needle, small vials of fuel, and metal containers of experimental fuel capsules.	e
	Uncategorized Metal	LA-WR01	Mixed Metal Scrap and Incidental Combustibles		Mixed metal scrap and incidental combustibles.	e
	Uncategorized Metal	LA-WR05	Noncombustible Scrap		Noncombustible scrap—small tools, cans, equipment items, broken glass, etc.	e

[a]Waste stream unique identifications (ID) and waste descriptions are taken from the U.S. Department of Energy (DOE), 1995, "Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report," CAO-94-1005, Rev. 1, U.S. Department of Energy, Albuquerque, New Mexico. The WTWBIR contains the most complete description information available at this time. Hazardous contents listed for individual waste streams are subject to verification through the WIPP Generator/Storage Site Waste Screening and Acceptance Audit Program (Appendix C8).
[b]TRUCON = TRUPACT-II Content
[c]Waste streams with unknown levels of TSCA waste, PCBs, or asbestos will have to meet WAP acceptability criteria.
[d]Although waste generators have previously indicated that some waste streams may have had the potential for reactivity, ignitability, or corrosivity (based on known waste generating processes), the final waste form accepted for disposal at the WIPP facility would not be permitted with these characteristics.
[e]EPA hazardous waste codes have not been reported by the generators at this time. These wastes will be subjected to the characterization requirements of this WAP prior to acceptance. These may or may not actually be TRU mixed wastes but are retained in the table for completeness.
[f]Classification of waste matrix code group is based on the waste stream being at least 50 percent of the indicated waste form (e.g., solidified inorganics). Therefore, a cement matrix containing trace quantities of F-listed solvents is classified as solidified inorganics.

NOTE: The use of trade names or brand names in this table does not constitute endorsement by the DOE or its contractors.

TABLE C-3
RATIONALE FOR SELECTION OF PARAMETERS OF INTEREST

Compound[a]	Synonyms	CAS[b] Number	Toxicity Characteristic Contaminant	Other Listed Constituent	Appendix VIII Constituent
Acetone	2-Propanone, dimethyl ketone	67-64-1		F003	
Antimony		7440-36-0			+
Arsenic		7440-38-2	D004		+
Barium		7440-39-3	D005		+
Benzene	Benzol	71-43-2	D018	F005	+
Beryllium		7440-41-7		P015	+
Bromoform	Tribromomethane, methyl tribromide	75-25-2			+
n-Butyl alcohol	Butanol, 1-butanol, n-butanol	71-36-3		F003	
Cadmium		7440-43-9	D006		+
Carbon disulfide	Carbon bisulfide	75-15-0		F005	+
Carbon tetrachloride	Tetrachloromethane	56-23-5	D019	F001	+
Chlorobenzene		108-90-7	D021	F002	+
Chloroform	Trichloromethane	67-66-3	D022		+
Chromium	Chrome	7440-47-3	D007		+
Cresols	Cresylic acid	1319-77-3	D026	F004	+
1,4-Dichlorobenzene	p-Dichlorobenzene	106-46-7	D027		+
1,2-Dichlorobenzene	o-Dichlorobenzene	95-50-1		F002	+
1,1-Dichloroethane	Ethylidene dichloride	75-34-3			+
1,2-Dichloroethane	Ethylene dichloride	107-06-2	D028		+
cis-1,2-Dichloroethylene	cis-1,2-Dichloroethene, sym-Dichloroethylene	156-60-5			+
1,1-Dichloroethylene	1,1-Dichloroethene, vinylidene chloride	75-35-4	D029		+
2,4 Dinitrophenol		51-28-5			+
2,4-Dinitrotoluene	1-methyl-2, 4-dinitrobenzene	121-14-2	D030		+
Ethyl benzene		100-41-4		F003	
Ethyl ether	Diethyl ether, ether	60-29-7		F003	
Formaldehyde[c]		50-00-0			+
Hexachlorobenzene		118-74-1	D032		+
Hexachloroethane		67-72-1	D034		+
Hydrazine[d]		302-01-2			+
Isobutanol	Isobutyl alcohol, 2-methyl-1-propanol	78-83-1		F005	+
Lead		7439-92-1	D008		+
Mercury		7439-97-6	D009		+
Methanol	Methyl alcohol	67-56-1		F003	
Methyl ethyl ketone	2-Butanone	78-93-3	D035	F005	+
Methyl isobutyl ketone	4-Methyl-2-pentanone, hexone	108-10-1		F003	
Methylene chloride	Dichloromethane	75-09-2		F001,F002	+
Nickel		7440-02-0			+
Nitrobenzene	Nitrobenzol	98-95-3	D036	F004	+
Pentachlorophenol	PCP	87-86-5	D037		+
Polychlorinated biphenyls (PCBs)		1336-36-3			+
Pyridine		110-86-1	D038	F005	+
Selenium		7782-49-2	D010		+
Silver		7440-22-4	D011		+

TABLE C-3 (CONTINUED)
RATIONALE FOR SELECTION OF PARAMETERS OF INTEREST

Compound[a]	Synonyms	CAS[b] Number	Toxicity Characteristic Contaminant	Other Listed Constituent	Appendix VIII Constituent
1,1,2,2-Tetrachloroethane		79-34-5			+
Tetrachloroethylene	Tetrachloroethene, perchloroethylene	127-18-4	D039	F001,F002	+
Thallium		7440-28-0			+
Toluene	Methyl benzene	108-88-3		F005	+
1,1,1-Trichloroethane	Methyl chloroform	71-55-6		F001,F002	+
1,1,2-Trichloroethane	Ethane trichloride	79-00-5		F002	+
Trichloroethylene	Trichloroethene	79-01-6	D040	F001,F002	+
Trichlorofluoromethane	Freon-11	75-69-4		F001,F002	+
1,1,2-Trichloro-1,2,2-trifluoroethane	Freon-113	76-13-1		F001,F002	
Vanadium		7440-62-2			
Vinyl chloride	Chloroethene	75-01-4	D043		+
m-Xylene	1,3-Dimethylbenzene	108-38-3		F003	
o-Xylene	1,2-Dimethylbenzene	95-47-6		F003	
p-Xylene	1,4-Dimethylbenzene	106-42-3		F003	
Zinc[e]		7440-66-6			

[a] U.S. Department of Energy (DOE), 1995a, "Transuranic Waste Characterization Quality Assurance Program Plan" (QAPP), CAO-94-1010, Rev. 0, Carlsbad Area Office, Carlsbad, New Mexico.

[b] CAS=Chemical Abstracts Number

[c] Reported only by Los Alamos National Laboratory.

[d] Reported only by Oak Ridge National Laboratory and Savannah River Site.

[e] Zinc was added during development of the QAPP.

TABLE C-4
RATIONALE FOR COMPLIANCE WITH PROHIBITED CHARACTERISTIC WASTES

Prohibited Characteristics	Rationale for Transuranic Mixed Waste Compliance
Ignitability	Ignitability
• Liquid waste.	• Waste is not a liquid. Verified by radiography.
• Contains pyrophorics or materials capable of spontaneous chemical changes.	• Final waste form precludes pyrophorics or spontaneous reactions.[a] Pyrophorics prohibited by waste acceptance criteria (WAC).
• Contains ignitable compressed gases as defined in 49 Code of Federal Regulations (CFR) §173.300.	• Containers capable of containing any compressed gases are prohibited by the WAC . Verified by radiography.
• Contains oxidizers as defined in Title 49 CFR §173.151.	• Acceptable knowledge and final waste form precludes oxidizers.
Corrosivity	Corrosivity
• Contains aqueous or nonaqueous liquid waste.	• Liquid waste (greater than one percent by volume) is prohibited by WAC.
Reactivity	Reactivity
• Unstable and will readily undergo violent change without detonating.	• Final waste form precludes reactivity[a].
• When mixed with water, will react violently, form a potentially explosive mixture, or generate harmful toxic gases, vapors, or fumes.	• Acceptable knowledge and final waste form[a].
• If subjected to a strong initiating force or if heated under confinement, will detonate or explode.	• Acceptable knowledge and final waste form[a].
• Cyanide- or sulfide-bearing waste.	• Acceptable knowledge and final waste form[a].
• Capable of detonation or explosive decomposition at standard temperature and pressure.	• Final waste form precludes detonation or explosive decomposition[a].
• A forbidden explosive as defined in 49 CFR §173.51, a Class A explosive as defined in 49 CFR §173.53 or a Class B explosive as defined in 49 CFR §173.88.	• Explosives prohibited by WAC.

[a]Waste compatibility analysis in Appendix C1 shows that these reactions will not occur based on waste constituents and final waste form.

TABLE C-5
VOC HEADSPACE CONCENTRATION LIMITS

COMPOUND	VOC HEADSPACE CONCENTRATION LIMITS[a] (PPM)
Carbon Tetrachloride	7,510
Chlorobenzene	17,660
Chloroform	6,325
1,1-Dichloroethene	28,750
1,2-Dichloroethane	9,100
Methylene Chloride	100,000
1,1,2,2-Tetrachloroethane	7,924
Toluene	41,135
1,1,1-Trichloroethane	100,000

[a] There are no maximum headspace limits for other VOCs. These concentrations are based on calculations provided in Appendix D9.

TABLE C-6
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR CH TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	100% radiography or visual examination	• Verify waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas volatile organic compounds (VOC)	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of transuranic (TRU) waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Statistical sampling[a] (see Tables C-10 and C-11)	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR CH TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous waste • Composite filter waste	Physical waste form	100% Radiography Visual examination (statistical sample)[a]	• Verify waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs • Verify acceptable knowledge
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Acceptable knowledge	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR CH TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	Documentation and verification[b]	• Verify waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs (VOCs)	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Statistical sampling[a] (see Tables C-10 and C-11)	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR CH TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous waste • Composite filter waste	Physical waste form	Documentation and verification[b]	• Verify waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs • Verify acceptable knowledge
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Acceptable knowledge	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-6 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR CH TRANSURANIC MIXED WASTE (STORED WASTE)

[a] Number determined per Quality Assurance Program Plan (QAPP), Section 5.0.

[b] See discussion in Section 5.3.3 of the QAPP.

U.S. Department of Energy (DOE), 1995, "TRU Waste Characterization Quality Assurance Program Plan," CAO-94-1010, Rev 0, Carlsbad Area Office, Carlsbad, New Mexico.

TABLE C-7
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR RH TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	Radiography for wastes <1 rem/hour Acceptable knowledge	• Verify waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable volatile organic compounds (VOCs) • Determine potential flammability of transuranic (TRU) waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Statistical sampling (see Tables C-10 and C-11)	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-7 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR RH TRANSURANIC MIXED WASTE (STORED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous waste • Composite filter waste	Physical waste form	100% Radiography	• Verify waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs • Verify acceptable knowledge
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Acceptable knowledge	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-7 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR RH TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S3000-Homogeneous Solids S4000-Soil/Gravel	• Solidified inorganics • Salt waste • Solidified organics • Contaminated soil/debris	Physical waste form	Documentation and verification	• Verify waste matrix • Demonstrate compliance with waste acceptance criteria (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas volatile organic compounds (VOCs)	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Statistical sampling (see Tables C-10 and C-11)	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-7 (CONTINUED)
SUMMARY OF PARAMETERS, CHARACTERIZATION METHODS, AND RATIONALE FOR RH TRANSURANIC MIXED WASTE (NEWLY GENERATED WASTE)

Waste Matrix Code Summary Categories	Waste Matrix Code Groups	Characterization Parameter	Method	Rationale
S5000–Debris Waste	• Uncategorized metal (metal waste other than lead/cadmium) • Lead/cadmium waste • Inorganic nonmetal waste • Combustible waste • Graphite waste • Heterogeneous waste • Composite filter waste	Physical waste form	Documentation and verification	• Verify waste matrix • Demonstrate compliance with waste acceptance (e.g., no free liquids, no incompatible wastes, no compressed gases)
		Headspace gases • Gas VOCs	100% gas sampling and analysis (see Table C-9)	• Quantify concentration of flammable VOCs • Determine potential flammability of TRU waste headspace gases • Quantify concentrations of VOC constituents in headspace of containers • Support demonstration of no migration by headspace VOCs • Verify acceptable knowledge
		Hazardous constituents • Total metals • Total VOCs • Total semi-VOCs	Acceptable knowledge	• Determine characteristic metals and organics • Determine total quantity of metals, VOCs, and semi-VOCs

TABLE C-8

SUMMARY OF HAZARDOUS WASTE CHARACTERIZATION REQUIREMENTS FOR TRANSURANIC MIXED WASTE[a]

Parameter	Techniques and Methods Manual Procedure
Physical Waste Form Matrix Parameter Categories Summary Category Names S3000 Homogeneous Solid S4000 Soil/Gravel S5000 Debris Wastes	**Waste Inspection Procedures** Radiography, Procedure 310.1 Visual Examination, Procedure 310.2 (QAPP Section 10.0)
Headspace Gases **Volatile Organic Compounds** Benzene Bromoform Carbon tetrachloride Chlorobenzene Chloroform 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethylene (cis)-1,2-Dichloroethylene Ethyl benzene Ethyl ether Formaldehyde[b] Hydrazine[c] Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene Toluene 1,1,1-Trichloroethane Trichloroethylene 1,1,2-Trichloro-1,2,2-trifluoroethane Xylenes Alcohols and Ketones Acetone Butanol Methanol Methyl ethyl ketone Methyl isobutyl ketone	**Gas Analysis** Gas Chromatography (GC)/Mass Spectroscopy (MS), Procedure 430.1 or 430.2 (QAPP Section 12.0) GC/MS GC/Flame Ionization Detector (FID), Procedure 440.1 (QAPP Section 12.0) Fourier Transform Infrared Spectroscopy (FTIRS), Procedure 430.7

TABLE C-8 (CONTINUED)
SUMMARY OF HAZARDOUS WASTE CHARACTERIZATION REQUIREMENTS FOR TRANSURANIC MIXED WASTE[a]

Parameter		Techniques and Methods Manual Procedure
Total Volatile Organic Compounds		**Total Volatile Organic Compound Analysis**
Acetone	Isobutanol	GC/MS, Procedure 430.3 or 430.4
Benzene	Methanol	GC/FID, Procedure 440.2
Bromoform	Methyl ethyl ketone	(QAPP Section 13.0)
Butanol	Methylene chloride	
Carbon disulfide	Pyridine[d]	Acceptable Knowledge for Matrix Parameter Summary
Carbon tetrachloride	1,1,2,2-Tetrachloroethane	Category S5000 (Debris Wastes)
Chlorobenzene	Tetrachloroethylene	
Chloroform	Toluene	
1,4-Dichlorobenzene[d]	1,1,2-Trichloro-1,2,2-trifluoroethane	
1,2-Dichlorobenzene[d]	Trichlorofluoromethane	
1,2-Dichloroethane	1,1,1-Trichloroethane	
1,1-Dichloroethylene	1,1,2-Trichloroethane	
Ethyl benzene	Trichloroethylene	
Ethyl ether	Vinyl chloride	
Formaldehyde[b]	Xylenes	
Hydrazine[c]		
Total Semivolatile Organic Compounds		**Total Semivolatile Organic Compound Analysis**
Cresols		GC/MS, Procedure 430.5 or 430.6
1,4-Dichlorobenzene[e]		GC/ECD for PCBs , Procedure 440.3
1,2-Dichlorobenzene[e]		(QAPP Section 14.0)
2,4-Dinitrophenol		
2,4-Dinitrotoluene		Acceptable Knowledge for Matrix Parameter Summary
Hexachlorobenzene		Category S5000 (Debris Wastes)
Hexachloroethane		
Nitrobenzene		
Polychlorinated biphenyls		
Pentachlorophenol		
Pyridine[e]		
Total Metals		**Total Metals Analysis**
Antimony	Mercury	Atomic MS, Procedure 630.1
Arsenic	Nickel	Atomic Emission Spectroscopy, Procedure 640.1
Barium	Selenium	Atomic Absorption Spectroscopy , Procedures 650.1
Beryllium	Silver	through 650.7
Cadmium	Thallium	(QAPP Section 15.0)
Chromium	Vanadium	
Lead	Zinc	Acceptable Knowledge for Matrix Parameter Summary
		Category S5000 (Debris Wastes)

[a] U.S. Department of Energy (DOE), 1995a, "TRU Waste Characterization Quality Assurance Program Plan" (QAPP), CAO-94-1010, Rev. 0, Carlsbad Area Office, Carlsbad, New Mexico.
[b] Required only for homogeneous solids and soil/gravel from Los Alamos National Laboratory.
[c] Required only for homogeneous solids and soil/gravel from Oak Ridge National Laboratory and Savannah River Site.
[d] Can also be analyzed as a semi-volatile organic compound.
[e] Can also be analyzed as a volatile organic compound.

TABLE C-9
HEADSPACE TARGET ANALYTE LIST AND METHODS

Parameter	Methods Manual Procedure	EPA Specified Analytical Method
Benzene Bromoform Carbon tetrachloride Chlorobenzene Chloroform 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethylene (cis)-1,2-Dichloroethylene Ethyl benzene Ethyl ether Formaldehyde[b] Hydrazine[c] Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene Toluene 1,1,1-Trichloroethane Trichloroethylene 1,1,2-Trichloro-1,2,2-trifluoroethane Xylenes	430.1 430.2 430.7	EPA: Modified TO-14[a]; Modified 8240/8260 EPA - Approved Fourier Transform Infrared Spectroscopy
Acetone Butanol Methanol Methy ethyl ketone Methyl isobutyl ketone	430.1 430.2 430.7 440.1	EPA: Modified TO-14[a]; Modified 8240/8260 EPA - Approved Fourier Transform Infrared Spectroscopy No Equivalent EPA Method for Methods Manual Procedure 440.1

[a] U.S. Environmental Protection Agency (EPA), 1988, "Compendium Method TO-14, the Determination of Volatile Organic Compounds (VOC) in Ambient Air Using SUMMA® Passivated Canister Sampling and Gas Chromatographic Analysis," in Compendium of Methods for the Determination of Toxic Organic Compounds on Ambient Air. Research Triangle Park, North Carolina, Quality Assurance Division, Monitoring System Laboratory, U.S. EPA. The most current revision of the specified methods will be used.

[b] Required only for containers of homogeneous solids and soil/gravel waste from Los Alamos National Laboratory.

[c] Required only for containers of homogeneous solids and soil/gravel waste from Oak Ridge National Laboratory and the Savannah River Site.

TABLE C-10
REQUIRED TOTAL ORGANIC ANALYSES AND TEST METHODS ORGANIZED BY ORGANIC ANALYTICAL GROUPS

Organic Analytical Group	Required Organic Analyses	Methods Manual Procedure	EPA Specified Analytical Method[a]
Nonhalogenated Volatile Organic Compounds (VOCs)	Acetone Benzene n-Butanol Carbon disulfide Ethyl benzene Ethyl ether Formaldehyde Hydrazine[b] Isobutanol Methanol Methyl ethyl ketone Toluene Xylenes	430.3 430.4 440.2	8240B 8260A
Halogenated VOCs	Bromoform Carbon tetrachloride Chlorobenzene Chloroform 1,2-Dichloroethane 1,1-Dichloroethylene Methylene chloride 1,1,2,2-Tetrachloroethane Tetrachloroethylene 1,1,2-Trichloroethane 1,1,1-Trichloroethane Trichloroethylene Trichlorofluoromethane 1,1,2-Trichloro-1,2,2-trifluoroethane Vinyl Chloride	430.3 430.4	8240B 8260A
Semivolatile Organic Compounds (SVOCs)	Cresols (o, m, p) 1,2-Dichlorobenzene[c] 1,4-Dichlorobenzene[c] 2,4-Dinitrophenol 2,4-Dinitrotoluene Hexachlorobenzene Hexachloroethane Nitrobenzene Polychlorinated biphenyls (PCB)[d] Pentachlorophenol Pyridine[c]	430.5 430.6 440.3 (for PCBs only)	8250A 8270B 3620 8081 (for PCBs only) 3550

TABLE C-10 (CONTINUED)
REQUIRED ORGANIC ANALYSES AND TEST METHODS ORGANIZED BY ORGANIC ANALYTICAL GROUPS

[a] U.S. Environmental Protection Agency (EPA), 1993, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition Final Update I and Final Update II. Equivalent methods are demonstrated by meeting the quality assurance/quality control requirements specified in the QAPP and SW-846 protocols.

[b] Sites will have to develop an analytical method for hydrazine. This method will be submitted to the DOE CAO for approval.

[c] These compounds may also be analyzed as VOCs by SW-846 Methods 8240B and 8260A.

[d] Transformer oils containing PCBs have been identified in a limited number of waste streams included in the organic sludges waste matrix code. Therefore, only waste streams included in the solidified organics final waste form must be analyzed for PCBs.

TABLE C-11
SUMMARY OF SAMPLE PREPARATION AND ANALYTICAL METHODS FOR TOTAL METALS

Parameters	Methods Manual Procedure	EPA-Specified Analytical Methods[a]
Sample Preparation	610.1	3051, or equivalent, as appropriate for analytical method
Total Antimony	630.1, 640.1, 650.1, 650.2, 650.5	6010A, 6020, 7040, 7041, 7062
Total Arsenic	630.1, 640.1, 650.4, 650.5	6010A, 6020, 7060A, 7061A, 7062
Total Barium	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7080A, 7081
Total Beryllium	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7090, 7091
Total Cadmium	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7130, 7131A
Total Chromium	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7190, 7191
Total Lead	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7420, 7421
Total Mercury	650.3	7471A
Total Nickel	630.1, 640.1, 650.1	6010A, 6020, 7520
Total Selenium	630.1, 650.2, 650.6, 650.7	6010A, 7740, 7741A, 7742
Total Silver	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7760A, 7761
Total Thallium	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7840, 7841
Total Vanadium	630.1, 650.1, 650.2	6010A, 7910, 7911
Total Zinc	630.1, 640.1, 650.1, 650.2	6010A, 6020, 7950, 7951

[a] U.S. Environmental Protection Agency (EPA), 1986 as amended by FR 46040, August 31, 1993. "Test Methods for Evaluating Solid Waste," Laboratory Manual Physical/Chemical Methods, SW-846, 3rd ed., U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Equivalent methods are demonstrated by meeting the quality assurance/quality control requirements specified in the Quality Assurance Program Plan (QAPP) and SW-846 protocols.

TABLE C-12
WIPP WASTE INFORMATION SYSTEM DATA FIELDS[a]

Characterization Module Data Fields [b]	
Container ID [c]	Total VOC Sample Date
Generator EPA ID	Total VOC Analysis Date
Generator Address	Total VOC Analyte Name [d]
Generator Name	Total VOC Analyte Concentration [d]
Generator Contact	Total Metal Sample Date
Hazardous Code	Total Metal Analysis Date
Headspace Gas Sample Date	Total Metal Analyte Name [d]
Headspace Gas Analysis Date	Total Metal Analyte Concentration [d]
Headspace Gas Analyte [d]	Semi-VOC Sample Date
Headspace Gas Concentration [d]	Semi-VOC Analysis Date
Headspace Gas Char. Method [d]	Semi-VOC Analyte Name [d]
Total VOC Char. Method [d]	Semi-VOC Concentration [d]
Total Metals Char. Method [d]	Transporter EPA ID
Total Semi-VOC Char. Method [d]	Transporter Name
Item Description Code	Visual Exam Container [e]
Haz. Manifest Number	Waste Material Parameter [d]
NDE Complete [e]	Waste Material Weight [d]
PCB Concentration [f]	Waste Matrix Code
	Waste Matrix Code Group
	Waste Stream Profile Number

Certification Module Data Fields	
Container ID [c]	Fissile Gram Equiv.
Container type	Radioassay (RA) Date
Container Weight	RA Method
Contact Dose Rate	Radionuclide [d]
Container Certification date	Radionuclide Quan.[d]
Container Closure Date	Handling Code
Container Liner Type	Waste Weight
Decay Heat	Waste Fill %
Overpack Number (if any)	Surface Contamination
PE Curie Equiv.	Alpha Activity

Transportation Data Module	
Shipment Number	Layers of Packaging
TRUPACT Number	Ship Category
Assembly Number[g]	Ship Certification Date
Container IDs [c,d]	Ship Date
Filter Model	Receive Date
Filter Date	Vehicle Type
ICV Closure Date	

TABLE C-12 (CONTINUED)
WIPP WASTE INFORMATION SYSTEM DATA FIELDS

Disposal Module Data
Container ID [c] Disposal Date Disposal Location

[a] This is not a complete list of the WWIS data fields, but is a subset that contains the fields that are pertinent to RCRA.

[b] Some of the fields required for characterization are also required for certification and/or transportation.

[c] Container ID is the main relational field in the WWIS Database.

[d] This is a multiple occurring field for each analyte, nuclide, etc.

[e] These are logical fields requiring only a yes/no.

[f] Limits are applied to many fields. The limit for PCBs is 50 ppm.

[g] Required for 7-Packs of 55 gal drums to tie all of the drums in that assembly together. This facilitates the identification of waste containers in a shipment without need to breakup the assembly.

TABLE C-13
REQUIRED PROGRAM RECORDS MAINTAINED IN SITE PROJECT FILES

Lifetime Records

- Field sampling data forms
- Field and laboratory chain-of-custody forms
- Test facility and laboratory analytical data reports
- Summary data packages
- Sampling Plans
- Data reduction, validation, and reporting documentation
- Acceptable knowledge documentation
- Data reconciliation report
- Waste Stream Profile Form

Non-Permanent Records

- Nonconformance documentation
- Variance documentation
- Assessment documentation
- Gas canister tags
- Methods performance documentation
- Performance Demonstration Program documentation
- Sampling equipment certifications
- Calculations and related software documentation
- Training/qualification documentation
- QAPP (CAO)/QAPjPs (sites) documentation (all revisions)
- Calibration documentation
- Analytical raw data
- Procurement documentation
- QA procedures (all revisions)
- Technical implementing procedures (all revisions)
- Audio/video recording (RTR, visual, etc.)

1

FIGURES

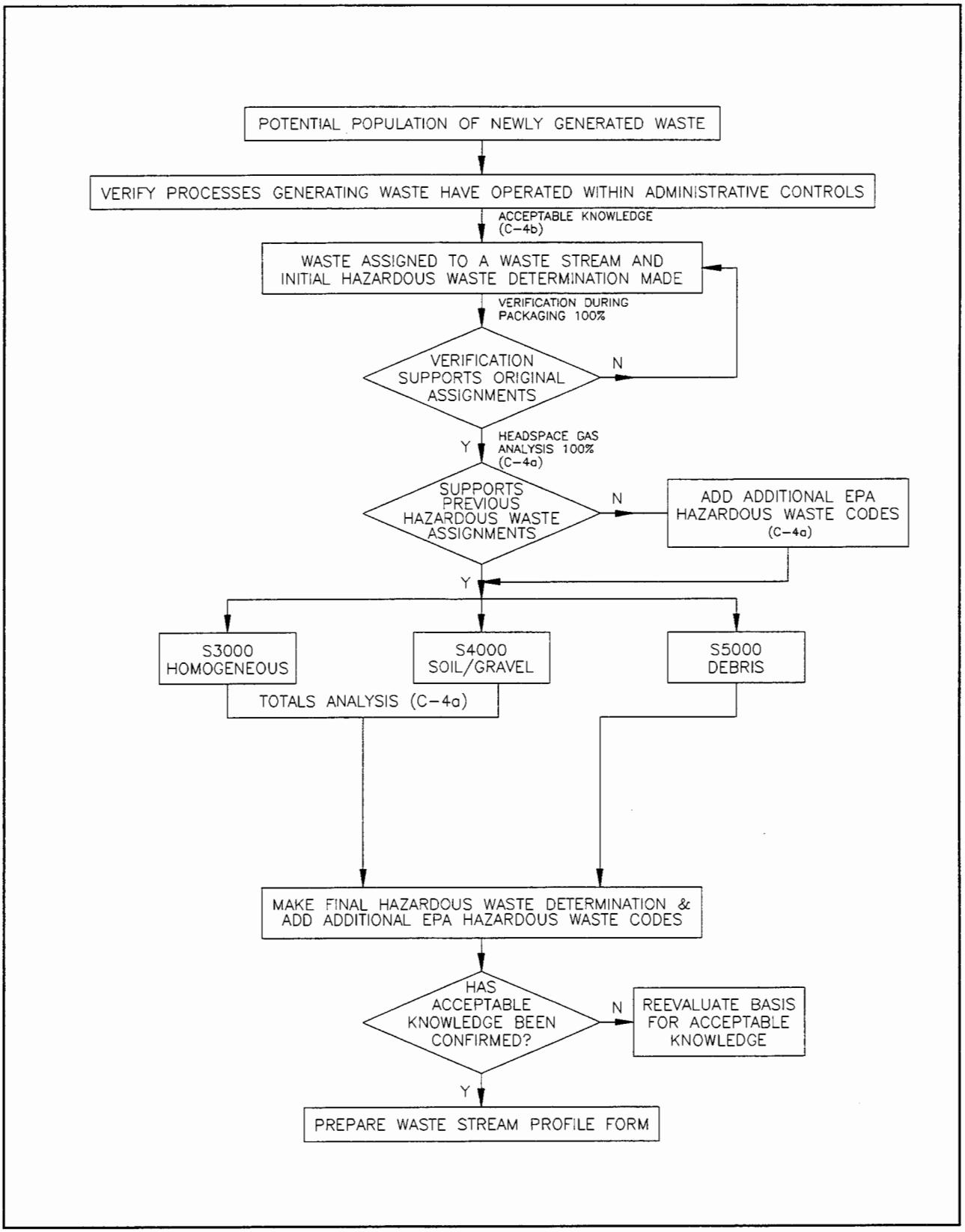

Figure C-1

Data Collection Design for Characterization of Newly Generated Waste

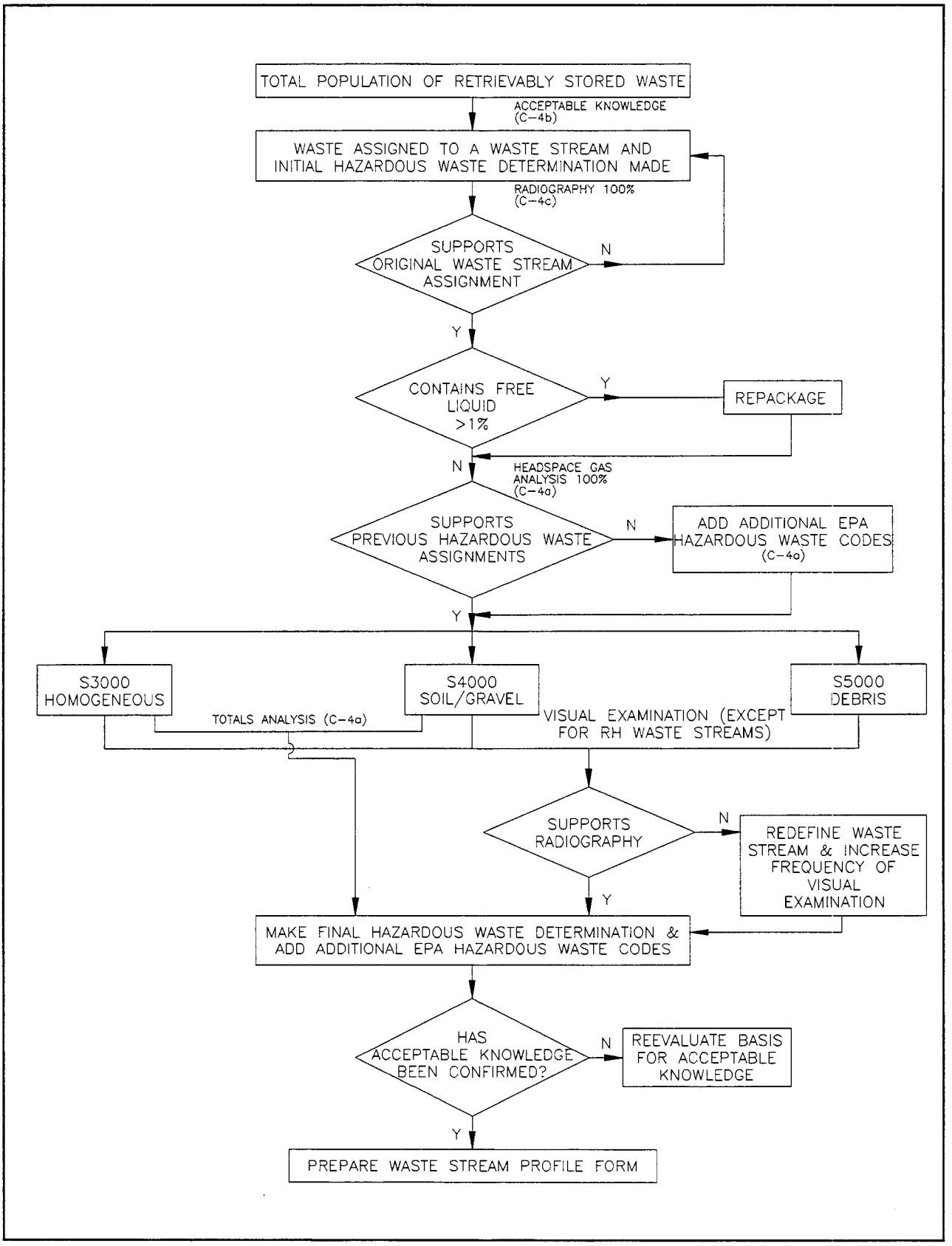

Figure C-2

Data Collection Design for Characterization of Retrievably Stored Waste

AL Ames Laboratory
AE Argonne National Laboratory–East
AW Argonne National Laboratory–West
ET Energy Technology Engineering Center
IN Idaho National Engineering Laboratory
KA Knolls Atomic Power Laboratory–Knolls Site
LA Los Alamos National Laboratory
LB Lawrence Berkeley Laboratory
LL Lawrence Livermore National Laboratory
MD Mound Plant
MU University of Missouri
NT Nevada Test Site
OR Oak Ridge National Laboratory
PA Paducah Gaseous Diffusion Plant
RF Rocky Flats Environmental Technology Site
RL Richland (Hanford) Site
SA Sandia National Laboratories/New Mexico
SR Savannah River Site

★ Indicates Major Site

◊ Indicates Minor Site

Figure C-3

U.S. Department of Energy Transuranic Mixed Waste Generator/Storage Sites

Form Number_____
Page ____ of ____

WIPP WASTE STREAM PROFILE FORM

Shipper/Generator Information:

Site Name _____ / EPA ID _____

Tech. Contact _____ / Phone _____

Orig. Generator _____ / EPA ID _____

Waste Stream Information:

Check one: ☐ CH ☐ RH

Waste Stream WIPP ID _____

Summary Category Group _____ /Waste Matrix Code Group _____

Waste Stream Name _____

Description _____

_____

_____

Date of WAC Certification _____

Title, version number, and date of documents used for WAC certification:

_____

Number of SWBs _____ Number of Drums _____ Number of Canisters _____

List all applicable EPA Hazardous Waste Codes _____

Acceptable Knowledge Information:

Required Program Information	Supporting Documentation Used (References and dates)
☐ Map of Site	_____
☐ Facility Mission Description	_____
☐ Description of Operations that Generate Waste	_____
☐ Waste Identification/Categorization Schemes	_____
☐ Types and quantities of waste generated	_____
☐ Correlation of waste streams generated from the same building and process, as appropriate	_____
☐ Waste certification procedures	_____

Required Waste Stream Information

☐ Area(s) and building(s) from which the waste stream was generated	_____
☐ Waste stream volume and time period of generation	_____
☐ Process flow diagrams	_____

Figure C-4
WIPP Waste Stream Profile Form

Form Number_____
Page ____ of ____

- ☐ Waste Generating Process Description _____
- ☐ Material inputs of other information identifying chemical/radionuclide content and physical waste form _____

Supplemental Documentation

- ☐ Process design documents _____
- ☐ Standard operating procedures _____
- ☐ Safety Analysis Reports _____
- ☐ Waste Packaging Logs _____
- ☐ Test Plans/Research Project Reports _____
- ☐ Site Databases _____
- ☐ Information from Site Personnel _____
- ☐ Standard Industry Documents _____
- ☐ Previous Analytical Data _____
- ☐ Material Safety Data Sheets _____
- ☐ Sampling and Analysis Data from _____
  Comparable/Surrogate Waste _____
- ☐ Laboratory Notebooks _____

Sampling and Analysis Information*: Sampling and Analysis Procedures (reference and date)

- ☐ Radiography _____
- ☐ Visual Examination _____
- ☐ Headspace Gas Analysis
  - VOCs _____
  - Other Gases (Specify) _____
- ☐ Homogeneous Solids/Soil/Gravel Sample Analysis
  - VOCs _____
  - Semi-VOCs _____
  - PCBs _____
  - Total Metals _____
  - Other (specify) _____

☐ Ignitable ☐ Corrosive ☐ Reactive ☐ Compatible

Waste Characterization Data Package Numbers: _____

_____

* Attach signed waste characterization summary data package to support hazardous waste code assignment to form

Certification:
I hereby certify that I have reviewed the information in this Waste Stream Profile Form, and it is complete and accurate to the best of my knowledge. I understand that this information will be made available to regulatory agencies and that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

_____	_____	_____
Signature of Site Project Manager	Printed Name and Title	Date

Figure C-4
WIPP Waste Stream Profile Form (Continued)

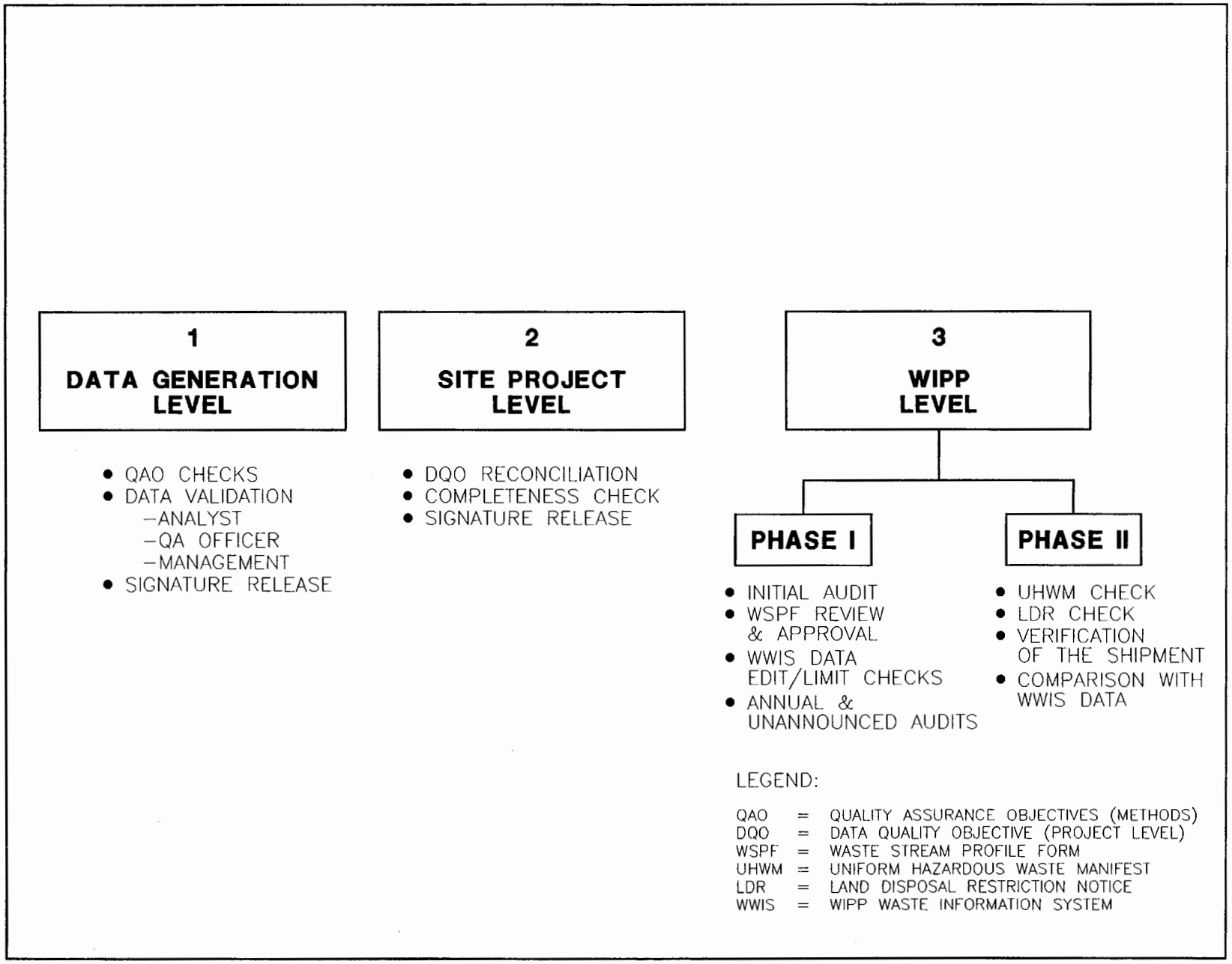

Figure C-5
Levels of Data Verification

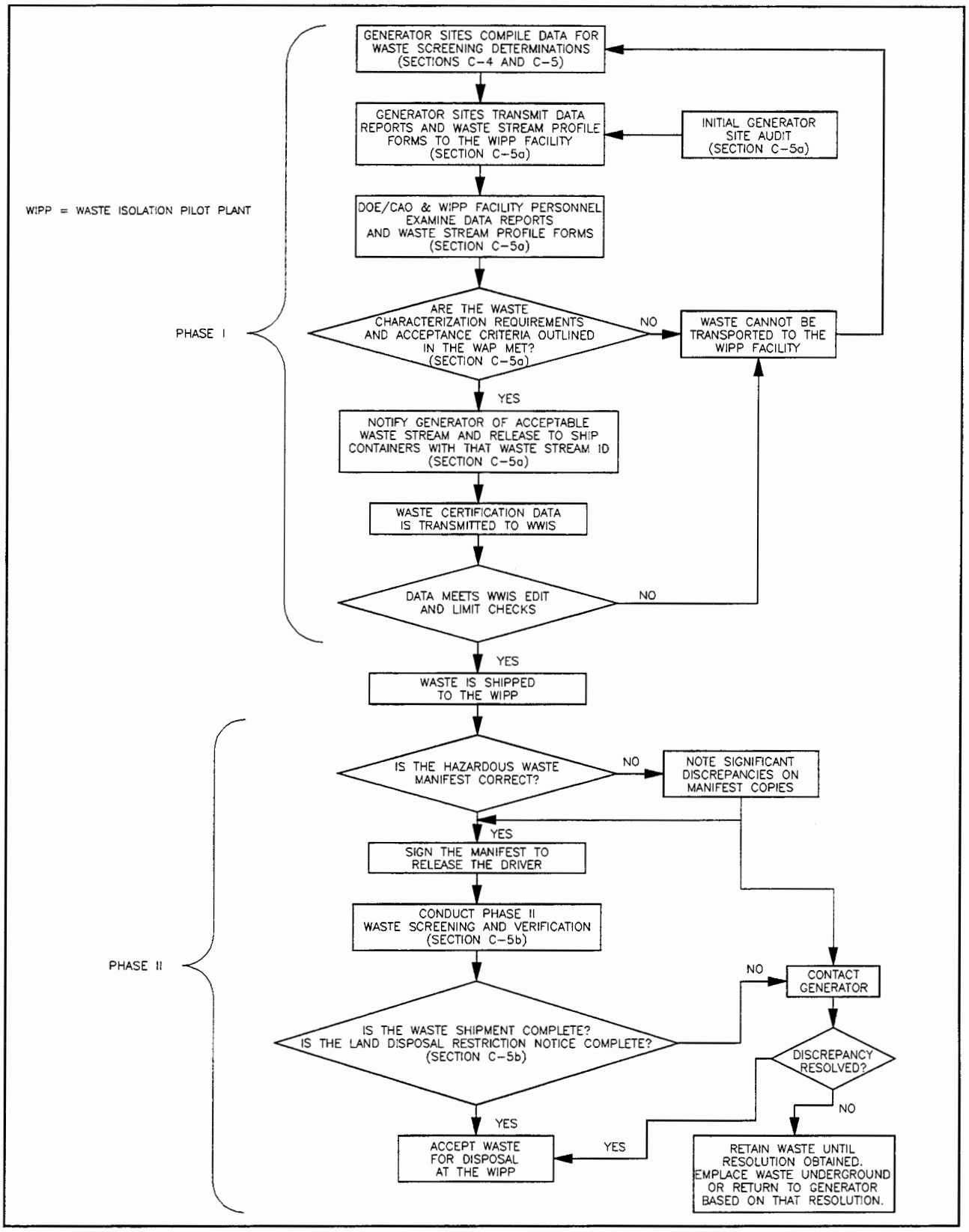

Figure C-6
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CHAPTER D

FACILITY AND PROCESS INFORMATION

CHAPTER D
FACILITY AND PROCESS INFORMATION
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Appendix D4 Waste Isolation Pilot Plant Site Environmental Report for Calendar Year 1994
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CHAPTER D
FACILITY AND PROCESS INFORMATION

Introduction

Disposal of transuranic (TRU) mixed waste in the Waste Isolation Pilot Plant (WIPP) facility is subject to regulation under Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart V. As required by 20 NMAC 4.1, Subpart V, §264.601, the U.S. Department of Energy (DOE) must demonstrate that the environmental performance standards for a miscellaneous unit, which are applied to the hazardous waste management units (HWMU) in the underground, will be met. In addition, the technical requirements of 20 NMAC 4.1, Subpart V, §264.170 to §264.178 are applied to the operation of the container storage units in the Waste Handling Building (WHB), and the parking area. This chapter of the permit application describes the HWMUs, the TRU waste management facilities and operations, and compliance with the environmental performance standards and with the technical requirements of 20 NMAC 4.1. The configuration of the WIPP facility consists of completed structures, including all buildings and systems for the operation of the facility. Technical materials submitted with this permit application fall into two classes: design information and as-built information. Specifically, as required by 20 NMAC 4.1, Subpart IX, §270.23, technical reports on site and location characteristics are provided in Appendix D1, and engineering design basis reports are provided in Appendix D2. Detailed plans and appropriate as-built and design drawings for HWMUs and associated facilities and equipment are provided in Appendix D3. Appendix D3 also includes engineering change orders for the drawings. A list of these drawings is provided in Table D-1.

Certain technical data, such as design drawings and specifications and engineering studies for newly designed facility features (e.g., panel closures), are certified by a registered professional engineer (in accordance with 20 NMAC 4.1, Subpart X, §270.14[a]). Other drawings provided in this permit application are "as-built"[1]. The DOE commissions an independent review of "as-built" drawings by a team of qualified engineers and scientists. Through this process, the WIPP facility "as-built" drawings have been subjected to independent reviews and approvals that: 1) are documented and functionally equivalent to an independent review by a professional engineer, and 2) accomplish the goal of assessing and validating that the WIPP facility design and operations afford protection of the public health and the environment as required by 20 NMAC 4.1, Subpart X, § 270.23(a). Documentation of this review is provided in Appendix D19.

[1]The term "as-built" is not defined in 20 NMAC. However, the term is used in 20 NMAC 4.1, Subpart V, §264.571(c), Subpart VI, §265.571(c), and Subpart IX, §270.26(c), to describe existing facilities subject to the regulations. This use is similar to DOE's definition of as-builts which is, "documentation (includes drawings, computer software, and database records) which has been verified to reflect the actual condition (as-found) of the structure, system, equipment, or computer software."[1]

Disposal Phase Overview

The Disposal Phase will consist of receiving both contact-handled (CH) and remote-handled (RH) TRU mixed waste shipping containers, unloading and transporting the waste containers to the underground HWMUs, emplacing the waste in the underground HWMUs, and subsequently achieving closure of the underground HWMUs in compliance with applicable state and federal regulations. The DOE is seeking a permit to perform these disposal and closure activities. To support this permit application, Appendices D2 and D3 present detailed information on the design of waste disposal facilities and equipment.

Chapter C of this permit application describes the waste types to be disposed of at the WIPP facility. Closure activities will be performed in accordance with Chapter I of this permit application

D-1 Containers

The waste containers that will be used at the WIPP facility qualify as "containers," in accordance with 20 NMAC 4.1, Subpart I, §260.10. That is, they are "portable devices in which a material is stored, transported, treated, disposed of, or otherwise handled."

Management practices for containers are discussed in Section D-10; physical descriptions of the containers that address requirements of 20 NMAC 4.1, Subpart V, Use and Management of Containers, are presented in Section D-1a(1).

D-1a Containers with Free Liquids

The WIPP Waste Acceptance Criteria (WAC) place a prohibition on the shipment of liquid waste to the WIPP. This prohibition is enforced as a "no free-liquids"[2] requirement. Generators generally enforce this as no liquids. This means that if liquids are detected during waste characterization activities (both real time radiography and visual examination can be used to determine the presence of liquids in containers of waste), they are returned to the point of generation or the point of packaging, and the non-conforming items are removed. Storage sites, however, cannot send containers that contain liquids back for remedial action. Consequently, these sites petitioned the DOE to provide a quantitative limit for liquids in stored TRU waste. The DOE responded with the following WAC criterion:

> Liquid waste will not be emplaced in the WIPP. TRU waste for emplacement in the WIPP shall contain as little residual liquid as is reasonably achievable. All internal containers (e.g., bottles, cans, etc.) must be well-drained, but may contain residual liquids. As a guideline, residual liquids in well-drained containers will be restricted to

[2]"Free-liquids" is a term that is used throughout the DOE complex to define liquids in waste which are not chemically bound or sorbed. No attempt has been made to reconcile this term with liquid definitions used in other regulatory systems. Consequently, discussions of liquids with regard to waste that will be placed in WIPP must always be considered within the context of the definition in this section.

> approximately one percent of the volume of the internal container. In no case shall the total liquid equal or exceed one volume percent of the waste container (e.g., drum or SWB). (DOE, 1991)

While this criterion is likely to change with regard to how the limiting volume is measured (on the overall waste container instead of individual containers), the one percent limit will not change nor will the requirement that containers be well drained. This control notwithstanding, for the purposes of discussing container management practices, the DOE has prepared this application as though all containers have one percent liquids which, if the container is breached, is free to flow out of the container. This assumption is made since it is not possible to perform a liquids test on TRU mixed waste, due to the radioactivity and the heterogeneous nature of much of the waste. The assumption, however, does not carry over to the modeling of the waste after it is disposed. In this case, Sandia National Laboratories uses a probability distribution function for the moisture content of the waste. This probability distribution function was developed based on measurements of liquids in over 9,100 drums of waste at the Idaho National Engineering Laboratory (INEL). The summary of these data is included in Appendix D14. The resulting range is 0 to 0.39 pint (0 to 0.18 liter (L)) with an average of 0.18 pint (0.09 L). One percent of a 55-gallon (gal) drum is 4.4 pints (2.1 L).

Since the maximum amount of liquid is one percent, calculations made to determine the secondary containment as required by 20 NMAC 4.1, Subpart V, §264.175 are based on ten percent of one percent of the volume of the containers, or one percent of the largest container, whichever is greater.

Description of Surface Hazardous Waste Management Units

The WHB is the surface facility where waste handling activities will take place (Figure D-1). The WHB has a total area of approximately 84,000 square feet (ft^2) (7,804 square meters (m^2)) of which 33,175 ft^2 (3,082 m^2) are designated for the waste handling and container storage of CH TRU mixed waste and 21,318 ft^2 (1,980 m^2) are designated for the waste handling and container storage of RH TRU mixed waste, as shown in Figure D-1. These areas are being permitted as a container storage unit. The concrete floors are sealed with an impermeable coating that has excellent resistance to the chemicals in TRU mixed waste and, consequently, provide secondary containment for TRU mixed waste. In addition, a parking area south of the WHB (see Figure D-2) will be used for storage of waste in sealed shipping containers awaiting unloading. This area is also being permitted as a container storage unit. The sealed shipping containers provide secondary containment in this HWMU. System descriptions for the WHB HWMU and TRU mixed waste handling systems and a description of the impermeable coating are provided in Sections D-10a(2)(b), D-10a(2)(c), D-10a(2)(d), and D-10a(3).

D-1a(1) Description of Containers

20 NMAC 4.1, Subpart V, §264.171 requires that containers holding waste be in good condition. The WIPP WAC requires that waste containers be in good condition prior to shipment from the generator sites, i.e., containers will be of high integrity, intact, and free of surface contamination

above DOE limits. The Manager of the DOE Carlsbad Area Office has the authority to suspend a generator's certification to ship TRU mixed waste to the WIPP facility should the generator fail to meet this requirement. Such nonconformances would be noted in the generator certification audits discussed in Chapter C of this permit application. The WAC also requires that the containers be certified free of surface contamination above DOE limits upon shipment. This condition shall be verified upon receipt of the waste at WIPP. The level of rigor applied in these areas to ensure container integrity and the absence of external contamination on both ends of the transportation process will ensure that waste containers entering the waste management process line at WIPP meet the applicable Resource Conservation and Recovery Act (RCRA) requirements for container condition.

CH TRU mixed waste containers will be either 55-gal (208-L) drums singly or arranged into 7-packs, 85-gal (321-L) drums singly or arranged into 4-packs, ten-drum overpacks (TDOP), or Standard Waste Boxes (SWB). RH mixed waste containers will be canisters. A summary description of each container type is provided below.

Standard 55-Gallon Drums

Standard 55-gal (208-L) drums meet the requirements for U.S. Department of Transportation (DOT) specification 7A regulations. The drums are also required to have a nominal life of 20 years from the date of TRU mixed waste certification.

A standard 55-gal (208-L) drum has a gross internal volume of 7.4 cubic feet (ft^3) (0.210 cubic meters (m^3)). Figure D-3 shows a standard TRU mixed waste drum. A carbon-composite filtered vent will be installed in the drum lid to prevent the escape of any radioactive particulates and to eliminate any potential of pressurization.

Standard 55-gal (208-L) drums are constructed of mild steel and may also contain rigid, molded polyethylene (or other compatible material) liners. These liners are procured to a specification describing the functional requirements of fitting inside the drum, material thickness and tolerances, and quality controls and required testing. A quality assurance surveillance program is applied to all procurements to verify that the liners meet the specification.

Standard 55-gal (208-L) drums may be used to collect derived waste.

Standard Waste Boxes

The SWBs meet all the requirements of DOT specification 7A regulations. The SWBs are also required to have a nominal design life of 20 years from the date of TRU mixed waste certification.

The SWBs are fitted at the generator sites with a standard carbon-composite filter as required for shipment in a Transuranic Package Transporter, Type II (TRUPACT-II) and for safety during TRU mixed waste storage. They have an internal volume of 66.3 ft^3 (1.88 m^3). Appendix D3 provides detailed design drawings for the SWBs (165-F-001-W).

The SWB is the largest container that may be used to collect derived waste.

Ten-Drum Overpack

The TDOP is a metal container, similar to a SWB, that meets DOT specification 7A and is certified to be noncombustible and to meet all applicable requirements for Type A packaging. The TDOP is a welded-steel, right circular cylinder, approximately 74 inches (in.) (1.9 meters (m)) high and 71 in. (1.8 m) in diameter (Figure D-4). The maximum loaded weight of a TDOP is 7,265 pounds (lbs) (3,295.4 kilograms (kg)). A bolted lid on one end is removable; sealing is accomplished by clamping a neoprene gasket between the lid and the body. Filter ports are located near the top of the TDOP. Each TDOP contains carbon-composite filters. A TDOP may contain up to ten standard 55-gal (208-L) drums or one SWB. TDOPs may be used to overpack drums or SWBs containing CH TRU mixed waste.

Eighty-Five Gallon Drum Overpack

The 85-gal (321-L) drums meet the requirements for DOT specification 7A regulations. The drums are required to have a nominal life of 20 years from the date of TRU mixed waste certification. These drums are also equipped with filter vents.

The 85-gal (321-L) drum overpack, which is shown in Figure D-5, will be used primarily for overpacking contaminated 55-gal (208 L) drums at the WIPP facility.

85-gal (321-L) drums may be used to collect derived waste.

RH Canister

The payload canister, or RH canister, meets all the requirements of DOT specification 7A regulations. It is a carbon-steel single-shell container measuring 26 in. (0.7 m) in diameter, with an overall length of 121 in. (3.1 m). The canister is vented using a carbon-composite high efficiency particulate air (HEPA)-grade filter and is capable of overpacking three 30-gal (114-L) or 55-gal (208-L) waste drums or 235 gal (890 L) of uncontainerized waste for handling purposes.

Overpack RH Canister

The overpack RH TRU waste canister is the same as the payload RH canister, except it is 28 in. (0.7 m) in diameter and 133 in. (3.4 m) in maximum length and weighs a maximum of 10,000 lbs (4,535 kg) when loaded.

Container Compatibility

All containers are made of steel, and some contain rigid, molded polyethylene liners. The compatibility study, documented in Appendix C1, included container materials to assure containers are compatible with the waste. Therefore, these containers meet the requirements of 20 NMAC 4.1, Subpart V, §264.172.

D-1a(1)(a) CH Bay and RH Bay Storage Areas

Upon receipt and removal of CH TRU waste containers from the TRUPACT-IIs, the waste containers will be checked for physical damage and for external surface contamination. If a primary waste container does not meet the requirements for acceptability, corrective action will be taken to mitigate unacceptable conditions. Such unacceptable conditions may be mitigated by initiating local decontamination, returning unacceptable containers to a DOE generator site, or sending the TRUPACT-II to the third party contractor. If local decontamination activities are opted for, the work will be conducted inside the WHB on the TRUPACT-II Dock (TRUDOCK). These processes are described in Section D-10a. The area previously designated as the Overpack and Repair Room will not be used for TRU mixed waste management in any instances.

When RH canisters are removed from the road cask in the unloading room of the hot cell complex, they will be transported to the Hot Cell and checked for external surface contamination and container integrity. If an unacceptable condition is identified, the canister will be overpacked. The overpacked canister will then reenter the normal waste management process line.

D-1a(1)(b) Parking Area Storage Unit

Wastes placed in the Parking Area Storage Unit will remain sealed in their transportation containers at all times while in this area. The Certificate of Compliance requires that sealed TRUPACT-IIs, which contain waste, be vented every 60 days to avoid unacceptable levels of internal pressure. Internal primary waste containers will be checked for container integrity and surface contamination when the waste is unloaded for emplacement in the underground. The Nuclear Regulatory Commission (NRC) has not established a maximum sealing time for RH TRU transportation casks.

D-1a(2) Container Management Practices

20 NMAC 4.1, Subpart V, §264.173 requires that containers be managed in a manner that does not result in spills or leaks. Containers are required to be closed at all times, unless waste is being placed in the container or removed. Because containers at the WIPP will contain radioactive waste, safety concerns require that containers be continuously vented to obviate the buildup of gases within the container. These gases could result from radiolysis, which is the

breakdown of moisture by radiation. The vents, which are nominally 0.75 in. (1.9 centimeters [cm]) in diameter, are generally installed on or near the lids of the containers. These vents are filtered so that gas can escape while particulates are retained.

TRU waste containers, containing off-site waste, are never opened at the WIPP facility. Derived waste containers are kept closed at all times unless waste is being added or removed.

The following sections describe container management practices during normal operations and during off-normal events.

D-1a(2)(a) Normal Operations

The waste handling process and detailed descriptions of facilities are included in Section D-10.

D-1a(2)(a)(i) CH Bay and RH Bay

The maximum processing rate for CH waste is 14 TRUPACT-IIs per day, or seven pallet loads. Two shifts per day are planned, four days per week. The fifth day is for equipment maintenance with weekends available for more extensive maintenance, when necessary.

Once unloaded from the TRUPACT-IIs, CH waste containers (7-packs or SWBs) are placed in one of two positions on the facility pallet (See Section D-10a(2)(c)). The 7-packs or SWBs are stacked, as they arrive in the TRUPACT-II, on the facility pallets (one- or two-high, depending on weight considerations). The use of facility pallets will elevate the waste approximately 9.5 in. (24 cm) from the floor surface. Pallets of waste will then be relocated to the northeast area of the CH bay for normal storage. This storage area, which is shown in Figure D-6, will be clearly marked to indicate the lateral limits of the storage area. This storage area will have a maximum capacity of seven pallets (1,856 ft^3 [52.6 m^3]) of waste during normal operations. These pallets will typically be staged in this area for a period of up to five days.

In addition, four TRUPACT-IIs, containing up to eight 7-packs or SWBs, may occupy the staging positions at the TRUDOCK (See Section D-10a(2)(c)). If waste are left in this area, they will be in the TRUPACT-II shipping container. The volume of waste in four TRUPACT-IIs is 530.4 ft^3 (15 m^3).

A derived waste storage area is shown on the north wall of the CH Bay. This area will contain containers up to the volume of a SWB for collecting derived waste from all waste handling processes in the WHB. The DOE is permitting this area so that containers in size up to a SWB can be used to accumulate derived waste. Using a SWB facilitates safer, easier, and more efficient handling of filled derived waste containers. The volume stored in this area will be up to 66.3 ft^3 (1.88 m^3).

An area has also been designated for the temporary storage of waste containers for which manifest discrepancies were noted after the TRUPACT-IIs were opened. Discrepant payloads will either be placed onto a facility pallet or placed back into the TRUPACT-II and placed into the

Shielded Storage Room. In either case the waste containers will be elevated approximately six inches from the floor surface. The storage capacity of this area is one pallet load (i.e., 4 SWBs, 2 TDOPs, or 28 drums, or combinations of all three).

The amount of RH TRU mixed waste disposal planned is two canisters per day or eight per week on the same shifts as CH waste operations.

During normal operations, a maximum of five RH canisters will be stored in the Hot Cell and a maximum of seven canisters will be stored in the Transfer Cell, as shown in Figures D-7 and D-8. The combined storage capacity of the Hot Cell and the Transfer Cell is 377 ft^3 (10.7 m^3). The floor and wall coatings provide an impermeable surface that serves as secondary containment in the Hot Cell and the Transfer Cell. The storage positions that hold the canisters have openings which keep the canisters from standing in liquid. (The Hot Cell and the Transfer Cell are discussed in Section D-10a(2)(b)(ii).)

Aisle space shall be maintained in all CH Bay waste storage areas. The aisle space shall be adequate to allow unobstructed movement of fire-fighting personnel, spill-control equipment, and decontamination equipment that would be used in the event of an off-normal event. An aisle space of 44 in. (1.1 m) between facility pallets will be maintained in all CH TRU waste storage areas. Aisle space requirements shall not be met for RH canisters. Because of the high radiation fields, inspections and cleanup of spills and releases will not be conducted while waste is located in these storage areas. If a release were to occur, all waste would be removed from the Hot Cell prior to initiating any clean up activities.

D-1a(2)(a)(ii) Parking Area

The area extending south from the WHB across the rail sidings is defined as the parking area container storage unit (HWMU) (Figure D-6). This area provides space for 12 loaded TRUPACT-IIs and three loaded road casks or four rail casks, corresponding to 1,536 ft^3 (43.5 m^3) of CH waste and 125.6 ft^3 (3.56 m^3) of RH waste. Secondary containment and protection of the waste containers from standing liquid are provided by the transportation containers.

The maximum number of TRUPACT-IIs that will be stored in the parking area is 20 percent of the TRUPACT-II fleet. This is equivalent to 12 TRUPACT-IIs, containing a maximum of 24 SWBs or 168 drums of CH waste. The TRUPACT-II safety criteria require that they be opened and vented at a frequency of at least once every 60 days. In addition, three road casks or four rail casks containing RH waste will be stored in this area. During normal operations the maximum residence time of any one container in the parking area storage area is five days. Therefore, during normal waste handling operations, no TRUPACT-IIs will require venting while located in the parking area storage area. Any off-normal event that drives residence times to 60 days or greater in this storage area shall be mitigated by moving the TRUPACT-IIs or casks inside the WHB for the venting process prior to returning them to the parking area.

D-1a(2)(b) Off-Normal Events

Off-normal events could interrupt normal operations in the waste management process line. These off normal events fall into the following categories:

- Waste management system equipment malfunctions
- Waste shipments with unacceptable levels of surface contamination
- Hazardous Waste Manifest discrepancies that are not immediately resolved
- A suspension of emplacement activities for regulatory reasons

Additional storage capacity is available on the west side of the CH bay for use during off-normal events. If such off-normal events occur, the NMED will be informed of: 1) how much waste is to be stored, 2) where the waste will be placed, 3) how any applicable secondary containment requirements will be met, and 4) how long the waste is expected to be located in the designated storage area. Waste stored in this area will be inspected at a frequency of at least once weekly, with the exception of the Hot Cell and Transfer Cell, as previously noted.

Shipments of waste from the generator sites will be stopped in any event which results in an interruption to normal waste handling operations that exceeds three days. This will minimize the potential for large quantities of waste requiring storage in the parking area for extended periods of time.

D-1a(3) Inspections

Inspection of containers and container storage area are required by 20 NMAC 4.1, Subpart V, §264.174. These inspections are described in this section.

D-1a(3)(a) CH Bay and RH Bay Storage Areas

The 7-packs and SWBs will be visually inspected prior to each movement and, at a minimum, weekly, to ensure that the waste containers are in good condition and that there are no signs that a release has occurred. This visual inspection shall not include the center drums of 7-packs and waste containers positioned such that visual observation is precluded due to the arrangement of waste assemblies on the facility pallets. Containers of waste stored in the Hot Cell or the Transfer Cell will not be inspected, as this would violate the radiological control program goal to minimize occupational radiological exposures As Low As Reasonably Achievable. However, these areas are monitored using closed circuit video cameras. If waste handling operations should stop for any reason with containers located on the TRUDOCKS in the TRUPACT-II shipping containers, primary waste container inspections could not be accomplished until the containers of waste are removed from the TRUPACT-II, however, limited weekly camera inspections can be conducted in the Hot Cell. If the lid to the TRUPACT-II inner container vessel is removed, radiological checks (swipes of TRUPACT-II inner surfaces) can be

used to determine if there is contamination within the TRUPACT-II. Such contamination could indicate a waste container leak or spill. Using the principle of co-detection, a spill or leak of a radioactive contamination from a waste container would also be assumed to be a hazardous waste spill or release.

Inspections of the area designated for holding waste while manifest discrepancies are resolved, are performed prior to use and weekly thereafter, so long as waste containers reside in the storage area. Waste containers residing within a TRUPACT-II would however, undergo only limited inspection as described in the first bullet in Section D-1a(3)(b).

Waste containers will be inspected prior to reentering the waste management process line for downloading to the underground. Waste containers stored in this area will be inspected at least once weekly.

D-1a(3)(b) Parking Area

Inspections will be conducted in the parking area at a frequency not less than once weekly. These inspections are applicable to loaded, stored TRUPACT-IIs and road casks. The perimeter fence located at the lateral limit of the parking area, coupled with personnel access restrictions into the WHB, will provide the needed security. The perimeter fence and the southern border of the WHB shall mark the lateral limit of the parking area storage area. Inspections of the TRUPACT-IIs and/or road casks stored in the parking area will focus on the inventory and integrity of the shipping containers and the spacing between TRUPACT-II trailers and road casks. This spacing will be maintained at a minimum of four feet.

Loaded TRUPACT-IIs and road casks will be inspected weekly during use and prior to each reuse.

Inspection of waste containers is not possible when the containers are in their shipping container (i.e., TRUPACT-II or road cask). Inspections can be accomplished by bringing the shipping containers into the WHB and opening them and lifting the waste containers out for inspection. The DOE, however, believes that removing containers strictly for the purposes of inspection results in unnecessary worker exposures and subjects the waste to additional handling. The DOE has proposed that waste containers need not be inspected at all until they are ready to be removed from the shipping container for emplacement underground. Because shipping containers are sealed and are of robust design, no harm can come to the waste while in the shipping containers and the waste cannot leak or otherwise be released to the environment. TRUPACT-II shipping containers must be opened every 60 days for the purposes of venting, so that the longest waste would be uninspected would be for 60 days from the day the waste was first placed in the TRUPACT-II at the generator site. Note that the road cask has not yet been certified by the NRC so that the length of time it can be sealed prior to venting has not yet been established. Venting the containers involves removing the outer and inner lids. Removal of the road cask inner lid occurs only with the cask in the unloading room using the hot cell hoist. Inspection of the RH canister can only be done at the hot cell inspection station.

The NMED has indicated that they prefer DOE sample the TRUPACT-II headspace every 30 days to determine if there has been a leak or spill. This is in lieu of inspecting waste containers within the shipping container. Since taking such samples would involve additional radiation exposure, the DOE has decided to adopt the following strategy for inspecting waste containers that must be retained within their shipping containers for an extended period of time:

- If the reason for retaining the waste in the shipping container is due to an unresolved manifest discrepancy, the DOE will return the shipment to the generator prior to the expiration of the 60 day NRC venting period or within 30 days after receipt at the WIPP, whichever comes sooner. In this case, no inspections of the internal containers will be performed. The stored TRUPACT-II will be inspected weekly as described above.

- If the reason for retaining the waste in the TRUPACT-II is due to an equipment malfunction that prevents unloading the waste in the WHB, the DOE will return the shipment to the generator prior to the expiration of the 60 day NRC venting period. In this case, the DOE would have to ship the waste back with sufficient time for the generator to vent the shipment within the 60 day limit. In this case, no inspections of the internal containers will be performed. The stored TRUPACT-II will be inspected weekly as described above.

- If the reason for retaining the waste is due to an equipment malfunction that prevents the timely movement of the waste into the underground, the waste will be kept in the TRUPACT-II until day 30 (after receipt at the WIPP) or the expiration of the 60 day limit, whichever comes sooner. At that time the TRUPACT-II will be moved into the WHB and the waste removed and placed in one of the permitted storage areas. If there is no additional space within the permitted storage areas, the DOE will discuss an emergency permit with the NMED for the purposes of storing the waste elsewhere in the WHB. Waste containers will be inspected when removed from the TRUPACT-II and weekly while in storage in the WHB. TRUPACT-IIs will be inspected weekly while they contain waste as discussed above.

The DOE believes that this strategy minimizes both the amount of shipping that is necessary and the amount of waste handling, while maintaining a reasonable inspection schedule. The DOE will stop shipments of waste for any equipment outage that will extend beyond three days. The DOE will not store RH waste at the facility outside the shipping cask beyond the permitted capacity of the Hot Cell and Transfer Cell.

D-1a(4) <u>Containment</u>

The WHB has concrete floors, which are sealed with an impermeable coating (see Appendix D8) that resists all but the strongest oxidizing agents. Such oxidizing agents do not meet the WAC and will not be accepted in TRU mixed waste at the WIPP facility. Therefore, TRU mixed wastes pose no compatibility problems with respect to the WHB floor. The impermeable floor coating consists of Carboline® 1340 clear primer-sealer on top of prepared concrete, Carboline® 191

primer epoxy, and Carboline® 195 surface epoxy. The manufacturer's chemical resistance guide shows "Very Good" for acids and "Excellent" for alkalies, solvents, salt, and water. Uses are indicated for nuclear power plants, industrial equipment and components, chemical processing plants, and pulp and paper mills for protection of structural steel and concrete. During the Disposal Phase, should the floors need to be re-coated, any floor coating used in the WHB TRU mixed waste handling areas will be compatible with the TRU mixed waste constituents and will have chemical resistance at least equivalent to the Carboline® products described in Appendix D8. Figure D-9 is a plan view of the WHB, showing areas where TRU mixed waste handling activities discussed in this section occur.

During normal operations, the floor of the normal storage areas within the CH Bay shall be visually inspected on a weekly basis to verify that it is in good condition and free of cracks and gaps. Floors in the Hot Cell and the Transfer Cell can only be inspected when no waste is present. Inspections will occur at least annually when these areas undergo routine maintenance. This less frequent inspection schedule is justified because of the high radiation fields that are present when waste is present and because these floors are not subjected to vehicle traffic.

Floor areas of the WHB in use during off-normal events will be inspected prior to use and weekly thereafter. All containers located in the permitted storage areas shall be elevated at least 6 in. (15 cm) from the surface of the floor. Waste containers that have been removed from TRUPACT-II shipping containers shall be stored at a designated storage area inside the WHB so as to preclude exposure to the elements.

Secondary containment at permitted storage areas inside the WHB shall be provided by the floor. These areas include the CH bay floor (see Figure D-1), the Hot Cell (see Figure D-7), and the Transfer Cell (see Figure D-8). The WHB is engineered such that during normal operations, the floor capacity is sufficient to contain liquids upon release. The parking area and TRUDOCK require no engineered secondary containment since no waste is to be stored there unless it is protected by the TRUPACT-II shipping containers or the road casks.

Calculations to determine the floor surface area required to provide secondary containment in the event of a release are based on the maximum quantity of liquid which could be present within ten percent of one percent of the volume of all the containers or one percent of the capacity of the largest single container, whichever is greater.

D-1a(4)(a) <u>Secondary Containment Requirements</u>

D-1a(4)(a)(i) <u>CH Bay</u>:

Seven facility pallets @ 4 SWBs per pallet = 28 SWBs of waste. 28 SWBs @ 496 gal (1878 L) per SWB = 13,888 gal (52,570 L) waste container capacity. 13,888 gal (52,570 L) x ten percent of the total volume = 1,389 gal (5,258 L) of waste. Since 1,389 gal (5,263 L) is greater than 496 gal (1,878 L), the volume of the largest single container, the configuration of all SWBs in the

storage area is used for the calculation of secondary containment requirements. 1,389 gal (5,258 L) of liquid x one percent liquids = 13.9 gal (52.6 L) of liquid needed for secondary containment.

D-1a(4)(a)(ii) Hot Cell:

Five canisters @ 235 gal (890 L) per canister = 1,175 gal (4,448 L) of waste. 1,175 gal (4,448 L) of waste x ten percent of total volume = 118 gal (447 L) of waste. However, 118 gal (447 L) is less than the volume of a single container, which is 235 gal (890 L), therefore, the larger volume is used for determining the secondary containment requirements. 235 gal (890 L) of waste x one percent liquids = 2.35 gal (8.9 L) of liquid needed for secondary containment.

D-1a(4)(a)(iii) Transfer Cell:

Seven canisters @ 235 gal (890 L) per canister = 1,645 gal (6,227 L) of waste. 1,645 gal (6,227 L) of waste x ten percent of total volume = 165 gal (625 L) of waste. However, 165 gal (625 L) is less than the volume of a single container, which is 235 gal (890 L), therefore, the larger volume is used for determining the secondary containment requirements. 235 gal (890 L) of waste x one percent liquids = 2.35 gal (8.9 L) of liquid needed for secondary containment.

D-1a(4)(b) Secondary Containment Description

The following is a calculation of the surface area the quantities of liquid would cover. Using a conversion factor of 0.1337 ft^3/gal (0.001 m^3/L) and assuming the spill is 0.0033 ft (0.001 m) thick, the following calculation can be used:

gallons x cubic feet per gallon ÷ thickness in feet = area covered in square feet

D-1a(4)(b)(i) CH Bay:

13.9 gal x 0.1337 ft^3/gal ÷ 0.0033 ft = 563 ft^2 (52.3 m^2)

2.35 gal x 0.1337 ft^3/gal ÷ 0.0033 ft = 95 ft^2 (88m^2)

Since the CH Bay has over 33,000 ft^2 (3066 m^2) of floor space, and the storage area in the northeast corner of the CH Bay (Figure D-6) has over 2,924 ft^2 (272 m^2), there is plenty of secondary containment.

D-1a(4)(b)(ii) Hot Cell and Transfer Cell:

The Hot Cell floor is 873 ft^2 (81 m^2) and provides sufficient secondary containment for RH TRU waste stored in that area. The Transfer Cell floor is 1,012 ft^2 (94 m^2). This too, is sufficient secondary containment. In addition, both the Hot Cell the Transfer Cell each contain a 135 gal (511 L) sump that will collect any liquids that spill from containers.

Any liquid observed on the secondary containment system will be removed in a timely manner, with the exception of RH waste storage areas, as previously noted. Since RH waste is designated for storage in the Hot Cell and Transfer Cell only, a release would not pose an immediate threat to human health or the environment. The Hot Cell will undergo periodic maintenance activities, at which time any releases that occurred since the last maintenance activity will be cleaned up.

Waste to be stored in the parking area will be in TRUPACT-II shipping containers and/or road casks. There will be no additional requirements for engineered secondary containment systems.

D-1a(5) Special Requirements for Ignitable, Reactive, and Incompatible Waste

Special requirements for ignitable, reactive, and incompatible waste are addressed in 20 NMAC 4.1, Subpart V, §§264.176 and 264.177. The WIPP WAC precludes ignitable, reactive, or incompatible waste at the WIPP. No additional measures outside the generator certification audit program in Chapter C of the application, and contingency plans described in Chapter G of the application are required for compliance with these requirements.

D-1a(6) Closure

Clean closure is planned in accordance with 20 NMAC 4.1, Subpart V, §264.178 for all permitted container storage areas. The applicable areas and the plans for clean closure are detailed in Chapter I of this application.

D-1a(7) Control of Run On

The CH Bay and the RH Bay are both indoors so that run on from a precipitation event is prevented. In addition, the containers are stored on pallets, which hold CH TRU waste 6 in. (15 cm) off the floor, or in racks, which hold RH TRU waste several feet off the floor, so that any firewater released in the building will not pool around containers. In the parking lot area, the wastes are always in shipping containers which protect them from precipitation and run on. Therefore, the WIPP container storage areas comply with the requirements of 20 NMAC 4.1, Subpart V, §264.175(b)(4).

D-1b Containers Without Free Liquids

As discussed above, the DOE manages all TRU mixed waste containers as though they contain up to one percent liquids. Consequently, the requirements in 20 NMAC 4.1, Subpart V, §264.175(c) do not apply to the WIPP facility.

D-2 Tank Systems

The WIPP facility does not manage hazardous or TRU mixed waste using a tank system as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Tank Systems. Tank system regulations are not applicable to the WIPP facility.

D-3 Waste Piles

The WIPP facility does not manage hazardous or TRU mixed waste using a waste pile as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Waste Piles. Waste pile regulations are not applicable to the WIPP facility.

D-4 Surface Impoundments

The WIPP facility does not manage hazardous or TRU mixed waste using a surface impoundment as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Surface Impoundments. Surface impoundment regulations are not applicable to the WIPP facility.

D-5 Incinerators

The WIPP facility does not manage hazardous or TRU mixed waste using an incinerator as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Incinerators. Incinerator regulations are not applicable to the WIPP facility.

D-6 Landfills

The WIPP facility does not manage hazardous or TRU mixed waste using a landfill as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Landfills. Resource Conservation and Recovery Act (RCRA) landfill regulations are not applicable to the WIPP facility.

D-7 Land Treatment

The WIPP facility does not manage hazardous or TRU mixed waste using land treatment as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Land Treatment. Land treatment regulations are not applicable to the WIPP facility.

D-8 Drip Pads

The WIPP facility does not manage hazardous or TRU mixed waste using a drip pad as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Drip Pads. Requirements for drip pads are not applicable to the WIPP facility.

D-9 Miscellaneous Unit

The WIPP facility is a geologic repository mined within a bedded salt formation, which is defined in 20 NMAC 4.1, Subpart I, §260.10 as a miscellaneous unit. As such, HWMUs within the repository are eligible for permitting according to 20 NMAC 4.1, Subpart I, §260.10, and are regulated under 20 NMAC 4.1, Subpart V, Miscellaneous Units.

D-9a Description of the Miscellaneous Unit

The WIPP repository is mined within a 2,000-ft (610-m)-thick bedded-salt formation. The underground (miscellaneous unit) is 2,150 ft (655 m) beneath the ground surface. TRU mixed waste management activities underground will be confined to the southern portion of the 120-acre (48.5 hectares) mined area during the Disposal Phase. This portion has been designated as Panels 1 through 8. In addition, the north-south entries marked as E-300, E-140, W-30, and W-170, between S-1600 and S-3650 are also available for waste disposal. These areas are referred to as the disposal area access drifts and have been designated as Panels 9 and 10 in Figure D-10. Waste will be disposed of in the HWMUs (i.e., Panels 1 through 10; Figure D-10). A detailed discussion of these areas is included in Section D-10a(2)(f).

Panels 1 through 8 will consist of seven rooms and two access drifts each. Access drifts connect the rooms and have the same cross section (see Section D-10a(2)(f)). The closure system installed in each HWMU after it is filled will prevent anyone from entering the HWMU and will stop ventilation airflow. The point of compliance for air emissions from the underground HWMUs is the facility boundary defined in the Land Withdrawal Act of 1992 (LWA) (Public Law 102-579), which is the location where any member of the public would be subject to the greatest risk from emissions from the waste.

Four shafts connect the underground area with the surface. The Waste Shaft headframe and hoist are located within the WHB and will be used to transport TRU mixed waste, equipment, and materials to the repository horizon. The waste hoist can also be used to transport personnel. The Air Intake Shaft and the Salt Handling Shaft provide ventilation to all areas of the mine except for the Waste Shaft Station. This area is ventilated by the Waste Shaft itself. The Salt Handling Shaft is also used to hoist mined salt to the surface and serves as the principal personnel transport shaft. The Exhaust Shaft serves as a common exhaust air duct for all areas of the mine.

The disposal area (Figure D-10) provides room for 6.2 million ft^3 (175,600 m^3) of TRU mixed waste, of which 250,000 ft^3 (7,080 m^3) may be RH TRU mixed waste. The CH TRU mixed waste containers (typically, 7-packs and SWBs) may be stacked three-high across the width of the room.

Because the emplacement of CH TRU mixed waste into the HWMUs will typically be in the order received and unloaded from the TRUPACT-IIs, 7-packs of drums, SWBs, TDOPs, and 85-gal (321-L) overpack containers will be emplaced as they arrive (except that 85-gal

(321-L) overpacks will only be placed on the top row in the repository). There is no intent to leave a specified amount of space between the waste containers themselves, or between the waste containers and the walls. Containers will be stacked in the best manner to provide stability for the stack (which is up to three containers high) and to make best use of available space. It is anticipated that the space between the wall and the container could be from 8 to 18 in. (20 to 46 cm). This space is a function of disposal room wall irregularities, container type, and sequence of emplacement. Bags of backfill will occupy some of this space. Space is required to be maintained over the stacks of containers to assure adequate ventilation for waste handling operations. A minimum of 16 in. (41 cm) is specified in the Final Design Validation Report (Appendix D1, Chapter 12) to maintain air flow. Typically, the space above a stack of containers will be 36 to 48 in. (90 to 122 cm). However 18 in. (0.45 m) will contain backfill material consisting of bags of Magnesium Oxide (MgO). Figure D-11 shows a typical container configuration, although this figure does not mix containers on any row. Such mixing, while inefficient, will be allowed to assure timely movement of waste into the underground.

No aisle space will be maintained for personnel access to emplaced waste containers. No roof maintenance behind stacks of waste is planned. The Final Design Validation Report (Appendix D1) validated the room design with no roof support as long as container breaching due to creep closure at seven years for backfilled waste did not present an operational problem. Since normal operations anticipate five years from initial excavation until placement of panel closures, breaching of containers will not occur prior to panel closure, and there are no roof support system components to maintain. One exception, however, is Panel 1 which will be much older than seven years at the time it is used for waste disposal. Consequently, this panel is dealt with explicitly in the application in Section D-10a(2)(f) and Section D-10d(1)(c). All underground excavations are inspected and evaluated prior to each major activity period. If ground conditions of a particular area cannot be relied upon for the period of time the area is needed, the conditions will either be remediated (bolted or scaled) or the areas simply will not be used. In addition, areas of the underground in which personnel are working are inspected daily. If unsafe conditions are noted, prompt and appropriate action is taken to correct the problem.

RH TRU mixed waste canisters and RH TRU overpack canisters will be inserted into horizontal holes bored into the room and panel walls. A shield plug is then inserted into the hole to provide radiation shielding. Figure D-11 depicts a typical RH TRU mixed waste canister disposal configuration.

Section D-10 provides more detailed information on the TRU mixed waste handling facilities and the repository. The WIPP surface facility, shafts, and repository horizon are shown in Figure D12.

D-9a(1) Site Characteristics

The physical attributes of the WIPP site and its vicinity contribute to the ability of the WIPP facility to isolate TRU mixed waste and assure that human health and the environment are protected. Geologic studies indicate that the Salado Formation (hereinafter referred to as the Salado) is free of void space and unsaturated water that could cause dissolution of and create openings within the formation. This eliminates circulating brine water as a transport mechanism for TRU mixed waste migration to the surface or to groundwater.

Detailed studies and evaluations of the natural environmental setting of the repository area have been part of the site selection and characterization process. The following sections of this chapter describe the climatic, geologic, and hydrologic characteristics of the WIPP facility and local vicinity. This information also provides the basis for evaluation of potential migration pathways in Section D-9b, Environmental Performance Standards for the Miscellaneous Unit.

D-9a(1)(a) Climate

The WIPP facility is located in a region representing a transition between the northern Chihuahuan Desert and the southern Great Plains. The average annual precipitation is approximately 12 in. (30 cm), half of which is received during summer thunderstorms. Prevailing winds are from the southeast; however, strong winds are frequent, especially in the spring, and can blow from any direction, creating windstorms that carry large volumes of dust and sand. Detailed meteorological data on the site have been collected and published in the WIPP Annual Site Environmental Report since 1985. The WIPP Site Environmental Report for calendar year 1994 is provided for information as Appendix D4. Figure D-13 summarizes wind data collected from the Carlsbad, New Mexico, Airport for 1990 to 1994. (This is provided because meteorological data from the Carlsbad Airport was used in exposure analyses in Section D-9b.) Appendix D5 provides information on climate measurements at WIPP.

D-9a(1)(b) Geology, Geomorphology, and Geologic Stability

This section discusses the geology, geomorphology, and geologic stability of the region around the WIPP facility. Additional details are provided in Appendices D1 and D6.

D-9a(1)(b)(i) Geology

The WIPP site is situated within the Delaware Basin, which is part of the larger Permian Basin, located in the south-central region of North America. During the Permian period, which came to a close about 245 million years ago, ancient seas covered the basin. Their later evaporation resulted in the deposition of a thick sequence of evaporites. Appendix D6 presents a detailed discussion of the regional geologic history. Three major evaporite-bearing formations were deposited in the Delaware Basin (see Figures D-14 and D-15):

- The Castile Formation (hereinafter referred to as the Castile), which formed through evaporation of the Permian Sea, consists of interbedded anhydrites and halite . Its upper boundary is at a depth of about 2,825 ft (861 m) below ground surface (BGS), and its thickness at the WIPP facility is 1,250 ft (381 m) (see Appendix D6).

- The Salado, in which the repository is located, overlies the Castile and resulted from prolonged desiccation that produced predominantly halite, with some carbonates, anhydrites, and clay seams. Its upper boundary is at a depth of about 850 ft (259 m) BGS, and it is about 2,000 ft (610 m) thick in the repository area (see Appendix D6).

- The Rustler Formation (hereinafter referred to as the Rustler) was deposited in a lagoonal environment during a major freshening of the basin and consists of carbonates, anhydrites, and halites. Its beds consists of clay and anhydrite and contain small amounts of brine. The Rustler's upper boundary is about 500 ft (152 m) BGS, and it ranges up to 350 ft (107 m) in thickness in the area (see Appendix D6).

These evaporite-bearing formations lie between two other formations significant to the geology and hydrology of the WIPP site. The Dewey Lake overlying the Rustler is dominated by nonmarine sediments and consists almost entirely of mudstone, claystone, siltstone, and interbedded sandstone (Appendix D6). This formation forms a 500-ft (152-m)-thick barrier of fine-grained sediments that retard the downward percolation of water into the evaporite units below.[3] The Bell Canyon Formation (hereinafter referred to as the Bell Canyon), the first water-bearing unit below the repository (Appendix D6), is confined by the thick evaporite sequences of the Castile above. It consists of 1,200 ft (366 m) of interbedded sandstone, shale, and siltstone.

The Salado was selected to host the WIPP repository for several reasons. First, it is regionally extensive, underlying an area of more than 36,000 square miles (mi^2) (93,240 square kilometers [km^2]). Second, its permeability is extremely low, and fluids within it are effectively immobile. Third, salt behaves mechanically in a plastic manner under pressure (the pressure at the facility horizon is more than 2,000 pounds per square in. [$lb/in.^2$] or 13.8 megapascals [MPa]) and moves to fill any opening (referred to as creep). Fourth, any fluid remaining in small fractures or openings is saturated with salt, is incapable of further salt dissolution, and has remained in place for millions of years. Finally, the Salado lies between the Rustler and the Castile (Figure D-15), which contain highly impermeable layers that further confine and isolate waste within and isolate water outside the WIPP repository (Appendix D6).

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[3]While there may be some uncertainty over the amount of vertical recharge occurring within the Rustler, the issue is only of significance to long-term performance calculations in which releases from the repository occur through the creation of a migration pathway resulting from drilling (inadvertently) in the WIPP area. The consequences of vertical recharge are bounded in the modeling by assuming that under future climate conditions (which are assumed to be cooler and wetter), the groundwater level (water table) moves to the land surface.

D-9a(1)(b)(ii) Geomorphology

The terrain of southeastern New Mexico is characterized by a gentle southwesterly slope and a rolling surface marked by karst features, caliche, and sand dunes. The Pecos River, 12 mi 19 km) west of the WIPP facility, is the nearest major perennial stream and receives almost all of the surface drainage in the region and a large part of its subsurface drainage (Appendix D6).

The Nash Draw is the nearest major geomorphic feature, located 5 mi (8 km) west of the WIPP facility. It is an undrained physiographic depression resulting from the differential dissolution of portions of the Rustler and the upper part of the Salado. Dissolution has also produced numerous small sinkholes within the Nash Draw. In the immediate area of the WIPP facility, however, post-depositional dissolution in the Rustler has been minor, reducing its thickness by a maximum of 30 ft (9 m). There has been no dissolution of the Salado within the WIPP facility area.

Most of the depressions in the immediate vicinity of the WIPP facility resulted from the erosion and deposition of windblown sand, not from the dissolution of underlying evaporites. Evaporite dissolution in the area is not occurring at the WIPP site today, and its future occurrence is highly improbable under foreseeable climatic conditions because:

- There is relatively little rainfall, and approximately 96 percent of the precipitation is lost through evapotranspiration.

- Geologic formations above the Salado act as confining layers, with extremely low transmissivity preventing infiltration of surface water.

In addition, the Mescalero caliche is laterally continuous at the WIPP site and in surrounding areas. Formed during the mid-Pleistocene time, the presence of the caliche indicates the absence of significant erosion or deeper intrusion of rainwater, creating one of the most stable landscapes in the world. At the WIPP facility, the caliche is about 10 ft (3 m) thick, and where it is well developed, most available porosity in its upper zone is plugged with calcium carbonate to form a nearly continuous additional barrier to the downward infiltration of the small amount of precipitation that falls in the area. (Appendix D6 provides an in-depth discussion of the existing and future dissolution features of the WIPP site area.)

D-9a(1)(b)(iii) Geologic Stability

No surface faults have been mapped within 5 mi (8 km) of the center of the WIPP facility, and no faults have been exposed in the underground openings or intersected in WIPP boreholes. Surface faults beyond 5 mi (8 km) are related to the dissolution and collapse of soluble materials rather than to tectonic activity. Deep-seated faults of tectonic origin are present throughout the Delaware Basin, but movement along these faults ceased well before deposition of the evaporite units. The Bell Lake Fault, 15 to 20 mi (24 to 32 km) east of the site, is the closest fault to the WIPP facility, with approximately 500 ft (152 m) of displacement. Tectonic folding is absent in

the area of the WIPP site. Some thickening of the Salado is associated with gravity-driven salt movement in the Castile. (Appendix D6 describes in detail the local and regional geologic structure and faulting in the Delaware Basin and provides a complete discussion of seismology in the vicinity of the WIPP facility.)

D-9a(1)(c) Groundwater Hydrology

The Salado was selected as the host geologic unit because it is hydrologically isolated and because of the plastic nature of the salt. The general hydrogeology of the area surrounding the WIPP facility is described in this section starting with the first geologic unit below the Salado. Appendix D6 provides more detailed discussions of the local and regional hydrogeology.

D-9a(1)(c)(i) The Castile Formation

The Castile is a basin-filling evaporite sequence of sediments surrounded by the Capitan Reef. The Castile represents a major regional groundwater aquiclude that effectively prevents upward migration of water from the underlying Bell Canyon. Fluid present in the Castile is very restricted because evaporites do not readily maintain pore space, solution channels, or open fractures at depth. Drill-stem tests conducted in the Castile during construction of the WIPP facility found its permeability to be lower than detection limits; however, the hydraulic conductivity has been conservatively estimated to be less than 10^{-8} ft (3×10^{-9} m) per day. A description of the Castile brine reservoirs outside the WIPP area provided in Appendix D6.

D-9a(1)(c)(ii) The Salado Formation

The Salado is an evaporite sequence that filled the remainder of the Delaware Basin and lapped extensively over the Capitan Reef and the back-reef sediments beyond. The Salado consists of approximately 2,000 ft (610 m) of bedded halite, with interbeds or seams of anhydrite, clay, and polyhalite. It acts hydrologically as a regional confining bed and does not contain circulating fluids. The porosity of the Salado is very low, and interconnected pores are virtually nonexistent at the depth of the facility horizon. Fluids associated with the Salado occur mainly as very small fluid inclusions in the halite crystals and also occur between crystal boundaries (interstitial fluid) of the massive crystalline salt formation; fluids also occur in clay seams and anhydrite beds. Permeabilities measured from the surface in the area of the WIPP facility range from 0.01 to 25 microdarcies. The most reliable value, 0.3 microdarcy, was obtained from well DOE-2. The results of permeability testing at the facility horizon are within the range of 0.001 to 0.01 microdarcy. As a comparison, the permeability of the Salado is roughly a thousand times more restrictive than that of the lower clay liner required of surface impoundments and landfills, assuming similar thicknesses. The results of recent testing suggest that permeabilities in undisturbed rock salt may approach zero (see Appendix D6).

Several features of the Salado have been extensively evaluated with regard to their potential impacts on repository integrity. Those of significance include:

- Pressurized Gas—Pressurized gas has been encountered within the Salado in surface boreholes, local mines, and WIPP facility excavations. It is likely the gas exsolved from brine as surrounding pressure was relieved.

- Brine Seepage—While the Permian salt beds of the Salado are considered to be dry in that the inflow of brine is virtually nonexistent, very small volumes of brine are observed to weep from exposed surfaces immediately after excavation. The rate of inflow is noted to decrease with time (see Appendix D6). The brine is not derived from inclusions but from interstitial fluid. The moisture readily evaporates, leaving behind thin salt crusts. For this reason, no natural brine accumulation is anticipated within the HWMUs prior to their closure.
- Disturbed Rock Zone—Following the excavation of underground openings at the WIPP disposal horizon, a disturbed rock zone (DRZ) forms in the wall, roof, and floor. The DRZ is defined as the zone of rock in which mechanical and hydrologic properties have changed in response to the excavation. The potential impacts of the DRZ have been investigated with regard to maintaining excavated openings during operations. Ground-control measures (rock bolting) will be implemented as necessary to minimize any adverse ground control impacts from the DRZ.

D-9a(1)(c)(iii) The Rustler/Salado Contact

The contact between the Rustler and the Salado is evidenced by a layer of thinly bedded clay and gypsum. This contact zone is seen in the shafts at the WIPP facility, but it is not water-bearing and is not a factor affecting the containment of TRU mixed waste at the WIPP facility. Appendix D6 presents a detailed discussion of the hydrogeology of the Rustler/Salado contact in the WIPP site area.

D-9a(1)(c)(iv) The Rustler Formation

The Rustler has been the subject of extensive characterization activities because it contains the most transmissive hydrologic units overlying the Salado. Within the Rustler, five members have been identified. Of these, the Culebra is the most transmissive and has been the focus of most of the Rustler hydrologic studies (see Appendix D6).

The Culebra is the first continuous water-bearing zone above the Salado and ranges up to 30 ft (9 m) in thickness. Water in the Culebra is usually present in fractures and is confined by overlying gypsum or anhydrite and underlying clay and anhydrite beds. Its hydraulic gradient in the area of the WIPP facility is approximately 20 ft per mi (6.1 m per km) and becomes much flatter south and southwest of the site (Figure D-16). Transmissivities in the Nash Draw range

up to 1,250 ft^2 (116 m^2) per day; closer to the WIPP facility, they are as low as 0.007 to 74 ft^2 (0.00065 to 7.0 m^2) per day. The Culebra is hydrologically confined, and testing indicates no significant leakage between it and other units (see Appendix D6).

Use of water from the Culebra is quite limited because of its varying yields and high salinity. The Culebra is not used for water supply in the immediate WIPP site vicinity. Its nearest use is approximately 7 mi (11 km) southwest of the WIPP facility, where salinity is low enough to allow its use for livestock watering (shown, for example, as Well H-8 in Figure D-17). Appendix D6 provides a detailed discussion of the hydrologic characteristics of the other Rustler members and the Dewey Lake, which lie above the Rustler.

D-9a(1)(d) Surface-Water Hydrology

The mean annual precipitation in the vicinity of the WIPP facility is approximately 12 in. (0.305 m), and mean annual runoff is up to 0.2 in. (0.5 cm). The maximum recorded 24-hour (hr) precipitation at Carlsbad was 5.12 in. (0.13 m) in August 1916. The potential evaporation is much greater than the annual precipitation. Most of the water that infiltrates the surface soil is retained above the extremely impermeable Mescalero and then is lost through evapotranspiration.

No natural drainage features exist at the WIPP site, which is situated more than 400 ft (122 m) above and 12 mi (19 km) east of the 100-year floodplain of the Pecos River. A few small unnamed drainage channels constitute all the tributaries to the Pecos River within 50 mi (80 km) north or south of the site.

There is no major surface-water body located within 5 mi (8 km) of the WIPP facility. However, beyond 10 mi (16 km), several water bodies lie to the north and south of the site. The largest of these, the Laguna Grande de la Sal, located southwest of the site, is several square miles in area and is a catchment basin for limited surface drainage and artesian saline springs.

Although large floods have occurred on the Pecos River, probable maximum flood calculations predict maximum flood levels on the Pecos near the WIPP facility to be near the levels of the modern floodplain. The horizontal and vertical separations between the Pecos River floodplain and the WIPP facility are great enough that the Pecos River cannot affect the surface structures of the WIPP facility. The elevation at the WIPP is 2,938 ft (896 m), which is about 500 ft (152 m) above the river bed and over 400 ft (122 m) above the maximum flood stage. (See Appendix D6 for more information on this topic.)

The drainage patterns at the WIPP facility are such that normal surface runoff from areas north, south, and west of the surface facilities drains westward without affecting the site structures. Surface runoff during intense precipitation events could potentially pass through the site from the east; however, storm-water runoff is diverted away from the surface facilities by a system of berms and ditches. The WIPP facility drainage system is designed so that storm runoff due to a probable maximum precipitation event would not flood the WIPP facility (see Appendix D7).

Appendix D6 presents a detailed discussion of the local and regional surface-water hydrology and water quality.

D-9a(1)(e) Soils

Regionally, soils in southeastern New Mexico developed from Quaternary and Permian parent material. The parent material from the Quaternary system is represented by alluvial deposits of major streams; dune sand, which is the dominant surficial deposit in the immediate area of the facility; and other surface deposits. These are mostly loam and sand sediments containing some coarse fragments. Parent material from the Permian system is represented by limestone, dolomite, and gypsum bedrock.

There are three soil associations within 5 mi (8 km) of the facility. Of these, only the Kermit-Berino association occurs at the facility. Generally, a hard caliche layer occurs at 7 to 13 ft (2 to 4 m) below the surface. The Berino series, which covers about 50 percent of the area, consists of deep, noncalcareous yellow-red to red sand soils that developed in wind-worked material of mixed origin. These soils occur as gently sloping (up to three percent slope), undulating to hummocky areas and are the most extensive of the deep sandy soils in the Eddy County area.

The Kermit series is made up of deep, lightly colored, noncalcareous, excessively drained loose sands, typically fine and yellowish-red in color. The surface is undulating (up to three percent slope) and consists primarily of stabilized sand dunes. Kermit soils are slightly to moderately eroded. Permeability is very high, and the potential for wind erosion is very high in denuded areas. Appendix D6 provides additional information concerning the area's soils.

D-9a(1)(f) Air Quality

An ambient air-monitoring program was initiated at the WIPP site in 1985 to establish an ambient air-quality baseline. In October 1994, the DOE made a determination that adequate baseline data had been gathered, and on October 30, 1994, the Ambient Air Monitoring

Station (AAMS) was taken off-line. The AAMS was not used to gather regulatory or compliance data. WIPP Project staff used the Hazardous Air Pollutant Inventory to evaluate potential air emissions related to permitting requirements under the Clean Air Act, the Clean Air Act Amendments, and the New Mexico Air Quality Control Commission regulations.

D-9a(1)(g) Biological Community Structure

In general, the biota of the region represent a transition between the northern Chihuahuan Desert and the southern Great Plains and are dominated by shinnery oak (*Quercus havardii*), sand sage (*Artemisia filifolia*), honey mesquite (*Prosopis glandulosa*), and perennial grasses. Extensive root systems of the dominant species provide stability to the erodible dune soil. Mammal species counted during trapping sessions include the Ord's kangaroo rat (*Dipodomys*

ordii), the Plains pocket mouse (Perognathus flavescens), the northern grasshopper mouse (Onchomys leucogaster), the Southern Plains woodrat (Neotoma micropus), the white-footed mouse (Peromyscus leucopus), and the deer mouse (Peromyscus maniculatus).

This area of southeastern New Mexico is unusual in that it supports a large population of raptors (birds of prey), particularly Harris' hawks, which reproduce more successfully here than in other parts of their range. A DOE-supported project was initiated in March 1985 to study the population dynamics, behavior, and strategies for management of raptors in the area around the WIPP facility. Consultations with the U.S. Fish and Wildlife Service and the New Mexico Department of Game and Fish regarding threatened and endangered species in the WIPP vicinity were held in 1979 and again in 1989. These consultations concluded that no state or federally listed threatened or endangered species or critical habitat is projected to be impacted by the construction and operation of the WIPP facility. Appendices D4 and D5 provide detailed discussions of the local biological community.

D-9b Environmental Performance Standards for the Miscellaneous Unit

The WIPP miscellaneous unit has been designed, sited, and constructed and will be operated, maintained, and closed in a manner that will ensure protection of human health and the environment, in accordance with 20 NMAC 4.1, Subpart V, §264.601. The WIPP facility is located in a sparsely populated area with site conditions favorable to isolation of TRU mixed waste from the biosphere. Geologic and hydrologic characteristics of the site related to its TRU mixed waste isolation capabilities are discussed in Section D-9a(1). The WIPP facility has been designed to facilitate safe handling and disposal in order to prevent adverse impacts to human health and/or the environment. Hazard prevention programs are described in Chapter F of this permit application. Contingency and emergency response actions to minimize impacts of unanticipated events, such as spills, are described in Chapter G of this permit application. The closure plan for the WIPP facility is described in Chapter I of this permit application.

The disposal system is modeled by the DOE in this application using three different configurations for purposes of demonstrating compliance to the environmental performance standards. These configurations have been designated because the DOE believes the environmental conditions in each configuration are sufficiently different to warrant separate compliance discussions. These configurations and their associated time durations are as follows (note that detailed discussions of the processes and mechanisms such as gas generation discussed in the following bullets are discussed subsequently):

- OPEN PANELS which includes panels that are actively receiving waste and backfill. This configuration will initially be established with the first emplacement of waste and backfill in the repository and ends when the final panel is removed from the mine ventilation system. Under this configuration, creep closure will proceed at expected rates. The design of the rooms is such that creep will not close the room to the top of the backfill (about 18 in. [91 cm]) while the panel is open. Brine inflow may occur immediately after excavation and continue throughout the period. No accumulation of brine is expected since observed brine inflow is readily evaporated into the dry

mine air and rapidly decreases with aging of the excavation. The ventilation system will remove any gas that is generated within the containers of waste in active waste rooms as well as any hazardous waste constituents that diffuse out through the filter vents in the containers. No corrosion of metals is expected due to the low humidity. Gas generation due to microbial degradation will proceed depending on the availability of moisture within the waste containers. Open panels will consist of active rooms and inactive rooms. Inactive rooms are filled with waste and are isolated from the ventilation system using bulkheads and other flow control devices. Since these rooms are not sealed, gases that are generated are free to escape into the active parts of the panel. Active rooms are those that are being ventilated.

- CLOSED PANELS which includes panels that have been isolated from the underground ventilation system. This configuration will begin when the first panel is removed from the ventilation system prior to emplacing the components of the panel closure system and will extend until the last lowermost short-term component of the shaft seals is in place. This could be on the order of 25 years for the first panel closed. Under this configuration, creep closure will proceed at expected rates to reduce the porosity of the disposal region. Deterioration could be sufficient to cause roof falls which could breach bags of backfill and containers of waste. All waste containers are assumed to be open, and the ambient air VOC concentrations are assumed to be in equilibrium throughout the panel. No ventilation air is allowed through the panel so that gases that are generated result in pressurization of the panel. Further pressurization is caused by the volume reduction associated with creep closure. Brine can begin to accumulate within the panel. Once the panel begins to pressurize, flow is established through the panel closure system so that hazardous constituents and generated gases can be displaced into the mine ventilation system where they are added to the inventory of constituents coming from open panels. Flow from the closed panel is assumed to be equal to the rate of gas generation so that significant pressures do not build up behind the panel closures. A nominal pressure of two atmospheres is assumed in closed panels. Since the shafts are not yet sealed, the condition in the closed panel is likely to remain oxic.

- SEALED FACILITY which occurs when the last of the lower most short-term shaft seal members is emplaced and is functional. This period begins with the emplacement of this seal member and ends 30 years after the certification of final closure is filed with the NMED. This period will not extend for more than a total of 35 years. During this period of time, brine inflow may continue and, depending on the rate of inflow, humid or inundated gas generation mechanisms may become operative. These mechanisms will result in greater quantities of gas being generated. Creep closure would continue to reduce the porosity of the disposal region until there is sufficient resistance from the solids in the repository (waste and backfill) or fluids (gas or brine) to impede further closure. Pressure equilibrium will exist throughout the underground and pressure will increase due to the low permeability of the short-term shaft seal components. As pressure increases, brine inflow will slow as the

difference between far-field and near-field pressures equalizes. The time at which the disposal region will reach lithostatic pressure with the resulting final porosity will depend on the interaction of three time dependent parameters: creep closure, brine inflow, and gas generation. Until the repository reaches hydrostatic pressure, flow gradients will be inward. Between hydrostatic and lithostatic pressure, flow will be either inward or outward, depending on the efficiency of seals in shafts and boreholes. Once lithostatic pressure is reached within the repository there will be no fluid flow unless internal repository pressure continues to increase.

Figure D-17A has been prepared to graphically depict the time frames associated with these configurations. The time frames are based on the closure schedules in Chapter I, Tables I-1 and I-2. For discussion purposes, the placement of the last lowermost short-term shaft seal is taken to be at the beginning of the shaft sealing activity in order to maximize potential gas and brine effects.

D-9b(1) Potential for Releases

The U.S. Environmental Protection Agency's (EPA) guidance manual for permitting geologic repositories (EPA, 1988) suggests that three factors be considered in evaluating the potential for releases from a geologic repository. These are: 1) the physical and chemical properties of the waste, 2) the design and operation of the facility, and 3) the characteristics of the release pathway. These factors and how they are evaluated are discussed below.

D-9b(1)(a) Physical-Chemical Properties of the Waste

The information with regard to the physical-chemical properties of the waste includes those factors that are important for each particular pathway for release.

For the air pathway the important factor is the concentration of the hazardous constituents within the waste container headspace. This concentration is measured for every container of waste sent to the WIPP facility from an off-site generator as detailed in the Waste Analysis Plan in Chapter C. Only wastes that are compatible with each other, and are compatible with the repository, repository components that come in contact with the waste (i.e., panel closure materials, shaft seal materials), and MgO backfill, are placed in the WIPP. This compatibility is demonstrated in Appendix C1 and leads to the conclusion that no reactions that would generate unstable conditions are expected to occur.

Because the waste contains organic matter and metals (principally ferrous metals), gas generation is expected to occur. Gas generation affects repository pressure, which in turn is an important parameter in other processes such as creep closure, interbed fracture, and two-phase flow. The computer simulation of this process[4] uses an average-stoichiometry model to estimate

[4]The DOE uses the code BRAGFLO to simulate repository processes. This code was developed by the Sandia National Laboratories specifically for the WIPP and is being used for the DOE's demonstration of compliance to long-term repository performance standards.

the potential for gas generation in the waste disposal region. Parameter values for the average-stoichiometry gas generation model are summarized in Table D-2 and detailed in Appendix D16, §D16-5.

Gas generation processes considered in the simulation include anoxic corrosion and microbial degradation. Radiolysis is not included in the model on the basis of laboratory experiments and model calculations that demonstrate the process to be an insignificant gas generation mechanism compared to corrosion and biodegradation. For the purpose of calculating repository pressure and fluid flow, the properties of the generated gas are assumed to be those of H_2.

Specific to the simulation, anoxic corrosion of ferrous metals and microbial degradation of cellulosics, plastics, and rubbers is assumed to occur and generate gas at rates limited only by the availability of brine and solid reactants. Assuming that all cellulosics, plastics, and rubbers are available to degrade and participate in the gas generation process is conservative because there are no reasonable mechanisms to mix microbes, moisture, cellulosics and nutrients in order to sustain degradation. Biodegradation is considered to have a 50% chance of occurring, primarily due to uncertainties in the long-term survival of microbes (Brush, 1995, pp. B-19 to B-24). These assumptions serve to maximize gas generation rates.

Anoxic corrosion is represented by an equation that accounts for corrosion only of the steel content in the repository by the two reactions expected to dominate corrosion rates. Because the total quantity of aluminum and aluminum alloys is a small fraction of the quantity of iron-based metals, corrosion of aluminum is omitted for simplicity. As corrosion proceeds the steel content of the repository is depleted over time. Brine is also consumed as gas generation proceeds. Effects of wicking (the retention of brine in a capillary fringe) on the corrosion gas generation rates are incorporated in the analysis through the use of a wicking parameter, as explained in Appendix D16, §D16-5. The DOE assumes no passivation of steel by interaction with microbial degradation reactions, a process capable of preventing anoxic corrosion. Important parameters in the corrosion equation are assigned fixed values, as summarized in Table D-2.

Similar to modeling anoxic corrosion, microbial degradation is represented by an equation with the inventory of cellulosics, plastic, and rubber materials also depleted with time. Biodegradable materials are depleted at a rate dependent on the amount of liquid present. It is assumed that the microbial degradation process neither produces nor consumes water. Depending on parameter values, gas generation by microbial degradation in the computer simulation can continue until all degradable materials or available brine are consumed. Important parameters used to model microbial degradation are summarized in Table D-2 and discussed further in Appendix D16, §D16-5.

D-9b(1)(b) Design and Operation of the Facility

The key features of the repository can be described in terms of the natural characteristics and barriers and the engineered facilities and their operations. The following discussions focus on those repository design and operation aspects which support meeting the environmental performance standards.

D-9b(1)(b)(i) Natural Features

The Salado is the most significant natural feature in the disposal system. Characteristics of the Salado that are relatively important to repository performance are hydrologic properties, creep closure, and brine inflow. Each is discussed below.

Hydrologic Properties

For the computer simulation used in this analysis, the DOE conceptualized the Salado as a porous medium composed of several rock types arranged in layers, through which fluid flow occurs according to Darcy's Law. This conceptual model corresponds to the first of the three postulated mechanisms for fluid flow. This model was chosen because it can be simulated using standard numerical techniques and because it is the most conservative of the three mechanisms in that it predicts the maximum rate and cumulative volume of brine inflow. Two rock types, impure halite and anhydrite, are used to represent the intact Salado. Near the repository, the DRZ has increased permeability compared to intact rock and offers little resistance to flow between anhydrite interbeds and the repository. Except for the DRZ and anhydrite interbeds, under certain circumstances, this simulation assumes spatially constant properties for Salado rock types based on observations of compositional and structural regularity in layers exposed by the repository. The inference is that there is little variation in large-scale averages of rock or flow properties across the disposal system. Assumptions about Salado flow in general are presented in Appendix D16, Section D16-6. This model serves to maximize the potential brine inflow to the repository.

Table D-3 shows various parameter values used in modeling the impure halite. Supported by four hydraulic tests in the WIPP underground believed to represent far-field conditions and stratigraphic variation in the Salado, the median value for permeability calculated for this region is 3.4×10^{-22} ft^2 (3.16×10^{-23} m^2). Additional information on parameter values is contained in Appendix D16, Section D16-6, including the distinction between rock compressibility and pore compressibility used in the simulation.

Gas may not be able to flow through or into intact, halite-rich strata of the Salado under realistic conditions for the repository. As halite is modeled as 100 percent brine saturated, the capillary resistance of the rock must be overcome to displace brine from pores and drive gas into the rock. This condition represents the concept of threshold pressure. While the permeability of halite is known to be low, its threshold pressure has never been measured. An empirical relationship between threshold pressure and permeability in non-WIPP rocks (Davies, 1991, pp.17–19) suggests that threshold pressure will be sufficiently high and gas will not be able to

flow into the halite-rich strata of the Salado under any conditions foreseeable for the WIPP. Values used by the DOE for impure halite threshold pressure are set to prevent the flow of gas into this material. This is a conservative assumption, because gas flow into impure or pure halite would decrease the pressure in the repository and the driving force available for flow.

Three distinct anhydrite interbeds are modeled in the computer simulation representing MB 138, anhydrite layers a and b, and MB 139. The three interbeds are assigned the same parameter values, and these values are initially spatially constant. The interbeds differ only in stratigraphic location and thickness. The three interbeds are included in the model simulation, because they exist in the disturbed region around the repository within which fluid is expected to be able to flow with relative ease compared to the surrounding formation. MB 139 and anhydrite layers a and b are present within the DRZ that forms around excavations; MB 138 may be above the DRZ, and is of no consequence during the post-closure period.

In the computer simulation, brine flows from the Salado into the repository in response to fluid potential gradients that form over time. Due to the low permeability of the impure halite and relatively small surface area of the excavation, direct brine flow between the impure halite and the repository is limited. The interbeds, however, can serve as conduits for brine flow between the impure halite and the repository. Conceptually, brine flows laterally along higher-permeability interbeds towards or away from the repository and vertically between the interbeds and the lower-permeability halite. Because the interbeds have a very large contact area with adjacent halite-rich rock, even very small flux from the halite into the interbeds (for brine inflow) or to the halite from the interbeds (for brine outflow) can accumulate into a significant quantity of brine. In this manner, halite serves as a source or sink for brine in the repository. It is expected that, due to density differences between gas and brine and their stratification within the repository, brine outflow will dominate in underlying MB 139, and gas outflow will occur in anhydrite a and b or overlying MB 138. Parameters associated with the interbeds are shown in Table D-4.

Creep Closure

Inward creep of rock salt and the repository response is a process generally referred to as creep closure. The amount of waste consolidation resulting from creep closure, and the time it takes to consolidate the waste, are governed by properties of the waste (waste strength), properties of the surrounding rock, the dimensions and location of the room, and the quantities and pressure of fluids present in the room. Creep closure of waste disposal areas will cause their volume to decrease as the Salado deforms to consolidate and encapsulate the waste, changing waste porosity and permeability. Waste strength and fluid pressure may act to resist creep closure.

Fluids that could affect closure are brine that may enter the repository from the Salado, air present in the repository when it is sealed, and gas produced by reactions occurring during

waste degradation. Closure and consolidation slowed by fluid pressure in the repository can be quantified according to the principle of effective stress:

$$\sigma_T = \sigma_e + p \tag{1}$$

where σ_T is the stress caused by the weight of the overlying rock and brine (an essentially constant value), p is the pressure of the repository pore fluid, and σ_e is the stress that is applied to the waste skeleton or matrix. In this formulation, the waste is considered a skeleton structure immersed in pore fluids. As the pore pressure increases, an increasing amount of overburden stress is supported by pore fluid pressure, and less overburden stress is supported by the strength of the waste matrix. Due to waste strength, waste consolidation can cease even if pore fluid pressures do not reach lithostatic. If gas and brine quantities in the repository stabilize, creep closure will act to establish a constant pressure and void volume.

Two material-response models are required for closure analyses. The first describes how the halite in the formation surrounding the waste deforms (creeps) as a function of time and stress. The second model describes the state of consolidation of the waste as a function of applied stress.

Halite deformation is predicted using a multimechanism deformation (M-D) steady-state creep model with workhardening/recovery transient response (Model 1). At the WIPP, there are potentially three distinct creep mechanisms involved, which are governed by the temperature and shear stress at a given location in the surroundings at any given time. WIPP conditions are expected to be isothermal so temperature is treated as a constant value. All three mechanisms can be active at the same time because of the large range of stress states that occur around underground rooms and shafts.

The focus of the mechanistic part of the model is definition of steady-state creep strain, with transient creep strain described through a multiplier on the steady-state rate, thus accommodating both transient changes in stress loading and loading. More information is presented in Munson et al. (1995).

The volumetric plasticity part of the model is the mathematical model for room closure and waste consolidation. The experimental data used in this model are summarized and interpreted in Butcher et al. (1991, pp. 65-76) and Luker et al. (1991). The volumetric plasticity model and M-D model are numerically implemented.

As a boundary condition, the computer code requires estimates of the fluid pressure and, hence, the initial quantity of gas present in a disposal room. These estimates are obtained using the average-stoichiometry model of gas generation with different rates of gas generation that reflect different assumptions about the quantity of brine that might be available in a waste disposal room. The different rates of gas generation used in the analysis bound the possible conditions for gas content in the repository. With the volumetric plasticity model and the fluid pressure boundary condition, the code calculates the void volume of the disposal room through time.

In the computer simulation, the time-dependent effects creep closure on volume are linked to the fluid flow via a look-up table, which relates porosity or void volume to: a) time after sealing, and b) gas pressure. At the beginning of a time step, the fluid flow code evaluates the pressure of a cell in the waste disposal region. The code then consults the look-up table to find the void volume of the cell appropriate for a given time and pressure. The void volume in the cell is iteratively adjusted during a time step solution for consistency with gas generation, fluid movement, and repository pressure. The look-up table method of incorporating the dynamic effect of creep closure in the simulation has been compared to more complex techniques that are computationally impractical. In these comparisons, the porosity surface method was found to be a reasonable representation of behavior observed in more complex models. Parameter values used in the computer simulation for repository and panel closure are given in Appendix D16, Section D16-7.

Brine Inflow

The short term gas generation is controlled by the amount of brine available and, in addition, the presence of oxygen in the repository. There have been numerous studies conducted by the DOE to characterize the rate of brine flow into the WIPP repository. These data have been interpreted to demonstrate on three separate mechanisms, which, in the final analysis, may all be applicable to the repository over the long term.

The first mechanism, far-field flow, proposes brine flow from the far field in response to potentiometric gradients through naturally interconnected intergranular pore spaces. There is in-situ flow test evidence supporting this mechanism for the anhydrite intervals and some non-anhydrite intervals. However, the in-situ results in pure halite are ambiguous. Test results are summarized in Appendix D16, §D16-6. In addition, geophysical evidence presented in Appendix D16, §D16-6 can be interpreted as showing a far-field source of brine which resaturates drained areas in the DRZ, and an ongoing flow around the repository. Based on this mechanism, the quantity of brine is, in effect, unlimited.

The second mechanism, redistribution, proposes that interconnected pore spaces do not exist naturally in most lithologic units in the Salado. Interconnected networks form due to fracturing and creep around excavations. Potentiometric flow occurs within the interconnected networks but, because the networks are limited in extent, the volume of brine available for inflow into the repository is limited compared to the naturally connected case.

The third postulated mechanism for fluid flow, clay consolidation, arises from nine years of observations of fluid seeping into the WIPP excavation. The Brine Sampling and Evaluation Program (BSEP) observed and sampled brine seepage throughout the underground. The mechanism proposes that the most significant source of brine flowing into the repository are clay layers exposed by the excavation. According to this model, clay layers compact and yield brine when stresses are relieved near the excavation. This mechanism also assumes that flow

through undisturbed geologic units is negligible. (The most recent report on the BSEP is Deal et. al., 1993). This mechanism also implies that brine inflow decreases with time and that the available brine reservoir is limited in extent.

D-9b(1)(b)(ii) Engineered Features and Operations

With regard to the engineered aspects, their design and operation are described in Section D-10 and in Section I-1e(2)(e). The key aspects of the facility design and operation that prevent releases that could contaminate soils, surface water, or groundwater are the use of multiple containments and the prohibition on opening containers of off-site generated waste at the WIPP facility. This is embodied in a "Start Clean-Stay Clean" operating philosophy.

Waste Containment

Primary containment is provided by the waste container. Secondary containment on the surface is provided by the shipping container and the WHB. Once waste is in its final disposal location, containment during the balance of the operational period is provided by the containers until panels are closed and then by the panel closures. Analyses performed by the WIPP architect and engineer and included in Appendix D1, considered expected creep closure rates in determining disposal room sizes. Figures 12-21 and 12-22, in the Final Design Validation Report in Appendix D1, show the creep closure histories used for designing the disposal rooms. The specified size was selected to assure no CH containers would breach due to creep closure while a panel is being filled with waste. A nominal five year life is used for operational purposes for mining, emplacement, and closure with no risk of CH waste containers breaching. RH canisters will not breach in this time period due to the canister wall thickness and the 2 to 4 in. creep tolerance in each RH emplacement hole.

Waste Handling Operations

Operations are conducted in a manner that minimizes the possibility of accidents or fires. Fork lifts that handle waste in the underground have speed governors to prevent speeds that could lead to accidents that would rupture containers. In addition, diesel powered waste handling equipment in the underground are equipped with rupture-proof fuel tanks and on-board automatic fire suppression systems for the engines to preclude fires that might involved the waste. On the surface all waste handling equipment is electric (battery), and all loads are secured prior to moving them to avoid spillage. Other safety measures taken to protect the waste, the employees, and the public and environment are discussed in Chapter F.

Repository Seals

After operations and during the post closure period, isolation of waste is provided by the shaft seals and the geologic barriers including the nearly impermeable Salado Formation. The characteristics of the Salado are detailed in Sections D-9a(1)(b) and D-9a(1)(c). The characteristics of the panel closures are detailed in Section I-1e(1). The effectiveness of these barriers is dependent on gas generation, brine inflow, and creep closure.

Repository seal properties are discussed in Appendix I2. For the purposes of long-term modeling, repository seals are divided into two functional elements: those that perform for the first 100 years after final facility closure, and those that perform after the first 100 years. The distinction is important. The short-term seals are made of cementitious and other materials that have little performance histories beyond about 100 years. Consequently, it is difficult to argue persuasively that they will last for several hundred years. In order to avoid a lapse in repository protection, the long-term component of the seal, namely crushed salt, is emplaced in a manner that assures sufficient consolidation by the end of the life of the short-term seals. As can be seen in the design report, this is accomplished by achieving a nominal emplacement compaction density for the long-term seal components in the shaft. Achieving these densities has been demonstrated on a limited scale.

The four shafts connecting the repository to the surface are represented in the computer simulation with a single shaft. This single shaft has a cross section and volume equal to the total cross section and volume of the four actual shafts and is separated from the waste disposal region in the model by the true north-south distance from the waste to the nearest shaft (the Waste Shaft).

Seal component materials and properties used in the simulation are given in Table D-5. From top to bottom, the seal system is represented in the simulation by the following materials (see Appendix I2 for details):

- an earthen fill region above the Rustler Formation
- a clay region in the Rustler Formation (designated Rustler Compacted Clay in Table D-5)
- an asphalt region at the top of the Salado
- three concrete sections (upper, middle, lower) within the Salado
- a thick section of compacted crushed salt within the Salado
- an upper compacted clay region within the Salado (designated Upper Salado Compacted Clay in Table D-5)
- a lower compacted clay region within the Salado (designated Lower Salado Compacted Clay in Table D-5)
- a basal clay component below MB 138 (designated Bottom Clay in Table D-5)
- a lower concrete section at the repository horizon (shaft station concrete monolith)

Conceptually, the simulation considers the maturation of the DRZ surrounding the shaft with respect to variation in the rate of DRZ healing with depth, time, and the type of adjacent seal material. For example, the DRZ in the halite adjacent to concrete members is assumed to heal very rapidly because of the rigidity of the concrete and the high lithostatic stress. Against less rigid seal components and at higher elevations in the shaft, the DRZ is assumed to heal more slowly. Depending on shaft material properties and depth of emplacement, the simulation also considers potential time-dependent consolidation.

To reflect shaft material consolidation and DRZ maturation, effective permeabilities of selected shaft regions are adjusted with time in a stepwise fashion (Table D-5). For those shaft regions in halite where enhanced flow is expected through the surrounding DRZ before healing occurs, the permeability of the adjacent shaft seal component is enhanced to reflect this condition for modeling purposes. In some cases, this adjustment acts to counteract the expected decrease in permeability resulting from consolidation. The increase in permeability noted for concrete from 1.9×10^{-18} to 1.1×10^{-13} ft^2 (1.8×10^{-19} to 10^{-14} m^2) is conservative; the permeability of concrete within the Salado section of the shaft is not expected to degrade to the permeability of silty-sand, and, in fact, physical and hydraulic properties of concrete seals are expected to remain stable over the long-term. Note that Appendix D16, §D16.8 lists only the initial permeability for shaft materials within the Salado and not the effective permeabilities calculated for each time step presented in Table D-5.

D-9b(1)(c) Release Pathways

The media available for hazardous-constituent transport at the WIPP facility include air, ground and surface waters, and soil. Each of these pathways is discussed for the three repository configurations described in Section D-9b. A computer simulation of disposal system performance has been completed for the DOE's demonstration of no-migration. This simulation, along with supporting documentation, is due to be submitted to the EPA in June 1996. Those portions of the simulation that are applicable to the closed panel and sealed shaft configurations, are summarized here as background for the subsequent discussions of pathways and environmental protection and to support the DOE's demonstration of compliance with the environmental performance standards in 20 NMAC 4.1, Subpart V, §264.601.

The computer simulation for the no-migration demonstration was conducted to predict disposal system performance over 10,000 years. Only the first 300 years are discussed here. This period goes sufficiently beyond the post-closure period to depict trends in the calculations.

Caution should to be exercised in using this simulation for interpreting repository performance prior to shaft sealing and during the first 100 years of the simulation. This is due to several reasons:

- The simulation assumes higher gas generation rates than anticipated in order to assure sufficient gas is present to evaluate the disposal system performance.

- The simulation assumes anoxic conditions exist from the outset and the gas

generation rates are those observed for anoxic conditions. It is anticpated that oxic conditions will prevail during the initial closure period, during which time there will likely be no gas generation.

- The model does not account for any dewatering of the DRZ that may have occurred during operations when the excavated surfaces were exposed to the ventilation system.

- The model assumes the repository is filled instantaneously.

These limitations notwithstanding, the modeling process and the results, along with the raw and interpreted data, are useful in the discussion of repository performance during the period covered by the hazardous waste permits.

The conceptual model used in this simulation includes creep closure of the waste-disposal panels, a process that will act to consolidate waste in the disposal areas. The altered stress field created by the excavation will also result in a system of fractures surrounding the excavation and the shaft, referred to as a disturbed rock zone. The conceptual model considers brine inflow to the waste-disposal panels in response to pressure gradients created by the excavation. Opposing brine inflow is the pressure increase expected in the repository resulting from creep closure and waste-generated gas. In general pressure increases due to closure, and gas generation may retard consolidation of the waste region and cause brine and gas to migrate away from the repository. The conceptual model includes two-phase flow from the repository and dilation or fracturing of interbeds, a process capable of accelerating the mass transport of contaminants.

The primary software code used in the simulation is BRAGFLO (BRine And Gas FLOw). BRAGFLO calculates the overall movement of gas and brine in the disposal unit formations and defines the flow fields for contaminant migration post-processing codes. BRAGFLO also contains the submodels for estimating gas generation in the repository, disposal room closure and consolidation, and interbed fracturing. Changes in void volume of the waste resulting from creep closure are coupled to BRAGFLO through SANTOS, a code that provides a look-up table used as a reference to track changes in room volume.

Actual quantities of hazardous constituents in waste containers can only be approximated from available waste characterization data. Furthermore, actual quantities available for transport are controlled by both the waste form and hazardous constituent mobility or immobility in the post-closure environment. Mobility is in turn controlled by long-term physical and chemical processes (e.g., availability of transport media and release mechanisms). Given these constraints, this simulation defines the source term, where appropriate, as the maximum concentration of hazardous constituents in a particular phase.

For the sealed shaft configuration, weighted average concentration for each VOC is used as the source term concentration in cases where waste characterization data are available. Weighted

headspace concentrations are corrected for void volume conditions expected in the repository. In cases where no waste characterization data are available, saturated vapor concentrations are used to represent source term concentrations for VOCs. Because waste characterization data are also not available for semi-volatile compounds, saturated vapor concentrations are also assumed for this class of organic constituents. Releases of gas to the soil is modeled therefore, soil-based concentrations are calculated assuming gas-available porosity within shaft seals and within anhydrite markers beds at the subsurface disposal unit boundaries and then compared to health based limits for soil.

The DOE concludes that an organic liquid-phase source term is required only if compliance cannot be demonstrated for organic gas-phase compounds using bounding calculations. For these bounding calculations, the assumption of no partitioning between the gas and the liquid phases ensures that maximum concentrations are used for the gas-phase source term. Because organic constituents must partition into the liquid phase from the gas phase according to Henry's Law, the concentrations in the brine phase must be less than that for the gas phase. If compliance can be demonstrated for the organic gas phase, liquid-phase compliance is also demonstrated.

The simulation results presented in Figures 17B to 17G and discussed below are based on a conservative assumption of higher than expected gas generation rates. Gas generation is purposely modeled in this manner to maximize the potential for migration of brine and gas away from the repository and into the anhydrite interbeds and sealed shaft. The modeling approach implemented is conservative, based on the assumption that the entire inventory of ferrous metals, cellulosics, plastics, and rubbers in the waste is available to generate gas. No credit is taken for the 50 percent probability that biodegradation may not occur and result in lower gas generation rates.

The BRAGFLO simulation indicates that average pressure in the waste disposal region increases with time (Figure D-17B). The pressure increase is primarily attributed to gas being generated more quickly than pressure can be relieved by fluids flowing out of the anhydrite layers or up the sealed shaft. Smaller contributions to the pressure build-up occur through reduction of void volume by creep closure. For the high gas generation conditions assumed, pressure rises rapidly from atmospheric pressure to about 725 lb/in.^{2} (5 MPa) over the first 100 years after shaft seal placement. The total amount of gas generated by biodegradation and by anoxic corrosion during 300 years is shown in Figure D-17C. Approximately 420 moles of gas per drum are generated during the first 100 years.

The simulation shows that brine flows into the repository from the DRZ and the far field (Figure D-17D). At the same time, the pore volume (void space) present in the repository is being reduced by creep closure, as shown in Figure D-17E. Eighty-nine percent of the brine inflow occurs during the first 50 years, (19,840 ft^3 (562 m^3) of brine per panel). Total void volume in a panel decreases from 1,310,000 ft^3 to 590,000 ft^3 (37,099 to 16,709 m^3) during the first 50 years. The closure rate subsequently slows. (The minimum pore volume is achieved after 1060 years.)

The average brine saturation in the panel is depicted in Figure D-17F. The initial increase in brine saturation during the first 50 years is due to brine inflow, to rapid creep closure, and a sharp reduction in pore volume in the waste. Once the repository ceases to close, brine consumption due to corrosion causes brine saturation to decrease. Figure D-17F shows this transition as a sharp increase in average brine saturation to just above five percent (at 50 years) followed by a steady decrease.

The simulation indicates the consumption of ferrous metals occurs by corrosion (Figure D-17G). Figure D-17G shows similar behavior involving consumption of the inventory of biodegradable materials. In order for biodegradation and corrosion to take place sufficient brine must be present to inundate the waste. However, microbial degradation is assumed to proceed at inundated rates even in the absence of brine. The moisture originally present in the waste, together with the brine flowing into the repository, are consumed by the ongoing corrosion but is not consumed by the biodegradation processes. Both processes eventually are limited by the lack of brine and proceed at much lower rates. As noted earlier, the reduction in brine inflow (and resulting brine availability) is a direct consequence of the pressure increase from gas generation and creep closure.

The simulation indicates no brine leaving the waste disposal region during the post-closure period. This conclusion results from two factors. First, the pressure never gets high enough to drive brine or gas from the disposal zone. Second, a comparison of calculated brine saturation in the waste region (see Appendix D16, §D16-7) with the estimated residual brine saturation (S_{br}) of the waste. As described in Appendix D16, §D16-7, S_{br} is the brine saturation required to permeate the waste matrix sufficiently to create an incipient network of interconnected pores. Wetting phase relative permeability begins at the residual brine saturation; below this point, brine existing in the waste matrix remains immobile.

Appendix D16, §D16-7 discusses the bases for the residual brine saturation of the post-closure waste region. Essentially, this demonstration takes advantage of literature-based data of residual brine saturations measured for unconsolidated analog materials. As an analog, the waste region is initially unconsolidated; the degree of consolidation increases rapidly with decreasing pore volume relatively early into the simulation, as indicated in Figure D-17E.

The presence of backfill is expected to have several effects on the results of the computer simulation. First, the placement of backfill over the waste uses some of the void volume that would be otherwise occupied by emissions from the containers of waste. This has no impact on VOC emissions, since in any area that is ventilated, a steady state rate is assumed based on filter characteristics and concentration gradients. Since concentrations within containers are assumed to remain constant, and since the ventilation flow of 35,000 cubic feet, (ft^3) (991 cubic meters [m^3]) per minute is the same for backfilled waste, the emissions remain the same. For unventilated rooms, an equilibrium condition is expected to be reached where the concentration in the room is equal to the average concentration in the container headspace. Since this

approach does not take credit for dilution by the room atmosphere, the void volume is not important and having backfill in part of that void does not change the assumption regarding VOC concentration.

Once the repository is sealed and repressurization begins; the amount of time required to reach lithostatic pressure is a direct function of the void space in the repository. The addition of backfill will have no notable effect in this regard because it occupies ten percent of the available void volume. It will therefore accelerate the room closure process by only one year.

The presence of backfill may also affect brine inflow. Since brine inflow is directly related to pressure and pressure directly related to void volume, the effect is positive. That is, the reduced void volume causes more rapid pressurization which limits brine inflow. Therefore, the no backfill assumption in the simulation is conservative.

Finally, the addition of backfill as a granular material will greatly increase the interstitial zone volume that must become saturated before contaminated brine will leave the disposal region. This effect would further delay any migration of contaminants.

D-9(b)(1)(c)(i) Open Panel Configuration

All TRU wastes are kept in containers during receipt, handling, and emplacement operations. By the nature of the WIPP facility and its operations, there are no credible mechanisms for direct release of hazardous constituents into water or soil. The WIPP Safety Analysis Report (SAR) (DOE, 1995) includes a Hazards and Operability Study (HAZOP) performed in accordance with the methodology and requirements of DOE Order 5480.23 (DOE, 1992a) and its implementing standards DOE-STD-1027-92 (DOE, 1992b) and DOE-STD-3009-94 (DOE, 1994). The SAR identifies the air pathway as the only possible migration pathway during disposal operations.[5] Accordingly, for the assessment of releases occurring during these operations, the migration of hazardous constituents from open panels in the WIPP repository is evaluated only for the air pathway. The rationale for excluding other pathways for this configuration are summarized in the following paragraphs.

Soil Pathway

In order for soil to become contaminated, hazardous waste would have to be released from the WHB. Such releases will not occur because the waste is always managed in closed containers, and the building is constructed to withstand the natural forces (earthquake, tornado, probable maximum precipitation, and snow loads) that are reasonably expected to occur during operations. Even during off-normal events within the WHB, ventilation practices and emergency response capability are such that releases to the soil are not possible. The WHB has no sewers or drain lines that can take such materials out of the building. Containers of derived waste are

[5]The HAZOP in the WIPP SAR only evaluated CH TRU waste. However, the manner in which RH TRU waste is managed (i.e., either in the Hot Cell Complex, or in special shielding equipment like the facility cask), and the isolation features of the facility for RH TRU are the same as those for CH TRU.

placed in the underground and are not discharged outside the WHB unless they are shown to be free of radioactive constituents. In this case, they are managed in accordance with the generator requirements of 20 NMAC 4.1, Subpart III. In addition, the soil pathway is routinely sampled in accordance with the WIPP Environmental Monitoring Plan (See Appendix D5).

Surface Water Pathway

Facility design and operational considerations with regard to surface water pathway are the same as for the soil pathway. The use of sealed containers, the response capability in the event of an accident, and the lack of lines that discharge liquids from the WHB to the environment lead to protection of surface water. In addition, any liquids that are created in the WHB as the result of a discharge of the fire suppression system will accumulate in a large sump. These liquids will be sampled to determine the level of contamination (radioactive, hazardous, or both) and will be managed accordingly, including solidifying the waste as they are placed in containers prior to their disposition. Surface runoff from the vicinity of the WHB is collected in a basin designed to meet the requirements of the EPA's Stormwater Discharge Regulations. Runoff that accumulates in these basins is sampled and analyzed in accordance with the "WIPP Site Effluent Hazardous Materials Sampling Plans (Westinghouse, 1994c).

Groundwater Pathway

During the open panel configuration, the groundwater is controlled in two ways. First, any brine that may seep into the facility as the result of excavation and the development of the DRZ will be evaporated by the ventilation system so that waste leachates cannot form. Second, brine or other groundwater known to exist in the horizons above the repository are controlled by shaft liners and by grouting. If liners deteriorate or if leaks develop which cause significant quantities of water to migrate into the underground, the DOE will take remedial actions. Significant quantities of water would be those quantities that cannot be managed using the existing underground sumps and catchment basins. Stormwater is precluded from reaching the underground as the result of berms and diversion structures (like shaft collar elevation) that are designed to accommodate the probable maximum precipitation event (See Section D-10a(2) and Appendix D7). Floods are not credible at WIPP (see Section D-9a(1)(d)). Groundwater surveillance is performed at the WIPP and in the immediate vicinity (See Appendix D17). This program is designed to monitor the general quality of groundwater and the water levels. The groundwater surveillance program is not aimed at detecting contaminants from the disposal zone, because the migration of contaminants from the disposal zone is indicated by the numerical simulation to take more than 10,000 years. Groundwater monitoring data are compared to background measurements provided in Appendix D18.

Air Pathway

All waste containers destined for shipment to the WIPP facility will be vented with a carbon composite filter to prevent the buildup of gases as a result of radiolysis and eliminate any pressurization caused by changes in temperature and elevation. During the WIPP operational

period, VOCs in the vapor state may diffuse across these filters; therefore, the migration of VOCs via the air pathway must be quantified. For the purposes of quantifying the releases, the number of filters in a panel of waste has been maximized. This number is not nearly as significant for the other modeling configurations.

The air pathway includes the movement of VOCs through the WIPP underground in the ventilation system and their discharge to the atmosphere at the mine ventilation exhaust fans. The nearest permanent human receptor is assumed to be a resident at the WIPP Site Boundary. The WIPP LWA precludes the establishment of permanent residences any closer to the WIPP facility. The area within the WIPP Site Boundary up to the Exclusive Use Area is open for cattle grazing; and game animals such as deer, rabbits, quail, and dove can be hunted outside the Exclusive Use Area (See Figure D-17H). As a consequence, exposures to other classes of public (e.g., hunters, ranch hands, campers) were considered in evaluating the air pathway. Public access is allowed inside the WIPP Site Boundary for various activities and for various periods of time. Activities that take place inside the WIPP Site Boundary are described in detail in DOE (1993). Should any activity that is currently allowed within the WIPP Site Boundary become dangerous or place the public at risk, the DOE has the requisite authority under the LWA to limit or prohibit the activity.

All the land within the WIPP Site Boundary outside the Exclusive Use Area has been leased for grazing, which is the only significant agricultural activity in the vicinity. There are two leaseholders as shown in Figure D-17I. The Livingston Ridge Allotment, currently leased by Kenneth Smith, Inc., of Carlsbad, New Mexico, includes 2,880 acres (1,166 hectares) within the northern portion of the WIPP Site. J.C. Mills of Abernathy, Texas, current leaser of the Antelope Ridge Allotment, has lease rights to 7,360 acres (2,979 hectares) within the southern portion of the WIPP Site. A ranch hand is assumed to spend 40 hours per week, 52 weeks per year working on these allotments. In reality, ranch hands are seldom seen within the vicinity of the WIPP, so the exposure assumptions are conservative.

There are no industrial facilities within a five-mile radius of the WIPP facility. Ranching is the only commercial operation within five miles of the facility, with the exception of oil- and gas-related activities. Oil and gas activities inside the WIPP Site Boundary are limited to the existing natural gas pipelines passing through the property. The DOE prohibits drilling inside the WIPP Site Boundary for purposes other than those that support the WIPP project. No activities related to oil and gas will require members of the public to spend long periods of time within the WIPP Site Boundary. Pipeline inspections generally require a worker to be within the WIPP Site Boundary for no more that several hours per year. Therefore, risk to this individual is bounded by the risk to the ranch hand.

Hunting, camping, horseback riding, hiking, wildlife watching, and sightseeing are all activities that may be permitted inside the WIPP Site Boundary up to the boundaries marked "No Trespassing." Campers are required to check in with WIPP Security personnel before establishing camp. Although all of these activities are allowed and managed (DOE 1993), no member of the public is expected to perform any of these activities on WIPP property for long periods of time. Hunting durations are short and are established and enforced by the State of

New Mexico. The other activities mentioned above are not likely to occur, because the WIPP facility is in a "desert-like" environment, and much more scenic areas are in the vicinity for these activities (i.e., Guadalupe Mountains). No camping has been observed within the WIPP Site Boundary. Hunting occurs occasionally outside the Off-Limits Area. Hunters spend no more that 8 hours per day, 14 days per year engaged in hunting in the vicinity. Therefore, their exposure is bounded by the ranch hand.

Some scientific research is conducted for WIPP-related activities (i.e., archaeological and geological studies), but public research inside the WIPP Site Boundary does not typically occur. If such studies were to occur in the future, the time frame for such studies would be short-term (hours, days, or weeks at most) and would not pose significant exposure concerns for the public. Such exposure is bounded by the exposure of the ranch hand.

VOCs from the waste do not pose a threat to animals because of the very short period of time they spend in the area and the low dose rates. For example, ranchers are allowed to graze cattle within the WIPP Site Boundary under leases granted by the Bureau of Land Management. Generally grazing occurs for a limited portion of the year, depending on range conditions. Due to recent drought conditions, cattle are rotated out of the area frequently to avoid irreparable damage to the rangeland. During wetter years, cattle would remain on the land for longer periods of time. These limited periods of time, and the fact that it is only during a portion of this time that cattle are actually downwind from the release point, lead to the conclusion that doses of VOCs are insignificant. Range animals and game animals are sampled periodically as part of the Environmental Monitoring Program, as described in Appendix D5.

Metals in the waste exist in predominantly monolithic forms, such as tools, equipment, and lead shielding. Since the carbon composite filters are designed to be HEPA grade filters, any metal particulates that may exist will not be released to the environment during routine waste handling operations.

D-9b(1)(c)(ii) <u>Closed Panel Configuration</u>

Within closed panels, TRU waste containers are assumed to be breached. This means that VOC concentrations can reach equilibrium with the panel atmosphere without the constraint of diffusion through the filter vents. This equilibrium is assumed to be established instantaneously and the concentration is equal to the average headspace concentration measured in the drums. That is, no credit is taken for dilution by the atmosphere in the closed panel. This assumption renders the number of containers less important than the volume of waste which is directly related to the gas generation rate. Since containers are assumed to be breached, and brine may begin to accumulate without the ventilation to evaporate it, the formation of leachates which could migrate from the disposal system warrants consideration. In addition, the changes in gas generation rates due to increasingly greater amounts of humidity within the waste region are also considerations for closed panels.

Soil Pathway

For soil to become contaminated from waste in the closed panel configuration, contaminants would have to be released from the closed panels. Panel closures are designed to withstand a deflagration that is assumed to be possible once sufficient quantities of flammable gas build up behind the panel closures. The details of the design of the closure are presented in Chapter I and Appendix I1. Based on the design, even if such an event were to occur, no contaminants would be released from the panel, therefore, contamination of any soil that is part of an exposure pathway is not possible.

Surface Water Pathway

The modeling conducted by the DOE to predict performance over the long-term shows that the disposal region serves as a brine "sink" during the early years after closure. At 100 years pressure is 710 lb/in.^{2} (4.9 MPa) which is well below the hydrostatic head needed to move brine from the room into the adjacent rock. The long-term calculations show that pressures must reach slightly over 1,450 lb/in.^{2} (10 MPa), before brine begins to move away from the disposal region within the lower Marker Bed. This does not occur before 300 years in the calculations. In addition, the DOE will continue to sample and analyze any water collected in the underground prior to discharging it to the environment.

Groundwater Pathway

The groundwater is protected from releases of contaminants from closed panels for the same reasons surface water is protected. That is, during the operational and post-closure periods, there is insufficient brine and pressure to drive contaminants out of the disposal system and into nearby groundwaters. Furthermore, the DOE routinely samples groundwaters in the vicinity of the WIPP to provide assurance that no contaminants are leaving the disposal system.

Air Pathway

Emissions from waste containers in the closed panel configuration are added to those from the open panel configuration for the purposes of assessing compliance to the environmental performance standards. VOCs are assumed to quickly equilibrate throughout the panel to the average headspace concentration. No credit is taken for dilution of VOCs by the volume of air in the closed panel. These VOCs are then driven from the panel by the pressure generated by the degradation of waste and by the reduction of volume due to creep closure of the excavation. For modeling, it is assumed that the closed panel only pressurizes to two atmospheres and that any additional pressure is relieved through the closure system. As explained in Appendix I1, the closure system is assumed not to restrict the flow of VOCs from the closed panel into the ventilation air stream. There are two rates that are important to the determination of the quantity of VOCs that will be released: gas generation rate and creep closure rate.

Gas Generation Rate: The panel closure design uses a gas generation rate of 0.005 moles of gas per pound of celluosics per year (mole/lb/year) (0.01 moles of gas per kilogram of celluosics per year [mole/kg/year]). This rate was established based on the memorandum in Appendix D11. The value chosen is neither the maximum or minimum. Instead, the value recommended as the "best estimate" by the technical expert (L. Brush of Sandia) was used. This value is described by Brush as "arbitrary" because there are few humid condition data to support estimating an expected value. The range of measured values, based on the most recent information from Sandia (See Appendix D16, §16-9), is from 0 to 0.018 moles/lb/year (0 to 0.04 moles/kg/year). The zero is well established, since numerous investigators (see discussion in Brush, 1991) have observed no reactions unless the experimental conditions are altered with nutrients. The maximum is based on observations of CO_2 production (Wang and Brush, 1996, p. 13). An average quantity of 22.1 lb (10 kg) of celluosics per drum is used in calculating the annual gas generation rate per drum. Estimates of the quantities of organics in the long-term analysis begin at about 72.8 lb (33 kg) per drum as shown in Figure D-17F. This is because in performing the long-term analysis, the DOE assumes that over this long period of time the rubbers and plastics may change their properties and become more degradable. Brush recommends that total celluosics be determined by converting rubbers and plastics to equivalent celluosics and adding the converted quantities to the quantity of actual celluosics.

This process is explained on page 14 of Wang and Brush (1996). Applying Wang and Brush's approach to the most recent estimates of organics in the waste provides an average organic loading of 66.2 lb (30 kg) per drum, of which 24.3 lb (11 kg) is actual celluosics.

The computer simulation used to assess the long-term performance of the WIPP disposal system (see D-9b(1)(c)) uses a rate of 0.01 mole/lb/year) (0.02 moles/kg/year) for microbial gas generation under humid conditions. This is twice the rate used in the design analysis for the panel closure system. The DOE has examined the effect of the new rate and has concluded that its impacts on the design are minimal. In addition, the impact on air emissions is small, since gas generation only contributes 20 percent of the pressure that drives VOCs from the closed panel.

Creep Closure Rate: The panel closure final design report in Appendix I1 calculates the rate at which the excavation in a closed panel will creep closed. The calculation is based on observed closure rates that are reported by the DOE annually in the Geotechnical Analysis Report. The assumptions and processes used in arriving at the volumetric closure rate are given in Appendix B of Appendix I1. The average value determined is 28,670 ft^3/year (812 m^3/year) based on 5 years of creep. As discussed in section D-9b(1)(c), the approach in determining the rate of creep closure for the long-term performance simulation was somewhat more theoretical in order to develop an algorithm that is implementable as a numerical model. Since the numerical model was "calibrated" using observed data, results similar to the manual calculations are expected. This similarity can be determined by analyzing the results depicted in Figure D-17E. This shows about 29,307 ft^3/year (830 m^3/year) of closure. Equation D9-5 in Appendix D9 gives the algorithm used to convert the creep closure rate into an equivalent gas generation rate. The calculated rate is 0.4 equivalent moles of gas per drum per year.

D-9b(1)(c)(iii) Sealed Shaft Configuration

The purpose and process for shaft sealing is described in detail in the Closure Plan in Chapter I and in Appendix I2. In essence, the shaft sealing components perform one or more of the following functions:

- Provide a short term seal to prevent the movement of contaminants from the disposal system
- Provide a long-term seal to prevent the movement of contaminants from the disposal system
- Provide protection for the primary long-term sealing component (crushed salt) while it consolidates to its final density

From the standpoint of evaluating the compliance to the environmental performance standards, the most important of these components are those that perform short-term sealing functions. Once these are emplaced, the repository is no longer subject to ventilation and the air pathway, in essence, disappears. Within the disposal region, oxygen is consumed and not replaced so that the environment approaches anoxic. In addition, pressures begin to build up past the nominal two atmospheres that were maintained by the panel closures. Brine inflow, which is modeled as Darcian flow, will slow appreciably in direct response to pressure buildup. As brine flows into the excavation, the saturation of the waste increases, thereby increasing the gas generation rates. These rates will be maximized if some portions of the waste become inundated, at which time iron corrosion will proceed and faster microbial degradation rates will occur. Creep closure will continue until further reduction in volume is impeded by the waste matrix and by brine and gas in pore spaces in the disposal region. Key pathways for the movement of contaminants from the disposal system become the excavation itself, the shafts, and the anhydrite layers.

Soil Pathway

Once the shafts are sealed, there is no soil pathway unless contaminants can escape as either liquids or gases, which subsequently are deposited on the ground surface. The potential for such releases is discussed subsequently.

Surface Water Pathway

Once the shafts are sealed, there is no surface water pathway unless contaminants can escape as either liquids or gases, which subsequently are deposited in surface waters. The potential for such releases is discussed subsequently.

Groundwater Pathway

An analysis of post-closure performance was conducted using a computer simulation as discussed in Section D-9b(1)(c). The pertinent results are shown for the first 300 years in Figures D-17B to D-17F. Input parameters and other key assumptions are summarized in Appendix D16. Based on these results, there are two reasons why contamination will not leave the disposal region. First, there is insufficient pressure during the post-closure period to drive brine from the disposal region. A pressure of 10.5 MPa is shown by the modeling to be needed for brine to move outward. This pressure is not reached by year 300. Second, no leachate can form. Brine that enters the disposal zone results in saturations less than those needed to create a network of saturated pores. Such a condition is needed for contaminated liquids to flow out of the waste region as additional brine flows in.

Air Pathway

As with brine, gas will not move out of the disposal region without a pathway and a driving force. Since pressure does not exceed near field lithostatic pressures during the post-closure period, gas will only accumulate within the disposal region.

D-9b(1)(d) Other Sources of Contamination

A survey was conducted by the DOE to determine other sources of contamination in the WIPP vicinity. With regard to the non-atmosphere pathways, the DOE has conducted an extensive background environmental characterization program. The results of the environmental sampling program are reported in Westinghouse (1992) and are updated in the annual site environmental report similar to the one provided in Appendix D4. No significant sources of underground contamination were found with the exception of one livestock watering well at a nearby ranch which showed relatively high nitrate values, likely due to its proximity to livestock corrals. Appendix D15 is a summary of permitted sources for VOC releases in the vicinity of the WIPP. Measurement of selected air pollutants at the WIPP site began in 1976 and were reported by DOE in the Final Environmental Impact Statement (DOE, 1980). Since the preparation of that document, a more extensive air quality monitoring program has been established. Seven classes of atmospheric gases regulated by the EPA have been monitored at the WIPP site between August 27, 1986, and October 30, 1994. These gases are carbon monoxide (CO), hydrogen sulfide (H_2S), ozone (O_3), nitrogen oxides (NO, NO_2, NO_x), and sulfur dioxide (SO_2). The total suspended particulates are monitored in conjunction with the air-monitoring programs of the WIPP. The results of the monitoring program are detailed in the annual reports for the WIPP Environmental Monitoring Program.

D-9b(2) Protection of Groundwater

Exposure of humans or environmental receptors to hazardous waste or hazardous constituents via the groundwater or subsurface environment will be unlikely. This conclusion is supported by the following considerations:

- The total TRU mixed waste volume to be emplaced during the Disposal Phase has been limited by the LWA to a volume of 6.2 million ft^3 (175,600 m^3). TRU mixed waste will be handled in unopened containers throughout the Disposal Phase. The physical form of the WIPP facility TRU mixed waste will be solid.

- The WIPP facility repository is hydrologically and geologically isolated. As discussed in Section D-9a and Appendix E1, and as modeled in Section D-9b the permeability of the Salado, which hosts the repository, is extremely low, and fluids within it are effectively immobilized. No driving force exists for TRU mixed waste to migrate from the disposal rooms into groundwater or the subsurface environment beyond the unit (see Chapter E of this permit application).

- The WIPP WAC prohibits the shipment of liquid waste to the WIPP facility.

- The operation of the WIPP is such that there will be no discharges from the waste management areas that will affect groundwaters.

- The placement of repository seals as described in the Closure Plan in Chapter I will prevent the migration of groundwater into the waste areas from upper water bearing zones and will prevent the movement of waste constituents from the repository to the groundwaters.

- Active and passive controls will prevent any intentional drilling into the repository which could create groundwater flow paths.

- Surface run-on during intense precipitation events, such as the probable maximum precipitation (PMP) event, could potentially pass through the WIPP site from the east but will be diverted by a system of culverts and drainage ditches designed to protect the WIPP facility from flooding, as depicted in Appendix D3, Drawing 24-C-028-W1. Therefore, run-on will not affect the underground HWMUs. Appendix D3 provides the additional WIPP site grading and paving drawings. Appendix D7 provides the PMP calculations.

With regard to the formation of leachate; first, the WIPP WAC are such that liquid waste is not allowed in the WIPP facility, so that leachate cannot form within containers (the WAC criterion on liquids is discussed in Section C-1b). Second, based on conceptual models limited brine seepage from the Salado slows down rapidly and is stopped by pressure buildup so that the waste does not become saturated and subsequently cause the formation of leachates during the operational, closure, and post-closure care periods. The characteristics of brine flow in the Salado are discussed in Appendix D6, §D6-2a(3)). Third, repository seals prevent brine from higher units from running down the shafts and forming leachates and prevent the movement of any liquids that may accumulate in the underground into overlying groundwaters (the characteristics of repository seals are described in Appendix I2). The rocks between the

overlying water bearing strata and the waste are nearly impermeable.[6] The nearest water bearing zone below the repository (the Bell Canyon Formation) is nearly 2,000 ft (610 m) below the waste and is separated from the waste by many hundreds of feet of nearly impermeable halites and anhydrites. There are no groundwater users within the WIPP land withdrawal area, and no one withdraws groundwaters from the Salado formation in the vicinity. The nearest oil and gas well is over one mile from the waste panels and taps resources from formations that lie from 2,000 to 10,000 ft (610 to 3,048 m) below the waste horizon. Land use in the region includes mining, oil and gas production, and ranching. However, the DOE owns all of the lands needed to protect the WIPP repository and will retain this ownership in perpetuity. In addition, the DOE has planned several active and passive institutional controls to assure that no one intentionally drills into the waste while seeking resources. These plans are described in Chapter I. Because there are no pathways to contaminate groundwater, there is no possibility that waste or waste constituents will migrate to root zones or otherwise expose the human population, animals, or otherwise threaten the environment via groundwater. By virtue of their placement in the WIPP repository and the sealing of the repository, the environmental performance standards in 20 NMAC 4.1, Subpart V, §264.601(a) will be met.

D-9b(3) Protection of Surface Water, Wetlands, and Soil Surface

Exposure of humans or environmental receptors to hazardous waste or hazardous waste constituents from surface water, wetlands, or the soil surface will be unlikely. This conclusion is supported by the following considerations:

- All TRU mixed waste will be contained throughout the Disposal Phase. As described above, the limitation on free liquids; provisions for containment of any release within the unit; and location of the unit deep within a stable, isolated geologic formation effectively preclude any potential for contamination of surface water, wetlands, or soil surface.

- While being managed on the surface, the waste will always be provided with two containments. These will consist of the waste container and either the shipping container, or the WHB. Furthermore, measures discussed previously have been taken to eliminate the potential of serious accidents with the waste. The epoxy coated floor and the HEPA filtered ventilation system in the WHB preclude the release of hazardous waste constituents to the surrounding soil, surface water, or wetlands.

- The WHB is built to withstand the effects of the most severe tornado, earthquake, or flood that could reasonably be expected to occur during Disposal Operations. The details of design and construction are documented in the WIPP SAR (DOE, 1995) and are summarized in Section D-10.

[6]The term nearly impermeable is used since over geologic time scales, all natural materials are believed to have a finite permeability. The permeability of the pure halites in the Salado is too small to measure. Measurements indicate it is than 10^{-23} m^2, which is the measurement threshold for the techniques used.

- Local and regional hydrological conditions are favorable for waste isolation. The site is 12 mi (19 km) northeast of and 500 ft (152.4 m) above the Pecos River. It is 400 ft (121.9 m) above the 100-year floodplain. The site has been graded to provide interceptor diversions to channel storm runoff away from surface structures. The site-drainage system has been designed to handle a probable maximum storm (Appendix D7). Local surface-water drainage and precipitation patterns are addressed in Section D-9a(1), Site Characteristics. Current surface use activities are not expected to alter the local hydrological conditions.[7]

- In the vicinity of the WIPP facility, there is no hydrologic communication with a surface-water source. There is no driving mechanism that will allow TRU mixed waste to migrate through the salt into a below-surface water-bearing unit that discharges to surface water.

- The climate is semi-arid, with an average of 12 in. (30 cm) of rainfall per year as discussed in Section D-9a(1)(a). Nearly all of this precipitation is lost to evapotranspiration so that infiltration is negligible.

- As discussed in Section D-9a(1)(d), there are no surface water bodies within 5 mi (8 km) of the facility. Several surface bodies exist beyond that distance, including a small salt lake known as Laguna Quattro, which was documented recently for contamination with arsenic, benzene, toluene, and xylenes as the result of oil field brine disposal. These surface waters have no effect on the WIPP repository due to their distance.

- The DOE owns all of the lands needed to protect the WIPP repository and will retain this ownership in perpetuity. In this way, the DOE will protect the WIPP from future changes in land use that may alter the surface. In addition, the DOE has planned several active and passive institutional controls to assure that no one intentionally drills into the waste while seeking resources. These plans are described in Chapter I.

- The WIPP facility contains all storm-water discharges in retention basins to meet the requirements of the WIPP National Pollutant Discharge Elimination System Storm Water General Permit. These retention basins contain surface water discharges from inside the fenced facility preventing discharge to regional surface waters, wetlands, or soil surfaces. Because there are no pathways to contaminate surface water, soils, or wetlands, there is no possibility that waste or waste constituents will create damage to domestic animals, wildlife, crops, vegetation, or physical structures. By virtue of their placement in the WIPP

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[7]Two local practices have been known to alter the local hydrological conditions. However, neither of these activities will affect the repository. Ranchers, at times, form "stock tanks" which are impoundments that are catchment basins for rainwater in order to water livestock. These occur to the south and north of the WIPP; however, such catchments are not likely in the sandy soil immediately around the WIPP. These only have limited effects on the surface and do not appear to affect the subsurface. The other activity is mining. The shallower potash mines have resulted in surface subsidence. The extent of how subsidence over the potash mines changes overall flow properties is not known but it is not expected to be significant since the long-term modeling conservatively bounds the transmissive properties of the Rustler and also assumes that the groundwater table moves to the land surface under wetter conditions. Potash mining will not occur close enough to the WIPP disposal system to have an impact on the waste that is disposed within the Salado. The closest mining at this time is 5 mi (8 km) away, although mining up to within 1 mi (1.6 km) is allowed and is not impactive.

repository and the sealing of the repository, the environmental performance standards in 20 NMAC 4.1, Subpart V, §264.601(b) will be met.

D-9b(4) Protection of the Atmosphere

Release of hazardous waste or hazardous constituents to the air that may have adverse effects on human health or the environment is unlikely. Although VOCs are present in the TRU mixed waste emplaced within the unit and could potentially be a source of release to the air, such a release would not pose risks to human health or the environment.

Lead and other heavy metals (presumed to have the characteristic of toxicity) will also be present in some TRU mixed waste forms. Metal in the TRU mixed waste, most of which will be lead in monolithic form, will be present in bricks, sheets, or shot, rather than in particulate form. The primary sources of other metals will be in the form of sheets, rods, plating, parts of equipment, or solidified sludges. Because all TRU mixed waste will be in containers and because waste container vents are particulate filters, releases of particulate metals to the atmosphere will be prevented.

D-9b(4)(a) Performance Standards

For human exposures to hazardous waste emissions, performance standards are defined in two categories. The first category is for occupational exposures to waste emissions, and the standard imposed by the DOE at the WIPP is consistent with standards codified by the Occupational Health and Safety Administration (OSHA) in 29 CFR 1910. The second category is for public exposures to waste emissions, and those standards are established by the EPA. For public exposures, the performance standards are based on the health effects of the exposure and are defined for carcinogenic (cancer-causing) effects and for non-carcinogenic (other health effects).

The methodology for assessing health risks is referred to as a risk assessment. The term "health risks" is used to describe occupational risk and public risk. However, the measure of risk is fundamentally different for the two groups of individuals for example, occupational exposure is calculated by assessing the effects on healthy adults of working age. Public risk includes effects on children, adults, the elderly and the infirm. As the result, risk assessment is different for each exposed group. EPA, in its guidance manual (EPA, 1988) mandates the consideration of both environmental risk (human health and the environment) and occupational risk. Furthermore, the EPA mandates OSHA as the appropriate occupational risk standard.

9-b(4)(a)(i) Occupational Risk

Occupational risk is typically assessed by comparing actual or anticipated exposure to a concentration of a hazardous substance in the work place. OSHA's overall approach to regulating occupational exposure to particular substances is a four-step process. In the first step, the Agency quantifies the pertinent risks, to the extent possible, performing quantitative risk

assessments. The Agency considers a number of factors such as the type of risk presented by the substance, the quality of the underlying data, the reasonableness of the risk assessment, the statistical significance of the findings, and the significance of risk. In the second step, OSHA considers which, if any, of the regulatory provisions being considered will substantially reduce the identified risks. In the third step, OSHA looks at the best available data to set permissible exposure limits that, to the extent possible, both protect employees from significant risks and are technologically and economically feasible. In the fourth step, OSHA considers the most cost-effective way to fulfill its statutory mandate. Because of this process, it is not possible to relate occupational risk to terms that make it directly comparable to public risk such as chances for excess cancer fatality. Therefore, the occupational risk levels used in this analysis are shown as a dose.

In the analysis of occupational exposure, the DOE compares the expected dose to the OSHA recommended permissable exposure limit (PEL) which is an 8-hour time weighted average. In practice, at the WIPP facility, the DOE implements the dose levels endorsed by the American Conference of Governmental Industrial Hygienists (ACGIH). Action levels for WIPP are at one/tenth of the ACGIH Level. This means that the DOE will take action to mitigate further exposure if an employee's exposure reaches ten percent of the ACGIH Level.

9-b(4)(a)(ii) Environmental Risk

The performance standard for environmental exposure to carcinogens has been established by the EPA and is based on excess risk of developing cancer in a population. The acceptable excess risk for the public to exposures from class A and B carcinogens is 1×10^{-6}, (i.e., one chance in one million of developing cancer) and class C carcinogens is 1×10^{-5}. The acceptable level of risk for the public to exposures from non-carcinogens is expressed in terms of a hazard quotient. A hazard quotient of less than 1.0 from exposure to emissions poses no known health risk and is acceptable.

D-9b(4)(b) Potential for Health Risks

This section is a summary of the exposure assessment presented in Appendix D9. The exposure assessment includes an analysis of the potential releases of hazardous waste emissions, the physical and chemical properties of the waste, the release pathways, and human exposure to potential releases to the atmosphere. The potential risk to human health from waste emissions is compared to acceptable levels and is summarized in Table D-6.

Since the only substances to be released are gases from the headspace of waste containers, the assessment focused on the release of those VOCs in the gas phase that represent approximately 99 percent of the risk to human health. The only pathway assessed is the atmosphere, or releases to the air from the mine ventilation system. Occupational exposures are assessed from potential VOC concentrations in the mine ventilation air underground and in the atmosphere on the surface of the facility. Public exposures are assessed at all locations where public exposure can occur from potential VOC concentrations in the atmosphere from releases of the mine ventilation air.

The calculation of risk and exposure to classes of public and occupational receptors is documented in Appendix D9. Based on these calculations, Table D-6 shows that the maximum estimated occupational exposure concentrations of VOCs underground and on the surface are 75 to 38,500 times and 4,170 to 263,000 times, respectively, below OSHA limits. The most exposed individual in the underground is a someone emplacing waste in an open panel. This task results in an exposure of 330 hours in 2.5 years for four waste handlers. At all other times, the waste handler will be upwind from the waste and will not be exposed to emissions. Any other workers who may be downwind of the waste will be operating under a safe work permit through which exposures are carefully monitored and controlled. The most exposed individual on the surface resides in the Training Building 1,920 hours per year. The maximum estimated environmental health risk from VOC emissions is to a resident at the WIPP Site Boundary. The risk levels are from one and one-half to three and one-half orders-of-magnitude below acceptable levels for carcinogens, and from five to six orders-of-magnitude below acceptable levels for non-carcinogens. The maximum risk for carcinogens is 3×10^{-8} from carbon tetrachloride. The maximum hazard quotient for non-carcinogens is 4×10^{-6} from chlorobenzene, which is well below the acceptable level of 1.0. Calculations of risk to the public used average headspace concentrations. Calculations of risk to workers use maximum average concentrations in Table C-5.

D-9b(4)(c) Compliance with Air Emission Standards

The air emission modeling for the WIPP underground is presented in Appendix D10. Emissions from the WHB are not regulated under 20 NMAC 4.1, Subpart V. The modeling considered the following aspects:

- The volume and the physical characteristics of the waste were evaluated. Since the waste cannot contain liquid hazardous waste, the emissions are due to residuals of organic compounds that are on surfaces or sorbed by laboratory equipment. An estimate has been made of the quantities of organics that are in the headspace of the containers since these are free to vent into the disposal areas through carbon-composite filters attached to each container of TRU waste. The 930 drums tested were from the Rocky Flats Environmental Technology Site and the INEL. These containers are considered representative of the waste throughout the DOE complex for the purposes of determining the modeling parameters. This is because all of the volatile constituents in the Waste Analysis Plan are represented. Furthermore, modeling results in waste characterization limits as discussed in Chapter C of this application. These limits which are the maximum average values shown in Table C-5 will have to be met by all generators that wish to send waste to WIPP, whether or not their waste was specifically included in the modeling.

- The modeling takes into account the various engineered and operating aspects of the facility; open panels, open rooms, filter vents on each container, the ventilation system for the facility, and the size and use of the land withdrawal area. For closed rooms and closed panels, the modeling takes into account gas generation rates and

creep closure rates as drivers for VOC emissions, the effectiveness of closures for preventing ventilation of a closed areas, the ventilation system, and the size of the land withdrawal area.

- The atmospheric and topographic conditions of the surrounding area are included in the modeling program as discussed in Appendix D10.

- Other sources of air pollution were not considered since, for the most part, they are far away from the WIPP. Sources of air pollution are summarized in Appendix D15.

The potential for public health risks are summarized in Table D-6. Exposure of animals, wildlife, crops, vegetation, and physical structures are considered to be negligible due to the short exposure periods and the low concentration of the releases.

D-10 Facility Design and Process Description

D-10a Process Description

Overview

The subject of this permit application is the management of TRU mixed waste and backfill during Disposal Phase operations. TRU mixed waste handling and management practices are summarized in this section. A detailed description of the facilities and systems associated with managing this waste is provided in Section D-9a(3). Specific container types are discussed in Section D-1a(1).

D-10a(1) Description of Waste and Containment

The total volume of TRU mixed waste that may be received for emplacement during the Disposal Phase is limited by Public Law 102-579 to 6.2 million ft^3 (175,600 m^3).

The DOE has determined that TRU mixed waste to be received at the WIPP facility exists in a variety of physical forms, ranging from unprocessed laboratory trash (e.g. tools, paper, glassware, gloves) to solidified wastewater treatment sludges. TRU mixed waste results from plutonium reprocessing and fabrication as well as from research and development activities at various DOE defense program facilities. In the future, significant quantities of TRU mixed waste may be generated from environmental restoration, decontamination, and decommissioning activities. Waste characterization is described in Chapter C of this permit application.

The DOE is requesting a permit to dispose of 6.2 million ft^3 (175,600 m^3) of CH and RH TRU mixed waste in the underground HWMUs designated as Panels 1 through 10.

D-10a(2) Facility Design and Construction

The WIPP facility has been sited and designed to ensure safe operations and to be protective of human health and the environment.[8] The normal maintenance activities in the underground facility will provide continued safety for the Disposal Phase and the facility closure period.

The WIPP repository host-rock (salt) characteristics (e.g., physical and chemical properties, geomechanical properties, stability, and strength) have been evaluated. Validation investigations have been conducted. These activities served as the basis for repository siting and design. Appendix D1 includes the Geological Characterization Report describing the repository location.

The main underground entries for the WIPP repository were designed based upon empirical data; site characterization data, including information from boreholes; surface geophysical measurements and laboratory tests; and mining and engineering standards universally applied to underground projects. The room-and-pillar design concept for the WIPP facility was based on general potash mining practice in the vicinity under similar lithologic conditions, although modifications were made to account for the differences in depth between potash mines and the WIPP facility repository horizon. Because the extraction ratio (the ratio of the area of salt removed by mining to the total area) at the WIPP facility is significantly lower than that used in potash mining, design parameters reflect this difference.

Design validation efforts for the WIPP facility began in 1981 with the Site and Preliminary Design Validation (SPDV) program, implemented to further characterize and validate the WIPP site geology and to provide preliminary validation of the underground excavation. The SPDV program involved the excavation of a test panel consisting of four full-sized SPDV test rooms, excavated 13 ft (4 m) high, 33 ft (10 m) wide, and 300 ft (91 m) long, and separated by 100-ft (31 m)-wide pillars. Data obtained from geologic field activities and geomechanical instrumentation were analyzed to determine the suitability of the design criteria and design bases and to provide confirmation of the underground opening reference design.

Additional information was gathered, analyzed, and evaluated after completion of the SPDV program. The report, "Summary of Site Characterization Studies Conducted from 1983 through 1987 at the Waste Isolation Pilot Plant Site," is included in Appendix D1. The Final Design Validation Report is also included in Appendix D1.

As a part of the design validation process, geomechanical tests were conducted in SPDV test rooms. During the tests, salt creep rates were measured. Separation of bedding planes and

[8]See Appendix D3. The following drawings provide as-built information regarding the facility location, general layout, access routes, and final grading and paving: 23-C-001-022, 24-C-022-W, and 24-C-028W1 and W2.

fracturing were also observed. Consequently, a ground-control strategy was implemented. The ground-control program at the WIPP facility mitigates the potential for roof or rib falls and maintains normal excavation dimensions[9], as long as access to the excavation is possible.

Data collected from geomechanical monitoring of the HWMUs during the Disposal Phase will be evaluated periodically to help assess ground conditions. Any ground conditions exceeding established criteria will be evaluated for immediate and longer-term safety. Any operational activity in a room may be terminated depending on the results of the evaluation. If a roof fall is indicated, appropriate action will be taken to protect human health and the environment long before any fall occurs.

Geologic and geomechanical information will be gathered from the WIPP facility underground on a regular basis, and HWMUs will be monitored. Geologic mapping, observational boreholes, and geomechanical instrumentation will be used to characterize the host rock, to assess the effects of excavation, to measure closure rates, and to evaluate the behavior of the salt. This information will be used to further validate design criteria and to monitor the stability of underground openings to ensure safety and operational reliability.

The data gathered from routine monitoring will be evaluated to provide early detection of conditions that could affect activities in the active HWMUs during the Disposal Phase. If development of an unstable condition is confirmed, corrective action will be implemented. Although the monitoring system cannot predict the exact timing of any instability, it does provide early warning of deteriorating ground conditions. Over one year's warning was provided by geotechnical monitoring before each roof fall in SPDV Test Rooms 1 and 2.

The WHB has been designed to meet DOE design and associated quality assurance requirements. Table D-7 summarizes basic design requirements, principal codes, and standards for the WIPP facility. Appendix D2 provides engineering design-basis earthquake and tornado reports. The design-basis earthquake report provides the basis for seismic design of WIPP facility structures, including the WHB foundation. The WIPP design-basis earthquake is 0.1 g. The WIPP design-basis tornado includes a maximum windspeed of 183 mi per hr (mi/hr) (294.5 km/hr), which is the vector sum of all velocity components. It is also limited to a translational velocity of 41 mi/hr (66 km/hr) and a tangential velocity of 124 mi/hr (200 km/hr). Other parameters are a radius of maximum wind of 325 ft (99 m), a pressure drop of 0.5 lb per in.^{2} (3.4 kilopascals [kPa]), and a rate-of-pressure drop of 0.09 lb/in.^{2}/s (0.6 kPa/s). A design-basis flood report is not available because flooding is not a credible phenomenon at the WIPP facility. Design calculations for the PMP event, provided in Appendix D7, illustrate run-on protection for the WIPP facility.

[9]See Appendix D3. Drawing 54-W-009-W.

The specific systems and facilities related to the protection of human health and the environment during waste handling and management operations are discussed in the following subsections. In addition to the specific systems and facilities discussed below, as-built drawings are provided in Appendix D3.

D-10a(2)(a) Site Security

The WIPP site has security protection that includes physical access control, fencing, lighting, warning signs noting potential hazards, 24-hr-per-day security protection personnel, and communication systems. Chapter F of this permit application describes site security. Appendix D3 provides details on the design of access control fencing.[10]

D-10a(2)(b) Waste Handling Building

Appendix D3 provides detailed design drawings for the WHB and waste handling systems.

D-10a(2)(b)(i) CH TRU Mixed Waste Handling Areas

The CH side of the WHB contains two major areas where CH TRU mixed waste handling operations will be conducted: the CH Bay and the conveyance loading room.

The CH Bay

The TRUPACT-IIs will be received through one of three air-lock entries to the CH Bay of the WHB. The WHB ventilation system maintains the interior of the WHB at a pressure lower than the ambient atmosphere to ensure that air flows into the WHB, preventing the inadvertent release of any hazardous or radioactive constituents contamination. The doors at each end of the air lock are interlocked to prevent both from opening simultaneously and equalizing CH Bay pressure with outside atmospheric pressure. The CH Bay houses a TRUDOCK equipped with overhead cranes for opening and unloading TRUPACT-IIs on either side of the central air lock.

The cranes are rated to lift the TRUPACT-II lids as well as their contents. The cranes are designed to remain on their tracks and hold their load even in the event of a design-basis earthquake.

The Conveyance Loading Room

After the TRUPACT-II contents are transferred to a facility pallet, a forklift will transport the pallet to the conveyance loading room adjacent to the waste hoist. There the facility pallet will be loaded on the conveyance loading car in preparation for transfer to the waste hoist

[10]The following as-built drawings are provided in Appendix D3: Access Control Fencing--24-C-022-W; WHB Fire Protection--41-F-087-014, 41-S-003-W1, W2, W3, and W4; and WHB Architectural and Framing--41-E-003-014, 41-005-014, 41-E-006-014, and 41-E-063-014.

(Figure D-18). The conveyance loading room serves as an air lock between the CH Bay and the waste hoist shaft, preventing excessive airflow between these two areas. With the waste hoist materials platform properly positioned and prepared, the conveyance loading car will move onto the waste hoist on rails. There the facility pallet will be transferred to the waste hoist, and the conveyance loading car will be returned to the conveyance loading room.

D-10a(2)(b)(ii) RH TRU Mixed Waste Handling Areas

RH-72B shielded road casks containing RH waste canisters (Figure D-19) will be received into the WHB through an entry on the RH side of the WHB. The WHB RH side contains two major areas for handling RH mixed waste: the RH Bay and the hot-cell complex. The hot-cell complex is divided into four subareas designed for specific functions: the cask-unloading room, the Hot Cell, the Transfer Cell, and the (facility) cask-loading room.

The RH Bay

The RH Bay is a high-bay area for RH-72B shielded road (or railroad) cask receiving and subsequent handling operations. The trailer carrying the RH-72B shielded road cask will enter the RH Bay through a set of double doors on the eastern side of the WHB. This entry also provides for rail car entry. Separate heating, ventilation, and air-conditioning (HVAC) systems are provided that maintain the pressure in the RH side of the WHB lower than the outside ambient atmospheric pressure for contamination control. Because there are no air locks at these access doors, the period of time that the doors will be open will be minimized and limited to times when there are no unsealed shielded road casks containing RH TRU mixed waste canisters in the RH Bay. The RH Bay houses the road-cask transfer car, which is a self-propelled rail-guided car that travels between the RH Bay and the cask unloading room. The RH Bay also provides space for an overhead bridge crane with an auxiliary hoist used for shielded road cask handling and maintenance operations.

Following shielded road-cask inspections, which include contamination surveys, the impact limiters will be removed while the shielded road cask is on the trailer. The shielded road cask will be unloaded from the trailer using the overhead bridge crane and will be placed on the road-cask transfer car. The road-cask transfer car (Figure D-20) incorporates an integral work platform that provides personnel access to the head area of the road cask for unloading and shipment preparations, including conducting radiological surveys, physical inspections, minor maintenance, and decontamination, if necessary.

During shipping preparations for the shielded road cask, lay-down space will be provided in the RH Bay for components that must be removed during unloading. Within the operating envelope of the overhead bridge crane, the RH Bay will provide space and equipment for periodic shielded road-cask and facility-cask maintenance. If required, this area will also be used for cask-decontamination activities.

The Hot Cell Complex

The inner containment vessels of the RH-72B shielded road casks will only be opened in the Hot Cell. This procedure will be performed remotely to preclude a threat to human health or the environment. The Hot Cell will be maintained at a greater negative differential pressure than the other areas of the WHB to ensure that gases or other airborne contaminants will be exhausted through the HEPA-grade filters dedicated to the Hot Cell area. The negative differential pressure will also prevent any contaminants from escaping the Hot Cell in the event that the Hot Cell is breached (e.g., a door is opened to the Hot Cell).

The Cask-Unloading Room

The cask-unloading room is a concrete-shielded room into which the shielded road cask will be moved by the road-cask transfer car. It is from this room that the RH canister will be moved from the road cask to the Hot Cell. During this cask-to-hot-cell transfer, a cask-seal collar and adapter rings shall be provided to allow the interior of the road cask to become an extension of the hot-cell ventilation system when mated to the floor port in the Hot Cell. This arrangement isolates the atmosphere of the road cask from that of the cask-unloading room. In this way, contamination that may be present within the road cask is restricted to the hot-cell atmosphere, which exhausts through HEPA filters. A concrete filled shield door, moved across the entrance to the cask unloading room on air bearings, will provide radiation protection for personnel in the RH Bay while the canister is being removed from the road cask.

The Hot Cell

The Hot Cell (Figures D-21, D-22, D-23) is a concrete-shielded room where RH canisters will be inspected following removal from the shielded road cask. The Hot Cell is designed to protect personnel outside the room from unshielded RH canisters with a gamma surface dose rate of 400,000 rem per hr and a neutron surface dose rate of 45 rem per hr.

Access to the Hot Cell above the cask-unloading room will be by the removal of shield plugs in the floor of the Hot Cell. These plugs must be in place when the shielded road cask enters the cask unloading room. The cask unloading room shield door must be closed prior to the removal of the shield plugs, to prevent personnel exposure to RH canisters that may be in the Hot Cell. The design incorporates a safety interlock that prevents the hot-cell grapple from closing while the shield door is open. When in place, the hot-cell shield plugs will provide shielding corresponding to the level of radiation protection provided by the cask unloading room.

A second floor port provides access to the Transfer Cell from the Hot Cell. This port is shielded by a remotely controlled shield valve mounted on the floor of the Hot Cell, which when closed, provides the levels of radiation protection afforded by the Transfer Cell. Safety interlocks prevent closing this shield valve unless the hot-cell crane hoist position is high enough to prevent closure on a canister or the hoist.

The Hot Cell contains two primary working stations: an inspection station and a welding station. The RH canisters will be inspected in the Hot Cell at the inspection station. Inspections will include visual inspection, verification of canister identification, and loose surface contamination checks. If the results of this inspection indicate that overpacking of the canister is required to prevent further contamination of RH mixed waste handling equipment, this overpacking will be accomplished at the welding station. There the canister will be inserted into an overpack canister body, and the overpack closure will be installed and welded using a remotely operated welding machine. A description of the RH canister and overpack RH canister is provided in Section D-1a(1).

The Hot Cell is outfitted with the following major equipment: a remotely operated bridge crane, a remotely operated bridge-mounted power manipulator, two pairs of fixed manipulators, a portable remotely operated overpack welder, a closed-circuit television system, and a shielded material-transfer drawer. Various locations supporting hot-cell operations are provided, including overpack canister storage; lay-down areas for overpack canister lids, cask-seal surface-protection devices, cask inner-vessel lids, floor-shield plugs, and shield-plug handling fixtures; a power manipulator tool stand; and inspection-station and welding-station canister receptacles.

The overhead bridge crane, outfitted with a rotating block and grapple, will be used for all heavy lifting operations in the Hot Cell, including the handling of the Hot Cell shield plugs, the shielded road-cask inner-vessel lid, the RH canister, and the canister overpack components. This crane is designed to stay on its rails and maintain control of its load in the event of a design-basis earthquake or an electrical outage. Other features of this crane include the manual override of the trolley and hoist at the cask-loading port and the canister-inspection station, mechanical override of the grapple or the grapple rotating block with the assistance of the power manipulator, and an interlock that prevents the cask-unloading room shield door from opening while the grapple is closed.

The Hot Cell is constructed for contact maintenance of installed equipment. Access to the Hot Cell will only be permitted when RH canisters are not present in the cell. The bridge crane may be moved to a crane maintenance room, using an overriding beam and a separate winch, if necessary, where maintenance can be performed on the crane. Maintenance personnel are shielded from canisters in the Hot Cell.

The following routine operations will be conducted in the Hot Cell:

- The Hot Cell floor shield plug will be removed and will be placed on the floor.
- The cask inner-vessel lid will be removed and placed on the floor.
- An optional cask-seal surface protector will be installed on the shielded road cask.
- The RH TRU canister will be moved to the inspection station.
- The canister will be inspected visually and on closed-circuit television.

- The canister will be surveyed for loose surface contamination using the master slave manipulators.

- The contamination survey samples will be placed in the shielded transfer drawer and will be checked for contamination.

- If the canister is contaminated or physically damaged, the canister will be moved to the welding station and will be overpacked and resurveyed for contamination.

- When the canister or overpack meets acceptable limits, the container will be moved to the Transfer Cell.

- The optional cask seal surface protector will be removed.

- The cask inner-vessel lid will be replaced on the shielded road cask.

- The hot cell shield plug will be replaced.

The Transfer Cell

The Transfer Cell, located beneath the Hot Cell, provides the means to transfer canisters from the Hot Cell to the cask loading room via a shuttle car. The shuttle car has seven positions for the temporary storage of RH mixed waste, if required. The cell includes provisions for a manual override tool to release the grapple from a RH canister at the cask-loading room port in the event of a grapple failure. This tool will be operated from an area shielded from the Transfer Cell. Canisters will be lowered into the shuttle car through a shield valve in the floor of the Hot Cell using the hot-cell bridge crane and grapple. Operations in the Transfer Cell will be monitored by closed-circuit television cameras.

The Cask Loading Room

The Cask Loading Room provides for transfer of a RH canister to the facility cask for subsequent transfer to the waste hoist and to the underground. The facility cask (Figure D-24) is designed to reduce radiation levels to less than 200 millirem per hr at the surface of the casks, with a canister reading of 1,000 rem per hr.

The transfer operation will be accomplished by lifting the canister from the shuttle car through the shield valve into a vertically oriented facility cask positioned in the Cask Loading Room. The shuttle car will position the canister directly under the Cask Loading Room shield valve. The telescoping port shield valve will mate with the underside of the facility cask to ensure shielding continuity, as does the shield bell, located above the facility cask. The operating console that will be used to accomplish this sequence of operations will be located behind a shadow shield.

Once loaded, the facility cask will be rotated to the horizontal position on the facility-cask transfer car (Figure D-25) and will then be ready for transfer onto the waste hoist. The Cask Loading Room functions as an air lock between the Waste Shaft and the Transfer Cell and RH Bay.

RH TRU Mixed Waste Support Facilities

The Hot Cell Operating Gallery, the Crane Maintenance Room, the Manipulator Repair Room, and the Hot Cell Filter Gallery support RH TRU mixed waste handling operations (see Figure D-26).

The Hot Cell Operating Gallery

The Hot Cell Operating Gallery, adjacent to the Hot Cell, provides the space for Hot Cell operating personnel to monitor and control operations. The fixed manipulators will be operated from this area, and they can be removed through this area to the Manipulator Repair Room for maintenance and repair. To prevent the spread of contamination, manipulators will be bagged out as they are removed from the Hot Cell. After transfer to the Manipulator Repair Room, the manipulators will be surveyed and decontaminated, if necessary. The Hot Cell Operating Gallery also contains closed-circuit television monitors and control-panel stations for selecting and monitoring the Hot Cell and Transfer Cell cameras.

D-10a(2)(b)(iii) Other TRU Mixed Waste Support Systems

Ventilation

The WHB HVAC system provides a filtered-air exhaust path consisting of two stages of prefilters (to remove larger dust particles and to prolong the useful life of the HEPA filters) and two stages of HEPA filters (to remove radioactive particulate contamination). These filters will be tested to American National Standards Institute (ANSI) requirements (ANSI-N-510) and have a combined 99.95 percent removal efficiency per stage of 0.3 micron particles.

Except for local air-handling units and the hot-cell exhaust filters, WHB HVAC equipment is contained within the mechanical equipment room, located on a second level of the CH side of the WHB. This room houses the exhaust fans and associated ducting that control WHB ventilation flow.

The WHB ventilation system channels exhaust through a single stack at a nominal flow of 55,000 ft^3 (1,556.5 m^3) per min. The final exhaust from the stack will be continuously monitored for radioactive particulate contamination.

In the event of a tornado, tornado dampers will close to prevent the outward rush of air caused by a rapid drop in atmospheric pressure. Damper closure mitigates the destruction of HEPA filters and ducts by preventing a high-pressure differential from affecting the filters.

If necessary, the exhaust systems can be powered from the backup-power system if off-site power is lost, thus maintaining negative-differential pressures in potentially contaminated areas.

During the initial opening phases of a TRUPACT-II, the TRUDOCK Vent Hood System (VHS) will function as a local exhaust system to control potential airborne-particulate contamination through the use of HEPA filters. Headspace gases will also be drawn into the WHB HVAC exhaust system.

Fire Protection

The design of the fire-protection system satisfies applicable sections of the National Fire Protection Association codes, DOE Orders, and other federal codes (see Chapter F). Fire barriers protect the cage-loading area and shaft areas within the WHB, separate support areas, and walls enclosing stairwells. In addition, the mechanical equipment room has fire barriers that separate this room from other areas of the WHB.

A sprinkler system is installed throughout the CH and RH TRU mixed waste handling areas of the WHB. A fire-suppression water-collection system is in the floor of the WHB to collect fire-suppression water. Fire-suppression water will be collected and held for hazardous contamination verification, and its management will be determined by the test results. The TRU mixed waste handling area will be provided with interior fire-hose connections and portable extinguishers for nonwaste-related fires. Chapter F provides additional information on fire protection.

Underground Access Control

Access to all HWMUs is restricted for the purposes of entry control to areas where wastes are being handled, the WHB, the boundaries of the parking area south of the WHB, and those portions of the underground where wastes are transported or disposed are posted as Controlled Areas (CAs). The WIPP Radiological Control Manual (Westinghouse, 1994) allows access to a CA by anyone who has successfully completed General Employee Radiological Training which is included in the General Employee Training Course described in Chapter H. Access for visitors can also be arranged with proper training.

D-10a(2)(c) CH TRU Mixed Waste Handling Equipment

The following sections provide descriptions of the major pieces of equipment that are used to manage CH TRU waste. A summary of equipment capacities, as required by 20 NMAC 4.1, Subpart V, is included in Table D-8.

TRUPACT-II Type B Shipping Containers

The TRUPACT-II (Figure D-27) is a double-contained cylindrical shipping container 8 ft (2.4 m) in diameter and 10 ft (3 m) high. It meets DOT Type B shipping container requirements

and has successfully completed rigorous container-integrity tests. The payload consists of 7,265 lbs (3,295 kg) gross weight in up to fourteen 55-gal (208-L) drums, two SWBs, or one TDOP.

Unloading Docks

Each TRUDOCK is designed to accommodate up to two TRUPACT-II shipping containers. The TRUDOCK functions as a work platform, providing TRU mixed waste handling personnel easy access to the container during unloading operations (see Figure D-28 and Drawing 41-M-001-W in Appendix D3).

Forklifts

Forklifts will be used to transfer the TRUPACT-II shipping containers into the WHB and to transfer palletized CH TRU mixed waste to the conveyance loading car. Another forklift will be used for general-purpose transfer operations. This forklift has attachments and adapters to handle individual TRU mixed waste containers, if required.

Cranes and Adjustable Center-of-Gravity Lift Fixtures

At each TRUDOCK, an overhead bridge crane is used with a specially designed lift fixture for disassembly of the TRUPACT-IIs. Separate lifting attachments have been specifically designed to accommodate SWBs and TDOPs. The lift fixture, attached to the crane, has built-in level indicators and two counterweights that can be moved to adjust the center of gravity of unbalanced loads and to keep them level.

Facility Pallets

Facility pallets are fabricated steel units designed to support drums, TDOPs, or SWBs and have a rated load of 25,000 lbs (11,340 kg). The facility pallets designed to support SWBs have two recesses on the upper surface sized to accept SWBs. Hold-down plates are used to clamp the lower lip of the SWBs to the facility pallet. The facility pallet will accommodate a maximum of four SWBs (two stacks of two high) with a total weight of 16,000 lbs (7,260 kg). If SWBs are stacked two-high, tie-down straps are used to strap the SWBs to the holding bars in the hold-down plate of the facility pallets. The facility pallets designed to support 7-packs have pockets approximately 3 in. (76 mm) deep in the top plate of the pallet to accommodate two sets of two-high 7-packs, two sets of two-high 4-packs of 85-gal (321 L) drums, or one TDOP. Each stack of waste drums is strapped down to holding bars in the top reinforcement plate of the facility pallet. Sets of 7-packs, SWBs, or 4-packs are separated by slipsheets. Facility pallets are shown in Figures D-29 and D-30. Fork pockets in the side of the pallet allow the facility pallet to be lifted and transferred by forklift to prevent direct contact between TRU mixed waste containers and forklift tines. This arrangement reduces the potential for puncture accidents. WIPP facility operational documents define the operational load of the facility pallet as the contents of two TRUPACT-IIs. Since the maximum TRUPACT-II load is 7,265 lbs (3,300 kg), the maximum weight of a loaded facility pallet is less than 19,000 lbs (8,630 kg), including the pallet weight.

Backfill

As specified in Appendix D22, magnesium oxide (MgO) will be used as a backfill in order to provide chemical control over the solubility of radionuclides in order to comply with the requirements of 40 CFR 191.13. The MgO backfill will be purchased prepackaged in the proper containers for emplacement in the underground. Purchasing prepackaged backfill eliminates handling and placement problems associated with bulk materials, such as dust creation. In addition, prepackaged materials will be easier to emplace, thus reducing potential worker exposure to radiation. Should a backfill container be breached, MgO is benign and cleanup is simple. No hazardous waste would result from a spill of backfill. A Material Safety Data Sheet is attached in Appendix D22.

The MgO backfill will be purchased and received in two different containers: 1) a supersack holding 4,000 lbs (1,814 kg); and 2) a mini sack holding 25 lbs (11.3 kg). Quality assurance requirements, such as material quality and quantity, will be addressed by using current quality assurance procedures in the procurement process and receipt inspection. The filled containers will be shipped by road or rail and will be delivered underground using current shaft and material handling procedures and processes.

The mini sack will be 34 in. (86.4 cm) long, 6 in. (15 cm) in diameter and will be fabricated of a single layer of polyethylene or other suitable material. It will have an integral handle/hook attached into the sack closure. Six sacks will be manually placed in the external voids of each 7-pack unit just before the 7-pack is positioned on the waste stack. The mini sack will be lifted up behind the shrink wrap around the top of the 7-pack, slid into place, and held there by the four inch hole in the lower slip sheet. See Figure D-30A. Once the sacks are in place, the 7-pack will be positioned on the waste stack in the normal manner. No new equipment or training of operators is necessary.

A similar process will be used for standard waste boxes (SWB) except that the sacks will be hung from the lift clips on these units. See Figure D-30A. Again, no new equipment or training is necessary.

Super sacks will be handled and placed using the slip sheet/BRUDI technique used for normal waste handling operations. Hence, no new equipment, procedures, or training are required. Once each row of waste units is in place, a layer of 6 super sacks will be placed on top of them. See Figure D-30B. The super sack will be 5 ft (1.5 m) wide by 6 ft (1.8 m) deep by 1.5 ft (0.45 m) high and will be of multi-wall construction with a vapor/moisture barrier. The super sack will have an integral slip sheet or base attachment so that it can be handled and placed in a manner that is identical to how waste units are emplaced, using a BRUDI-like attachment on a lift truck.

Finally, mini sacks will be manually stacked on the floor in the space between the waste stack and ribside. These sacks can be placed horizontally or vertically as may be convenient and loading rates up to 100 lbs per linear foot (148.8 kg per linear meter) can be achieved.

Quality control will be provided within waste handling operating procedure to record that the correct number of sacks are placed and that the condition of the sacks is acceptable.

There are about 3,700 linear feet (1,128 linear meters) of waste stack in a panel. The stated configuration provides about 4,000 pounds per linear foot (5,952 kg per linear meter) of waste stack or about 7,400 short tons (6,712 metric tons) per panel. About 10,836 waste disposal units (i.e., 7-packs of drums and SWBs) will be placed in a panel and at six 25-pound (11.3 kg) mini sacks per unit, this will provide about 800 short tons (726 metric tons) per panel. Finally, material stacked along the ribside at 100 pounds per linear foot (148.8 kg per linear meter) of rib will provide about 360 short tons (327 metric tons) per panel. This gives a total of about 8,560 short tons (7,764 metric tons) per panel or approximately 85,600 short tons 77,640 metric tons) for the repository.

Backfill placed in this manner is protected until exposed when sacks are broken during creep closure of the room and compaction of the backfill and waste. Backfill in sacks utilizes existing techniques and equipment and eliminates operational problems such as dust creation and introducing additional equipment and operations into waste handling areas. There are no mine operational considerations (e.g. ventilation flow and control) when backfill is placed in this manner. Backfill density is 224.6 lb/ft^3 (3.6 g/cm^3). Consequently, the volume of panel void space occupied by the backfill is calculated to be 76, 211 ft^3 (2158 m^3).

The Conveyance Loading Car

The conveyance loading car is an electric vehicle that operates on rails. It is designed with a flat bed that has adjustable height capability and will be used to transfer the facility pallets on or off the pallet support stands in the waste hoist cage by raising and lowering the bed (see Figure D-18).

The Waste Hoist Conveyance

The hoist systems in the shafts and all shaft furnishings are designed to resist the dynamic forces of the hoisting system and to withstand a design-basis earthquake as defined in Section D-10a(2). The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system (such as overtravel, overspeed, power loss, circuitry failure, or starting in a wrong direction) and will trigger an alarm that automatically shuts down the hoist.

The waste hoist operates in the Waste Shaft and is a multirope, friction-type hoist. A counterweight is used to balance the waste hoist conveyance. The waste hoist conveyance (outside dimensions) is 30 ft (9 m) high by 10 ft (3 m) wide by 15 ft (4.5 m) deep and can carry a payload of 45 tons (40,824 kg). During loading and unloading operations, it is steadied by fixed guides. The hoist's maximum rope speed is 500 ft (152.4 m) per min.

The Waste Shaft hoist system has two sets of brakes, with two units per set, plus a motor that is normally used to stop the hoist. The brakes are designed so that either set, acting alone, can stop a fully loaded conveyance under all emergency conditions.

The Underground Waste Transporter

The underground waste transporter is a commercially available diesel-powered tractor. The trailer was designed specifically for the WIPP for transporting facility pallets from the waste hoist to the waste storage panels at the HWMU in use. This transporter is shown in Figure D-30.

Underground Forklifts

CH TRU mixed waste containers loaded on slipsheets will be removed from the facility pallets using forklifts with a BRUDI attachment (Figure D-32) attached to the forklift-truck front carriage. The BRUDI attachment grips the edge of the slipsheet (on which the waste containers sit) to pull the containers onto the platen. After the forklift moves the waste containers to the emplacement location, the BRUDI attachment pushes the containers into position. The use of the BRUDI attachment prevents direct contact between waste containers and forklift tines. SWBs and TDOPs may also be removed from the facility pallet by using forklifts equipped with special adapters for these containers. These special adapters will prevent direct contact between SWBs or TDOPs and forklift tines.

D-10a(2)(d) RH TRU Mixed Waste Handling Equipment

The following sections provide descriptions of the major pieces of equipment that are used to manage RH TRU waste. A summary of equipment capacities, as required by 20 NMAC 4.1, Subpart V, is included in Table D-8.

RH-72B Shielded Road Cask

The RH-72B shielded road cask (Figure D-19) is designed to meet DOT Type B shipping container requirements and is a cylinder consisting of a separate inner vessel within an outer cask protected by impact limiters at each end. Neither the outer cask nor the inner-containment vessel will be vented. Each container is capable of withstanding an internal pressure of 150 lb/in.^{2} (1,034 kPa) gauge. Payload capacity of each RH-72B shielded road cask is 8,000 lbs (3,628 kg). The payload will consist of a canister of RH TRU mixed waste, which may contain 235 gal (890 L) noncontainerized waste or waste in 30 gal (114 L) or 55 gal (208 L) drums. The weight of the canister is included in the total payload.

The inner containment vessel is made of stainless steel and provides a cavity for the payload. The lid is secured to the body of the vessel by closure bolts. To center the canister and to facilitate insertion and removal, internal spacers are provided in the inner vessel.

The outer cask is also a stainless steel vessel that is constructed of two concentric shells enclosing a cast-lead shield to protect against gamma radiation. The outer cask will be protected at each end by energy-absorbing impact limiters, which are stainless steel shells filled with polyurethane foam. The impact limiters also act as thermal insulators to protect seal areas from fire in the event of an incident/accident.

Overhead Bridge Crane

The overhead bridge crane will be used to lift the RH-72B shielded road cask from the trailer, once it is admitted into the RH Bay, and place it on the road cask transfer car. It will also be used to remove the impact limiters and the outer lid of the RH-72B shielded road cask.

The Road-Cask Transfer Car

The road-cask transfer car (see Figure D-20), a self-propelled, rail-guided car, will travel between the RH Bay and the cask-unloading room, which is part of the hot-cell complex. The road-cask transfer car will support the shielded road cask and will incorporate an integral working platform that will provide personnel access to the head area of the shielded road cask for cask-unloading preparations, inspections, and repairs.

The Facility Cask

The RH canister will be placed inside the facility cask, which will be used for shielding during transfer of the RH canister from the hot-cell complex to the HWMU for emplacement underground. The facility cask body consists of two concentric steel cylinders. The annulus between the cylinders is filled with lead, and gate shield valves are located at either end. Figure D-24 provides an outline configuration of the facility cask.

The Facility-Cask Transfer Car

The facility-cask transfer car is a self-propelled rail car (see Figure D-25) that will operate in the cask-loading room for loading the RH canister from the shuttle car to the facility cask. Once the facility cask is loaded, the facility-cask transfer car will move onto the waste shaft conveyance and will then be transported underground. At the underground waste station, the facility-cask transfer car will proceed away from the waste hoist conveyance to provide access to the facility cask by a forklift.

The Facility-Cask Rotation Fixture

The facility-cask rotation fixture will be used to rotate the facility cask from the horizontal position to the vertical position to allow RH canister-loading into the facility cask from the shuttle car. Once the facility cask is loaded, the rotation fixture will rotate the facility cask back to the normal horizontal position.

The Grapple Hoist

A grapple hoist will be used to hoist the RH canister from the shuttle car into the facility cask.

Horizontal Emplacement Equipment

The horizontal emplacement equipment (see Figure D-33) is a waste transfer machine that will emplace RH canisters into a borehole in a room wall of an HWMU and cover the borehole opening with a shield plug after a canister has been emplaced.

D-10a(2)(e) Shafts and Subsurface Facilities

Shafts

The WIPP facility uses four shafts: the Waste Shaft, the Salt Handling Shaft, the Air Intake Shaft, and the Exhaust Shaft. These shafts are vertical openings that extend from the surface to the repository level.

The Waste Shaft is located beneath the WHB and is 19 to 20 ft (5.8 to 6.1 m) in diameter. The Salt Handling Shaft, located north of the Waste Shaft beneath the salt handling headframe, is 10 to 12 ft (3 to 3.6 m) in diameter. Salt mined from the repository horizon is removed through the Salt Handling Shaft. The Salt Handling Shaft is the main personnel and materials hoist and also serves as a secondary-supply air duct for the underground areas. The Air Intake Shaft, northwest of the WHB, varies in diameter from 16 ft 7 in. (4.51 m) to 20 ft 3 in. (6.19 m) and is the primary source of fresh air underground. The Exhaust Shaft, east of the WHB, is 14 to 15 ft (4.3 to 4.6 m) in diameter and serves as the exhaust duct for the underground air.

Openings excavated in salt experience closure because of salt creep (or time-dependent deformation at constant load). The closure affects the design of all of the openings discussed in this section. Underground excavation dimensions, therefore, are nominal, because they change with time. The unlined portions of the shafts have larger diameters than the lined portions, which allows for closure caused by salt creep. Each shaft includes a shaft collar, a shaft lining, and a shaft key section. The Final Design Validation Report in Appendix D1 discusses the shafts and shaft components in greater detail.

The reinforced-concrete shaft collars extend from the surface to the top of the underlying consolidated sediments. Each collar serves to retain adjacent unconsolidated sands and soils and to prevent surface runoff from entering the shafts. The shaft linings extend from the base of the collar to the top of the salt beds approximately 850 ft (259 m) below the surface. Grout injected behind the shaft lining retards water seeping into the shafts from water-bearing formations, and the liner is designed to withstand the natural water pressure associated with these formations. The shaft liners are concrete, except in the Salt Handling Shaft, where a steel shaft liner has been grouted in place.

The shaft key is a circular reinforced concrete section emplaced in each shaft below the liner in the base of the Rustler and extending about 50 ft (15 m) into the Salado. The key functions to resist lateral pressures and assures that the liner will not separate from the host rocks or fail under tension. This design feature also aids in preventing the shaft from becoming a route for groundwater flow into the underground facility. (See Chapter E of this permit application for more information on groundwater monitoring.)

On the inside surface of each shaft, excluding the Salt Handling Shaft, there are three water-collection rings: one just below the Magenta, one just below the Culebra, and one at the lowermost part of the key section. These collection rings will collect water that may seep into the shaft through the liner. The Salt Handling Shaft has a single water collection ring in the lower part of the key section. Water collection rings are drained by tubes to the base of the shafts where the water is accumulated.

WIPP shafts and other underground facilities are, for all practical purposes, dry. Minor quantities of water (which accumulate in some shaft sumps) are insufficient to affect the waste disposal area. This water is collected, brought to the surface, and disposed of in accordance with current standards and regulations.

The Waste Shaft is protected from precipitation by the roof of the waste hoist headframe tower. The Exhaust Shaft is configured at the top with a 14 ft- (4.3 m-) diameter duct that diverts air into the exhaust filtration system or to the atmosphere, as appropriate. The Salt Handling and Air Intake Shaft collars are open except for the headframes. Rainfall into the shafts is evaporated by ventilation air.

D-10a(2)(f) Subsurface Structures

The subsurface structures in the repository, located at 2,150 ft (655 m) below the surface, include the HWMUs, the northern experimental areas, and the support areas. Appendix D3 provides details of the underground layout.[11] Figure D-11 shows the proposed waste emplacement configuration for the HWMUs.

The status of important underground equipment, including fixed fire-protection systems, the ventilation system, and contamination detection systems, will be monitored by a central monitoring system, located in the Support Building adjacent to the WHB. Backup power will be provided as discussed in Chapter F. The subsurface support areas are constructed and maintained to conform to federal mine safety codes.

[11]Refer to drawings 54-W-001-W, and 54-W-009-W. For general underground layout information, refer to drawings 53-J-039-W, 53-J-042-W, 73-E-001-W1, 73-J-010-W1, and 73-J-011-W1 for underground utilities.

Underground Hazardous Waste Management Units

During the Disposal Phase, the volume of TRU mixed waste emplaced in the repository will not exceed 6.2 million ft^3 (175,600 m^3). Waste will be disposed of in the underground HWMUs.

Main entries and cross cuts in the repository provide access and ventilation to the HWMUs. The main entries link the shaft pillar/service area with the TRU mixed waste management area and are separated by pillars. Normal entries are 13 ft (4.0 m) high and 14 ft (4.3 m) wide. Each of the underground HWMUs labeled Panels 1 through 8 will have seven rooms. The locations of these HWMUs are shown in Figure D-10. The rooms will have nominal dimensions of 13 ft (4.0 m) high by 33 ft (10 m) wide by 300 ft (91 m) long and will be supported by 100 ft- (30 m-) wide pillars.

If waste volumes disposed of in the eight panels fail to reach the stated design capacity, the DOE may choose to use the four main entries and crosscuts adjacent to the waste panels (referred to as the disposal area access drifts) for disposal; however, the DOE is only seeking to permit the construction of these areas at this time. A permit modification or future permit would be submitted describing the condition of those drifts and the controls exercised for personnel safety and environmental protection while disposing of waste in these areas. These areas have the following nominal dimensions:

E-300 will be mined to be 14 ft (4.3 m) wide and 12 ft (3.7 m) high
E-140 is mined to 25 ft (7.6 m) wide by 13 ft (4 m) high
W-030 and W-170 will be similar to E-300.

All extend from S-1600 to S-3650 (i.e., 2050 ft long [625 m]). Crosscuts (east-west entries) will be 20 ft (6.1 m) wide by 13 ft (4 m) high by 470 ft (143 m) long. The layout of these excavations is shown on Figure D-10.

Panel 1 is the first HWMU to be used for waste disposal and was excavated from 1986 through 1988. Its rooms and access drifts have been rock-bolted to assure stability.
Panel 1 rooms are typically pattern-bolted with 10 ft (3 m) mechanical bolts. In addition, Room 1 has been supplied with a supplementary roof-support system consisting of rock bolts, steel channel sets, and a wire-mesh and lacing system. The DOE intends to mine panels in the following order:

Panel 9 (disposal area access drift)
Panel 2
Panel 10 (disposal area access drift)
Panel 3
Panel 4

Future panels are not expected to be needed during the duration of the permit being sought by this application. Panels 5 through 8 will be mined in order under a new permit.

At normal operating (waste throughput) rates, rock bolting in Panels 2 through 8 may only be required locally (i.e. spot bolting). Rock fixtures used at WIPP comply with 30 CFR 57, Subpart B. Each ground control support system installation is individually assessed and evaluated. As a result they vary from time to time and place to place.

A discussion of the design life of underground disposal rooms is included in Section D-10a(2). An evaluation of the effective life of the underground rooms in Panel 1 was performed during April 1991 by a panel of geotechnical experts (DOE 1991a). The panel members concluded that if no additional remedial measures were taken, the rooms in the panel would likely have to have a total life of seven to eleven years from the time of excavation using the installed roof support system, consisting of patterned mechanically anchored rockbolts. Experience in Panel 1 confirmed the conclusion of the expert panel.

Plans call for bolt systems installed in the future to equal or exceed the bearing characteristics of the bolts used in the primary pattern in Panel 1. The configuration of Panel 2 through 8 will be similar to Panel 1, therefore, the performance of these rooms should be similar to those in Panel 1. Supplementary support systems will further extend the effective life of the rooms, should they be required. A detailed discussion of initial and supplementary support systems is included in Section D-10d(1)(b).

The support system will be subjected to longitudinal and lateral loading due to the rock deformation. The anchorage components may undergo lateral deformation due to offsetting along clay seams or fractures and increasing tensile loading. Rigid, non-yielding support systems are not designed to accommodate salt creep; however, they do respond to creep and continue to provide support during ductile behavior. Yielding support systems are currently being evaluated in the WIPP underground. These systems are designed to yield at predetermined loads and provide support over their prescribed yield interval without maintenance. Preliminary data indicate that the design and performance of some of these systems are clearly superior to rigid systems in their ability to respond to salt creep while maintaining adequate ground support.

Because the disposal area access drifts must remain open and operational for a much longer period than any panel, they will require additional consideration from time to time. They are subject to regular and systematic inspection and evaluation and appropriate ground control measures will be implemented whenever necessary.

The DOE will ensure that any room in which waste will be placed will be sufficiently supported to assure compliance with the applicable portions of the LWA, which requires a regular review of roof-support plans and practices by the Bureau of Mines and the Mine Safety and Health Administration (MSHA). Creep and rock failure in WIPP excavations progress slowly. As a result, many years pass before any operationally significant instability could occur. This long period allows more than sufficient time for whatever actions are appropriate, such as additional monitoring, installing supplementary support, or taking other managerial and operational actions. Support is installed to the requirements of 30 CFR 57, Subpart B. Westinghouse includes random checks by Quality Assurance/Quality Control personnel as each system is installed. Westinghouse Geotechnical Engineering performs geotechnical monitoring, design, analysis, and

planning while Westinghouse Mine Operations is responsible for daily and regulatory inspections, maintenance, and construction.

Escape routes are designated by reflectors on the sides of the drift: green reflectors denote the primary escape route, and red reflectors denote the secondary escape route. The back of each reflector is white, denoting travel away from the egress point (see Chapter G).

Underground Facilities Ventilation System

The underground facilities ventilation system will provide a safe and suitable environment for underground operations during normal WIPP facility operations. The underground system is designed to provide control of potential airborne contaminants in the event of an accidental release or an underground fire.

The main underground ventilation system is divided into four separate flows (Figure D-34): one flow serving the mining areas, one serving the northern experimental areas, one serving the disposal areas, and one serving the Waste Shaft and station area. The four main airflows are recombined near the bottom of the Exhaust Shaft, which serves as a common exhaust route from the underground level to the surface.

Underground Ventilation System Description

The underground ventilation system consists of five centrifugal exhaust fans, two identical HEPA-filter assemblies arranged in parallel, isolation dampers, a filter bypass arrangement, and associated ductwork. The five fans, connected by the ductwork to the underground exhaust shaft so that they can independently draw air through the Exhaust Shaft, are divided into two groups. One group consists of two main exhaust fans that are utilized to provide the required nominal air flow of 425,000 standard ft^3 per min (SCFM) throughout the WIPP facility underground during normal operation. These fans are located near the Exhaust Shaft. The second group consists of the remaining three filtration fans, and each can provide 60,000 SCFM of air flow. These fans, located at the Exhaust Filter Building, are capable of being employed during the filtration mode, where exhaust is diverted through HEPA filters, or in the reduced or minimum ventilation mode where air is not drawn through the HEPA filters.

The underground mine ventilation is designed to supply sufficient quantities of air to all areas of the repository. During normal operating mode (simultaneous mining and waste emplacement operations), approximately 140,000 actual ft^3 (3,962 m^3) per min can be supplied to the panel area. This quantity is necessary in order to support the level of activity and the pieces of diesel equipment that are expected to be in operation.

At any given time during waste emplacement activities, there will be a significant level of activity in three rooms. One room will be receiving CH waste containers (e.g., Room No. 7), while the next room will be receiving RH waste (e.g., Room No. 6). RH emplacement boreholes will be drilled in the third room (e.g., Room No. 5). The remaining rooms in a panel will either be

completely filled with waste; be idle, awaiting waste handling operations; or being prepared for waste receipt. Approximately 35,000 ft^3 (990 m^3) per min will be required in each of these active rooms during operations. This quantity of air is required to support the numbers and types of diesel equipment that are expected to be in operation in the area, to support the underground personnel working in that area, and to exceed a minimum air velocity of 60 ft (18 m) per min as specified in the WIPP Ventilation Plan. The remainder of the air is needed in order to account for air leakage through inactive rooms.

Air will be routed into a panel from the intake side. Air is routed through the individual rooms within a panel using underground bulkheads and air regulators. Bulkheads are constructed by erecting framing of rectangular steel tubing and screwing galvanized sheet metal to the framing. Figure D-34A shows a typical bulkhead with a flow regulator installed. In order to accommodate creep, bulkhead members use telescoping extensions that are attached to the framing and which can be adjusted periodically. Since bulkheads are intended to seal the ventilation system, they use either a sheetmetal or rubber gasket that is attached to the bulkhead on one side and the salt on the other. Flow is also controlled using brattice cloth barricades. These consist of chainlink fence that is bolted to the salt and covered with brattice cloth; and are used in instances where the only flow control requirement is to block the air. A brattice cloth air barricade is shown in Figure D-34B. Ventilation will be maintained only in all active rooms within a panel until waste emplacement activities are completed and the panel-closure system is installed. The air will be routed simultaneously through all the active rooms within the panel. The rooms that are filled with waste will be isolated from the ventilation system, while the rooms that are actively being filled will receive a greater volume of air to assure worker safety. After all rooms within a panel are filled, the panel will be closed using a closure system described in Chapter I of this permit application.

Once a disposal room is filled and is no longer needed for emplacement activities, it will be barricaded against entry and isolated from the mine ventilation system by removing the air regulator bulkhead and constructing chain link/brattice cloth barricades at each end. There is no requirement for air for these rooms since personnel and/or equipment will not be in these areas. For air dispersion modeling purposes in Appendix D9, it is assumed that no air goes through each filled room.

The ventilation path for the waste disposal side is separated from the mining side by means of air locks, bulkheads, and salt pillars. A pressure differential is maintained between the mining side and the waste disposal side to ensure that any leakage is towards the disposal side. The pressure differential is produced by the surface fans in conjunction with the underground air regulators.

Underground Ventilation Modes of Operation

The underground ventilation system is designed to perform under two modes of operation: normal (the HEPA exhaust filtration system is bypassed), and filtered (the exhaust is filtered through the HEPA filtration system, if the concentrations of radioactive contaminants exceed pre-set limits).

In the normal mode, the two main surface exhaust fans, located near the Exhaust Shaft, will provide continuous ventilation of the underground areas. All underground flows join at the bottom of the Exhaust Shaft before discharge to the atmosphere.

Outside air will be supplied to the mining areas, the waste disposal areas, and the experimental complex through the Air Intake Shaft, the Salt Handling Shaft, and access entries. A small quantity of outside air will flow down the Waste Shaft to ventilate the Waste Shaft station. The ventilation system is designed to operate with the Air Intake Shaft as the primary source of fresh air. Under these circumstances, sufficient air will be available to simultaneously conduct all underground operations (e.g., waste handling, mining, experimentation, and support).

If the nominal flow of 425,000 cfm (12,028 m^3/min) is not available underground operations may proceed, but the number of activities that can be performed in parallel may be limited depending on the quantity of air available. Ventilation may be supplied by operating one or two of the filtration exhaust fans. To accomplish this, the isolation dampers will be opened, which will permit air to flow from the main exhaust duct to the filter outlet plenum. The filtration fans may also be operated to bypass the HEPA plenum. The isolation dampers of the filtration exhaust fan(s) to be employed will be opened, and the selected fan(s) will be switched on. In this mode, underground operations will be limited, because filtration exhaust fans cannot provide sufficient airflow to support the use of diesel equipment.

In the filtration mode, the exhaust air will pass through two identical filter assemblies, with only one of the three Exhaust Filter Building filtration fans operating (all other fans are stopped). This system provides a means for removing the airborne particulates that may contain radioactive and hazardous waste contaminants in the reduced exhaust flow before they are discharged through the exhaust stack to the atmosphere. The filtration mode is activated manually or automatically if the radiation monitoring system detects abnormally high concentrations of airborne radioactive particulates. Automatic activation will also occur if an alarm is received from one continuous air monitor at Station A (a monitoring system near the exhaust discharge point). The filtration mode is not initiated by the release of gases such as VOCs. This is for three reasons. First, the HEPA filters would not remove VOCs from the air stream. Second, VOCs are continuously being released at concentrations that are shown in Section D-9b(4) to be of little consequence to occupational or environmental receptors and, therefore, do not require filtration. Third, based on the types of accidents modeled in the Safety Analysis Report (SAR), the most severe credible accident results in the breaching of 21 drums of waste in a roof fall in an active panel results in a release (for carbon tetrachloride). That is, at most, 3.3% of the allowable off site dose.[12] This low dose is not a threat to human health or the environment. VOCs will be monitored in the underground using the VOC Confirmatory Monitoring Plan described in Section D-10d(1)(d)(xiv).

[12]For the analysis in the SAR the standard used is the threshold limit value/short term exposure limit (TLV/SLEL).

A set of three booster fans will allow selective reversal of airflow in the mining area, the northern experimental area, the Air Intake Shaft and its associated station, and the Salt Handling Shaft and its associated station. In these modes, airflow can be reversed by opening and closing certain ventilation doors and air regulators and by operating the underground booster fans (in either the forward or the reverse direction). These fans will normally be turned off and will be isolated, with air bypassing the fans and flowing through the air lock. The surface fans will be stopped before attempting any underground air reversals. These modes of ventilation will only be implemented under manual control for off-normal conditions (such as a fire).

Electrical System

The WIPP facility uses electrical power (utility power) supplied by Southwestern Public Service. If there is a loss of utility power, TRU mixed waste handling and related operations will cease.

Backup, alternating current power will be provided on site by two 1,100-kilowatt diesel generators. These units provide 480-volt power with a high degree of reliability. Each of the diesel generators can carry predetermined equipment loads while maintaining additional power reserves. Predetermined loads include lighting and ventilation for underground facilities, lighting and ventilation for the TRU mixed waste handling areas, and the Air Intake Shaft hoist. The diesel generator can be brought on line within 30 minutes either manually or from the control panel in the Central Monitoring Room (CMR).

Uninterruptible power supply units are also on line providing power to predetermined monitoring systems. These systems ensure that the power to the radiation detection system for airborne contamination, the local processing units, the computer room, and the CMR will always be available, even during the interval between the loss of off-site power and initiation of backup diesel generator power.

D-10a(3) TRU Mixed Waste Management Operations

Prior to receipt of TRU mixed waste at the WIPP facility, waste operators will be thoroughly trained in the safe use of TRU mixed waste handling and transport equipment. The training will include both classroom training and on-the-job training.

D-10a(3)(a) Derived Waste

The WIPP facility operational philosophy is to introduce no new hazardous chemical components into TRU mixed waste or TRU mixed waste residues that could be present in the controlled area. This will be accomplished through written procedures and the use of Safe Work Permits (SWP)[13] and Radiological Work Permits (RWP).[14] The purpose of this operating philosophy

[13]SWPs are prepared to assure that any hazardous work (not already covered by a procedure) is performed with due precaution. SWPs are issued by the WIPP Industrial Safety Section after a job supervisor completes the proper form detailing the job location, work description, personnel involved, specific hazards involved, and protective requirements.

(continued...)

is to avoid generating TRU mixed waste that is compositionally different than the TRU mixed waste shipped to the WIPP facility for disposal.

Some additional TRU mixed waste, such as used personal protective equipment, swipes, and tools, may result from decontamination operations and off-normal events. Such waste will be assumed to be contaminated with RCRA-regulated hazardous constituents in the TRU mixed waste containers from which it was derived. Derived waste may be generated as the result of decontamination activities during the waste handling process. Should decontamination activities be performed, water and a cleaning agent such as those listed in Section G-4d will be used. Derived waste will be considered acceptable for management at the WIPP facility, because any TRU mixed waste shipped to the facility will have already been determined to be acceptable and because no new constituents will be added (see Section C-6). Data on the derived waste will be entered into the WWIS database. Derived waste will be contained in standard DOT approved Type A containers.

The Safety Analysis Report for packaging requires the lids of TRU mixed waste containers to be vented through HEPA-grade filters to preclude container pressurization caused by gas generation and to prevent particulate material from escaping. Filtered vents used in CH TRU mixed waste containers (55-gal (208-L) drums, 85-gal (321 L) drums, TDOPs, and SWBs) have an orifice approximately 0.375-in. (9.53-millimeters) in diameter through which internally generated gas may pass. The filter media is manufactured from composite carbon.

As each derived waste container is filled, it will be closed with a lid containing a carbon-composite HEPA-grade filter and moved to a HWMU using the same equipment used for handling TRU mixed waste.

D-10a(3)(b) <u>CH TRU Mixed Waste Handling</u>

The CH TRU mixed waste handling process is illustrated in Figure B-4. CH TRU mixed waste will arrive by tractor-trailer at the WIPP facility in sealed shipping containers (e.g., TRUPACT-IIs) (see Figure D-35), at which time they will undergo security and radiological checks and shipping documentation reviews. A forklift will remove the TRUPACT-IIs and will transport them a short distance through an air lock that is designed to maintain differential pressure in the WHB. The forklift will place the shipping containers at one of the two TRUDOCKs inside the WHB, where an external survey of the TRUPACT-II inner vessel (see Figure D-27) will be performed as the

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[13](...continued)
The Industrial Safety personnel review the form, check on the adequacy of the protective measures, and if sufficient, approve the work permit. Conditions of the SWPs must be met while any hazardous work is proceeding. Examples of activities covered by the SWP program include confined space entry, overhead work, and work on energized equipment.

[14]RWPs are used to control entry into and performance of work within . Managers responsible for work within a CA must generate a work permit that specifies the work scope, limiting conditions, dosimetry, respiratory protection, protective clothing, specific worker qualifications, and radiation safety technician support. RWPs are approved by the Radiation Protection Section after thorough review. No work can proceed in a CA without a valid RWP.

outer containment vessel lid is lifted. The inner vessel lid will be lifted under the TRUDOCK VHS, and the contents will be surveyed during and after this lift. The TRUDOCK VHS[15] is attached to the TRUPACT-II to provide atmospheric control and confinement of headspace gases at their source. It also prevents potential personnel exposure and facility contamination due to the spread of radiologically contaminated airborne dust particles and minimizes personnel exposure to VOCs.

Contamination surveys at the WIPP facility are based in part on the concept of co-detection. Co-detection is used to describe the detection of releases from containers by virtue of detection of radioactive contamination (see Appendix I3). Co-detection applies to all releases except the release of gaseous VOCs from TRU mixed waste containers. Co-detection provides the WIPP facility with a very sensitive method of detecting the release of nongaseous hazardous constituents through the use of surface sampling (swipes) and radioactivity counting. Co-detection is used in addition to the more conventional techniques such as visual inspection to identify spills.

Under normal operations, it is not expected that removable surface contamination on the shipping package or the waste containers will be in excess of the DOE's free release limits (i.e.; 20 disintegrations per minute (dpm)[16] alpha or 200 dpm beta/gamma). In such a case, no further decontamination action is needed. The shipping package and waste container will be handled through the normal process. However, should the magnitude of contamination exceed the free release limits, yet still fall within the criteria for small area "spot" decontamination (i.e., less than or equal to 100 times the free release limit and less than or equal to 6 ft^2 [0.56 m^2]), the shipping package or the waste container will be decontaminated. In addition, if during the waste handling process at the WIPP, a waste container is breached, it will be overpacked or decontaminated as needed. Should WIPP structures or equipment become contaminated, waste handling operations in the affected area will be immediately suspended.

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[15]The TRU mixed waste container headspace may contain radiologically contaminated airborne dust particles.

1. Without the TRUDOCK VHS, a potential mechanism will exist to spread contamination (if present) in the immediate CH TRU mixed waste handling area, because lid removal will immediately expose headspace gases to prevailing air currents induced by the building ventilation system.

2. With the VHS, a confined and controlled set of prevailing air currents will be induced by the system blower. The TRUDOCK VHS will function as a local exhaust system to effectively control radiologically contaminated airborne dust particles (and VOCs) at essentially atmospheric pressure conditions.

   Functionally, the TRUDOCK VHS will draw the TRU mixed waste container headspace gases, convey them through a HEPA filter, and ultimately duct them through the WHB exhaust ventilation system. VOCs will pass through the HEPA filter and will be conveyed to the ventilation exhaust duct system. The system principally consists of a functional aggregation of 1) vent hood assembly, 2) HEPA filter assemblies (to capture any airborne radioactive particles), 3) blower (to provide forced airflow), 4) ductwork, and 5) flexible hose.

[16]The unit "dpm" stands for "disintegration per minute" and is the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

All decontamination operations will be performed under the controlled conditions of a RWP and the standard operating procedures found in the WIPP Radiological Control Manual (Westinghouse, 1994a). Decontamination activities will use water and cleaning agents (see Section G-4d) so as to not generate any waste that cannot be considered derived waste. Items that are radiologically contaminated are also assumed to be contaminated with the hazardous wastes that are in the container involved in the spill or release. A complete listing of these waste components can be obtained from the WIPP Waste Identification System (WWIS), as described in Section C-5b, for the purpose of characterizing derived waste.

It is assumed that the process of decontamination will remove the hazardous waste constituents along with the radioactive waste constituents. To provide verification of the effectiveness of the removal of hazardous waste constituents, once a contaminated surface is demonstrated to be radiologically clean, the "swipe" can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

For waste containers, the analyses becomes documentation of the condition of the container at the time of emplacement. The presence of hazardous waste constituents on a container after decontamination will be at trace levels and will likely not be visible and will not pose a threat to human health or the environment. These containers will be placed in the underground without further action once the radiological contamination is removed unless there is visible evidence of hazardous waste spills or hazardous waste on the container and this contamination is considered likely to be released prior to emplacement in the underground.

For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues. If the area is large, a sampling plan will be developed using the guidance in the "Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling" (Westinghouse 1994b) which incorporates the guidance of EPA's SW 846 in selecting random samples over large areas. Selection of constituents for sampling analysis will be based on information (in the WWIS) about the waste that was spilled and information on cleanup procedures. If the area is small, swipes will be used. If the results of the analysis show that residual contamination remains, a decision will be made whether further cleaning will be beneficial or whether final clean up must be deferred until closure. For example, if hazardous constituents react with the floor coating and are essentially nonremovable without removing the coating, then clean up will be deferred until closure when the coatings will be stripped. In any case, appropriate notations will be entered into the operating record to assure proper consideration of formerly contaminated areas at the time of closure. Furthermore, measures such as covering, barricading, and/or placarding will be used as needed to mark areas that remain contaminated.

Small area spot decontamination, if needed, will occur at the TRUDOCK for contamination that is less than 6 ft^2 (0.56 m^2) in area and is less than 100 times the free release limit. The free release limit is defined by DOE Orders as alpha contamination less than 20 dpm and beta-gamma contamination less than 200 dpm. Overpacking would only occur in the event the WIPP staff damages an otherwise intact container during handling activities. In such a case, a

radiological boundary will be established, inside which all activities are carefully controlled in accordance with the WIPP Radiological Control Manual (Westinghouse, 1994a) protocols for the cleanup of spills or releases. A plan of recovery will be developed and executed, including overpacking the damaged container in either a 85-gal (321 L) drum, SWB, or a TDOP. The overpacked container will be properly labeled and sent underground for disposal. The area will then be decontaminated and verified to be free of contamination using both radiological and hazardous waste sampling techniques (essentially, this is done with "swipes" of the surface for counting in sensitive radiation detection equipment or, if no radioactivity is present, by analysis for hazardous waste by an offsite laboratory).

In the event a large area contamination is discovered on a TRUPACT-II during unloading, the waste will be left in the TRUPACT-II and the shipping container will be resealed. The DOE considers such contamination problems the responsibility of the shipping site. Therefore, the shipper will have several options for disposition. These are as follows:

- The TRUPACT-II can be returned to the shipper for decontamination and repackaging of the waste. Such waste would have to be re-approved prior to shipment to the WIPP.

- Shipment to another DOE site for management in the event the original shipper does not have suitable facilities for decontamination. If the repairing site wishes to return the waste to WIPP, the site will have to have WAC certification authority and would have to re-certify the new shipment.

- The waste could go to a third (non-DOE) party for decontamination. In such cases, the repaired shipment would go to the original shipper and be recertified prior to shipment to the WIPP.

Written procedures specify materials, protocols, and steps needed to put an object into a safe configuration for decontamination of surfaces. A RWP will always be prepared prior to decontamination activities. TRU mixed waste products from decontamination will be managed as derived waste.[17]

The TRUPACT-II may hold up to two 7-packs, two SWBs, or one TDOP. An overhead bridge crane will be used to remove the contents of the TRUPACT-II.

For inventory control purposes, TRU mixed waste container identification numbers will be verified against the Uniform Hazardous Waste Manifest and the WWIS. Inconsistencies will be resolved

[17]Note that the DOE had previously proposed use of an Overpack and Repair Room to deal with major decontamination and overpacking activities. The DOE has eliminated the need for this area by: 1) limiting the size of contamination events that will be dealt with as described in this section, and 2) by performing overpacking at the point where a need for overpacking is identified instead of moving the waste to another area of the WHB. This strategy minimizes the spread of contamination.

with the generator before TRU mixed waste is emplaced. Discrepancies that are not resolved within 15 days will be reported to the NMED in accordance with 20 NMAC 4.1, Subpart V, §264.72.

Each facility pallet has two recessed pockets to accommodate two sets of 7-packs, two sets of 4-packs or two SWBs stacked two-high, or two TDOPs. Each stack of waste containers will be secured prior to transport underground (see Figures D-29 and D-30). A forklift will transport the loaded facility pallet to the conveyance loading car inside the air lock at the Waste Shaft. The conveyance loading car will be driven onto the waste hoist deck, where the loaded facility pallet will be transferred to the waste hoist, and the loading car will be backed off. Containers of CH TRU waste (55-gal (208 L) drums, SWBs, 85-gal (321 L) drums, and TDOPs) can be handled individually, if needed, using the forklift and lifting attachments (i.e., drum handlers, parrot beaks).

The waste hoist will lower the loaded facility pallet to the underground. At the waste shaft station, the CH TRU underground transporter will back up to the waste hoist cage, and the facility pallet will be transferred from the waste hoist onto the transporter (see Figure D-31). The transporter will then move the facility pallet to the appropriate underground HWMU for emplacement.

A forklift in the HWMU near the waste stack will be used to remove the waste containers from the facility pallets and to place them in the waste stack using a Brudi attachment. The waste will be emplaced room by room in Panels 1 through 8. Panels 9 and 10 may also be used in order to reach the full authorized capacity of 6.2 million ft^3 (175,600 m^3). Each panel will be closed off when filled. If a waste container is damaged during the Disposal Phase, it will be immediately overpacked or repaired. CH TRU waste containers will be continuously vented. The filter vents will allow aspiration, preventing internal pressurization of the container and minimizing the buildup of flammable gas concentrations.

Once a waste panel is mined and any initial ground control established, flow regulators will be constructed to assure adequate control over ventilation during waste emplacement activities. The first room to be filled with waste will be Room 7, which is the one that is farthest from the main access ways. The first activity in the room will be to drill RH TRU emplacement holes into the ribs. Once this is complete, the RH drilling machine will be moved to Room 6. A ventilation control point will be established for Room 7 just outside the exhaust side of Room 6. This ventilation control point will consist of a bulkhead with a ventilation regulator. The initial waste emplacement activity in the panel will be the placement of RH canisters in the predrilled holes in the ribs. Each room and associated access drifts will hold approximately 90 canisters of RH waste. Once RH emplacement is completed, CH emplacement will commence. Stacking of CH waste will begin at the ventilation control point and proceed down the access drift, through the room and up the intake access drift until the entrance of Room 6 is reached. At that point, a brattice cloth and chain link barricade will be emplaced. This process will be repeated for Room 6, and so on until Room 1 is filled. At that point, the panel closure system will be constructed.

The anticipated schedule for the filling of each of the underground HWMUs known as Panels 1 through 8 is as follows. The following assumptions are made in estimating the time to fill each HWMU:

- RH emplacement precedes CH emplacement and does not impede CH throughput
- Waste operations begin in July 1998
- Throughput for CH waste is 784 drums per week (7 pallets per day, 4 days per week, 28 drums per pallet)
- The capacity of a panel is 81,000 drums

Under these assumptions, a minimum of 104 weeks is needed to emplace the waste. Allowing a 25 percent contingency for maintenance delays and time to transition from one room to another, it is estimated that a panel will be filled 2.5 years after emplacement is initiated. Panel closure in accordance with the Closure Plan in Chapter I is estimated to require an additional 150 days.

Figure D-36 is a flow diagram of the CH TRU mixed waste handling process.

D-10a(3)(c) RH TRU Mixed Waste Handling

The RH TRU mixed waste handling process is illustrated in Figure D-37. RH TRU mixed waste will arrive at the WIPP facility in a shielded road cask loaded on a tractor-trailer or in a railroad cask loaded on a railcar. Figure D-38 is a flow diagram of the RH TRU mixed waste handling process.

Upon arrival, radiological surveys, security checks, and shipping documentation reviews will be performed. Upon completion of these checks, the Hazardous Waste Manifest will be signed to release the driver. Should radiological surveys (i.e., surface dose rate, contamination) exceed acceptable levels, the road cask and transport trailer will be placed outside the WHB in the controlled area or in the WHB itself. Factors such as weather conditions, time of receipt, and space availability will determine the actual location for placement of the road cask and transport trailer. This decision will be made on a case-by-case basis. Once the location is established, the appropriate radiological boundaries (i.e., ropes, placards, etc.) will be erected around the road cask and transport trailer.

In the RH Bay, the shielded cask will be unloaded from the tractor-trailer or railcar via a bridge crane and will be placed on the cask transfer car. The outer cask lid will be removed, and the inner cask lid will be prepared for removal. The shielded cask will be moved into the unloading room of the hot-cell complex and will be positioned under the hot-cell unloading port, where the cask-seal collar will be mated with the unloading port. At this point, all personnel will leave the

area, and the shield door will be closed. This area will remain an exclusion area until the shielded road cask is unloaded, the waste is moved into the Hot Cell, and the hot-cell shield plug is reinstalled.

Once the shielded road cask is empty, it will be moved on the road-cask transfer car back to the RH Bay. Surveys will be performed on the cask to detect exterior contamination, if any, and decontamination will be performed, if necessary.

In the Hot Cell Gallery, trained operators will remotely take sample swipes from the canisters. These samples will be removed via the shielded transfer drawer and will be checked for contamination. If a canister is contaminated or physically damaged, it will be decontaminated or overpacked. Upon the completion of the overpack, a sample swipe will be taken to verify that no external contamination exists. When a canister or an overpack is verified to be within acceptable limits, it will be moved to the Transfer Cell.

The RH TRU mixed waste identification numbers will be verified against the Hazardous Waste Manifest and WWIS to verify that waste is suitable for emplacement. The generator's copy of the manifest is then returned to the generator. If there are any discrepancies, the generator will be contacted for resolution. Discrepancies that are not resolved within 15 days will be reported to the NMED as required by 20 NMAC 4.1, Subpart V, §264.72.

Operations in the Transfer Cell will be monitored by a closed-circuit television. In the Transfer Cell, canisters will be moved to the (facility) cask-loading room port via a shuttle car. In the cask-loading room, the canister will be placed in a facility cask. This will be accomplished by lifting the canister from the shuttle car through a shield valve and into the facility cask oriented vertically on the facility-cask transfer car in the cask loading room. The shuttle car will position the canister directly under the cask-loading room shield valve. The telescoping port shield mates with the underside of the facility cask to ensure shielding continuity, as does the shield bell, located above the facility cask. The operating console for these operations will be located behind a shadow shield. Once the canister is loaded and the facility cask shield valves are closed, the facility cask will be rotated to the horizontal position. A shield door will then be opened, accessing the waste hoist. The facility-cask transfer car will be loaded onto the waste hoist and will be lowered to the waste shaft station underground.

At the waste shaft station underground, the facility cask will be moved from the waste hoist cage by the facility-cask transfer car. A forklift will be used to remove the cask from the transfer car and to transport the cask to the HWMU. There the facility cask will be placed on the horizontal emplacement equipment (Figure D-33), which will have been previously aligned with a horizontal hole bored into the room wall. The horizontal emplacement equipment assembly will then insert the canister into the hole. A shield plug will then be inserted into the hole to provide radiation shielding.

The effect of RH boreholes and RH waste heat are fully discussed in Molecke et. al., 1993. The report states, "Based on our current data, results, observations, and interpretations, RH TRU waste packages, materials, and emplacement geometry in unlined salt boreholes appear to be adequate and safe for repository - phase isolation at WIPP."

The shield plug is a cylinder 70 in. long, 29 in. in diameter, and a 1 3/4 in. wall thickness (175 cm by 4.4 cm). It has a 5 in. (12.5 cm) thick steel plate welded to the bottom of the cylinder and a 3 in. (7.5 cm) thick plate with a standard handling pintle on the other end. This shield plug weighs approximately 4,200 lbs (1,900 kg). An alternative shield plug design, better suited to disposal operations, is being developed. The alternative shield plug will be reinforced concrete with approximately the same outside dimensions as the steel shield plug and will be handled and emplaced in a similar fashion. The primary advantages in changing to a concrete shield plug are a reduction in cost and increased compatibility with the salt environment.

Shield plugs (29 in. (73 cm) in diameter) are inserted into the borehole (30 in. (75 cm) in diameter) after emplacement of the waste canister (26 in. (65 cm) in diameter or 28 in. (70 cm) in diameter for an overpacked canister). The shield plug is inserted into the borehole sleeve after emplacement of the waste canister. It provides the necessary shielding for the exposed end of the borehole, limiting the borehole radiation surface dose rate to less than 5 mrem/hr for 100 rem/hr surface dose rate canisters. Figure D-39 shows the shield plug installation. The shield plugs do not provide borehole closure. Stop bars prevent a shield plug from working its way out of the borehole. The stop bar is a 2 in. (5 cm) wide by 3/4 in. (1.9 cm) thick steel bar that is attached to the salt with rock bolts.

The amount of RH TRU mixed waste disposal in each panel is limited based on thermal and geomechanical considerations. A nominal spacing of 8 ft (2.4 m) between centers for RH TRU mixed waste canisters is planned.

D-10b Waste Characterization

TRU mixed waste characterization is described in Chapter C.

D-10c Treatment Effectiveness

TRU mixed waste treatment, as defined in 20 NMAC 4.1, Subpart I, §260.10, for which a permit is required, is not performed at the WIPP facility.

D-10d Monitoring, Inspection, and Reporting

The following section describes the activities at the WIPP facility that will be undertaken to satisfy the regulatory requirements in 20 NMAC 4.1, Subpart V, §§264.601 and 264.602.

D-10d(1) Monitoring

D-10d(1)(a) Groundwater Monitoring

In the development of the WIPP Project monitoring programs, potential pathways for release of hazardous constituents to the environment were evaluated. This evaluation indicated no credible release pathway via surface water. Release through groundwater is also believed to be implausible. In view of this, the DOE has prepared groundwater monitoring information consistent with 20 NMAC 4.1, Subpart V, §264.90(b)(4). This information is included as Chapter E of this permit application. However, the NMED has indicated that it is their policy to require the DOE to perform groundwater monitoring regardless of whether or not the WIPP is eligible for a groundwater monitoring waiver. Because of this, the DOE has prepared a groundwater monitoring plan (GMP). The GMP is presented in Appendix D18. The Appendix describes the basis for the GMP, the organization of the program, the Quality Assurance for the GMP, and the sampling program description. Sampling locations are shown in Figure D-39A. Details of the construction of the WQSP wells that will be sampled in this program are included in Appendix E18 Sampling frequency is defined in Table D-11 to be annually. However, the DOE is currently collecting background samples on these wells. This will involve a minimum of four semiannual samples prior to the end of fiscal year 1997. Analytes of interest are defined in Table D-12. Background samples will be analyzed for all constituents listed in 20 NMAC 4.1, Subpart V, §264, Appendix IX. Samples that will be taken during disposal operations include the most prevalent constituents in the waste as indicated in Table D-10, plus metals. Analysis of samples are performed by a commercial laboratory that participates in EPA's contract laboratory program. Methods are specified in procurement documents and are selected to be consistent with EPA recommended procedures in SW 846. Data analysis is to provide an objective and reliable means for interpreting data in relation to the objectives of the data collection program. For the GMP the principal goal of data analyses is the comparison of a data point or data set to equivalent data collected at another location and time (such as preoperational baseline data or data collected at a control location), or to a fixed standard.

Several levels of analyses are required for each parameter before statistically valid interpretation can be achieved. The type of analysis used at each level varies among parameters due to the particular characteristics of parameters and the specific objectives of monitoring. Five general levels of data analyses are described here. Analyses at each of these levels is considered for each parameter. The levels are:

(1) Determination of accuracy for each point measurement by quantification and control of precision and bias;

(2) Evaluation of the effects of auto-correlation on the expected value of the point measurement due to location and time of sampling;

(3) Identification of the appropriate model of variability (i.e., a probability density distribution) for each point measurement and the calculation of descriptive statistics based on the chosen model;

(4) Treatment of data anomalies; and

(5) Interpretation of data through statistically valid comparisons (tests) and trend analysis.

Each of these levels of data analyses are described below and with the requirements for application to the GMP.

Accuracy

Accuracy is the closeness of a measurement to its actual, or true, value. Since the true value cannot be determined independently, accuracy cannot be absolutely determined. However, accuracy is controlled by two basic elements: bias (consistent over or underestimation of the true value) and precision, [concentration of repeated measurements around a central (expected) value]. Accuracy is maximized when bias is minimized and precision is maximized.

To some extent precision and bias are controlled by strict adherence to sample collection, handling, and measurement protocols. GMP procedures specify the protocols for those functions performed at the WIPP and quality control procedures establish control on precision and bias for analytical contractors.

Temporal and Spatial Analysis

Environmental parameters vary with space and time. The effect of one or both of these two factors on the expected value of a point measurement is statistically evaluated through spatial analysis and time series analysis; however, these methods often require extensive sampling efforts which are in excess of the practical requirements of the WIPP GMP. The application of these methods to a particular parameter must, therefore, be limited by consideration of its significance in the final interpretation of the data.

In particular, spatial analysis has limited use in this program, although the effect of spatial auto-correlation on the interpretation of the data is considered for each parameter. Spatial variability is accounted for by the use of predetermined key sampling locations. Data analysis is performed on a location-specific basis, or data from different locations is combined only when the data have been determined to be statistically homogeneous.

Time series analysis plays a more important role in data analysis for the GMP. Parameters are reported as time series, either in tabular form or as time plots. For key time series parameters, these plots are in the form of control charts on which control levels will be identified based on preoperational data base, fixed standards, control location data bases, or other standards for

comparison. Where significant seasonal changes in the expected value of the parameter are identified in the preoperational data base or in the control locations, corrections in the control levels which reflect the seasonal change are made.

Distributions and Descriptive Statistics

For data sets which include more than ten data points that are homogeneous in space and time (including seasonal homogeneity), and have less than ten percent missing data, a test for conformance to the normal distribution is performed. A probability plot is an accepted method for performing this test; however, more powerful tests of normality, such as the W Test, or D'Agostino's Test (Gilbert, 1987) are more accurate. Any standard best fit test is acceptable, provided the assumptions of the tests are met.

If normality is not met, the data will be log-transformed and retested for normality. If the transformed data fit a normal distribution, the original data will be accepted as having log-normal distribution. If normality is still not found, two courses may be taken. One is to continue to test the fit to standard families of distributions, such as the gamma, beta, and Weibull, with proper modifications to subsequent analyses based on these results. The other course is to use nonparametric methods of data analysis.

For data sets smaller than ten, but homogeneous and complete, the log-normal distribution is assumed. Data sets with more than ten percent missing data are analyzed using nonparametric methods. Nonhomogeneous data sets are subdivided into homogeneous sets and each of these analyzed individually.

Descriptive statistics are calculated for each homogeneous data set. At a minimum, these include a central value and a range of variation. The central value is the arithmetic mean of the untransformed data if the data are not censored at either end. If the data are censored, either a trimmed mean or the median is used as the central value (which may be within the censored range). If the data set is greater than ten and is uncensored, the standard deviation is calculated and used as a basis for the reported range in variation. If these criteria are not met, the range between the 0.25 and 0.75 quartiles is used.

Data Anomalies

Data anomalies include data points reported as being below the limit of detection (LD) or otherwise censored over a specific range of values, missing data points occurring randomly in the data set, and outliers which cannot be ascribed to a known source of variation.

Whenever possible, values which are below detection limits are obtained and incorporated into the data base for statistical analysis. When values are not available, alternative methods of analysis, as described in previous sections, are used. In particular, the use of nonparametric statistics is required.

Missing data points comprising less than 10 percent of the data set do not affect data analyses. Results based on data in which more than 10 percent is missing are identified as such at the time of reporting. Consideration of the potential effect of missing data must be made when the majority of the data are missing from a discrete time span.

An outlier is defined as any data point occurring in either extreme upper or lower range of the data distribution for which there is less than 0.01 probability of occurrence. For normally distributed data, this is roughly 2.3 or more standard deviations above or below the mean. When no probability model is identified, outliers may only be found through visual inspection of the data.

If an outside source of variation is not identified to account for outliers in a data set, it is included in the data set and all subsequent analyses. If the inclusion of such outliers is found to affect the final results of the analyses significantly, both results (with and without outliers) are reported.

Comparisons and Reporting

Comparisons between data sets are performed using standard statistical tests. The selection of the specific test is dependent upon the relative power of the test and the degree to which the underlying requirements of the test are met. In addition to tests comparing data from distinct locations and times, trend analyses are performed on time series where sufficient data exist. A 95 percent confidence level will be used for the final interpretation of results.

Citation of the source of the test method or the software used to perform the tests will be made when results are reported. Data and subsequent calculated values are reported in the annual site environmental report in accordance with standard rules for significant figures.

D-10d(1)(b) Ground-Control Program

The ground-control program at the WIPP facility involves a very methodical approach to ensure that the underground is safe from any unplanned roof or rib falls. From the moment an excavation is mined and throughout the life of the opening, care is taken to remove or restrain any loose, unsafe pieces of ground. As the opening ages, areas of the roof, ribs, and floor may become unstable. To prevent this from occurring, a very comprehensive ground control monitoring and support system has been implemented.

D-10d(1)(b)(i) Ground Control Description

There are two major categories for the support systems: rock-bolt and supplementary. The rock-bolt systems are mechanically anchored bolts and resin-anchored threaded bar. The supplementary systems include cable with mesh, truss, and the design of Room 1, Panel 1.

The fundamentals on which the ground-control program at the WIPP facility are based are as follows:

- Ground stability is maintained as long as access is possible.
- 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 approach used in the ground-control program at the WIPP facility utilizes experience gained from observation and analysis of salt behavior underground. This experience allows various projections to be made regarding future ground-support requirements.

One of the key elements incorporated into this approach is that salt moves, or creeps. Because of its plastic nature, salt tends to flow into an excavated opening. Ground-support systems cannot resist salt creep, so in order to provide long-term support, the ground-control system must be able to accommodate the continuous creep of salt and to restrain broken or fractured rock in the roof.

As more information becomes available regarding the long-term behavior of the WIPP underground excavations, the ground-control maintenance plan will be revised accordingly. The long-term plans are, therefore, flexible enough to accommodate changes. The ground-control plan is regularly reviewed and revised as iterative, periodic evaluations are performed.

Initial Roof Support System (Rock-Bolt System)

Prior to waste emplacement in any specific area (room), the plans (for Panels 2-8) are to spot bolt with short, mechanically anchored bolts only as necessary, if spalls or loose ground are encountered during and after the mining process. Mesh may be used in conjunction with these bolts to secure any loose ground encountered during normal inspection processes. These bolts would not penetrate through to the next clay/anhydrite interface and would be anchored within the beam formed by the mine roof and the clay/anhydrite interface above. This is the primary or initial support which will be used in Panels 2-8.

As deteriorating ground conditions require, pattern bolting may commence at any time after excavation. However, based on experience with the SPDV rooms and the rooms in Panel 1, pattern bolting is not expected to be required until 2-5 years after excavation. Disposal rooms may be pattern bolted prior to waste emplacement. The expert panel convened to study Panel 1 in 1991 concluded that the then current support technology of 10 ft long mechanical bolt used in Panel 1 should be adequate to ensure stability for 7 to 11 years from the time of excavation. These bolts were installed beginning approximately two years after initial excavation on a pattern described as a 5 ft by 5 ft (1.5 m x 1.5 m) offset pattern (one bolt per 25 ft^2

[2.3 m^2]). Experience in Panel 1 confirms the conclusion of the expert panel. Plans call for bolt systems installed in future bolt patterns to be equal to or exceed the bearing characteristics of the mechanically anchored bolts used in the primary pattern in Panel 1.

Rigid support systems are currently available which provide superior load bearing capacity and ductility compared to mechanically anchored bolts. These include threaded bars (e.g. DSI or Williams manufacture) and cable bolts (e.g. Rocky Mountain Bolt or Jenmar manufacture). In addition, several yielding systems are now available which also provide superior load bearing capacities and have yielding capabilities in ranges exceeding one foot. These include yielding cable bolts (e.g. Rocky Mountain Bolt or Western Support Systems manufacture) and slip nut systems (e.g. DSI manufacture). The system judged best, which is available at the time a need for pattern bolting is identified, will be used in Panels 2-8. In all cases bolts will be located no more than 5 ft (1.5 m) apart (one bolt per 25 ft^2 [2.3 m^2]) in the center half of a room (8.25 ft [2.5 m] each side of centerline) where the potential for a detaching wedge exists. The pattern support in the center half of the room will be anchored above the first clay/anhydrite interface. Pattern support near the ribs will be capable of supporting spalls or fractured ground typically found near ribs, but is not expected to penetrate the first clay/anhydrite interface. Mesh may be used to control small pieces of broken rock.

The justification for choosing these systems includes their demonstrated ability to support the expected loads. In the case of yielding systems, they will be chosen based on their support capabilities and the ability to accommodate expected rock deformation.

Primary support will consist of Grade 75 steel mechanically anchored bolts of at least 5/8 in. (1.6 cm) diameter. Depending on the need, the bolts may be as short as 24 in. (61 cm) and as long as 72 in. (183 cm). Mesh may be chain-link, welded wire, or polymer.

Pattern bolting will be designed using the best support technology available at the time. Because yielding systems are still under evaluation, current plans call for use of Grade 60 threaded bars of at least 7/8 in. (2.2 cm) diameter installed on a maximum 5 ft by 5 ft (1.5 m x 1.5 m) pattern in the center half of the room. The bars would be resin anchored above the first clay/anhydrite interface. Four or 6 ft long mechanical bolts would be used near the ribs.

Materials procured for installation as primary support, spot bolting, and pattern support will meet the requirements of 30 CFR 57, Subpart B. This requirement will be verified as part of the quality assurance program. Primary support installation requires quality control by the installation crews. Proper installation is confirmed as part of the audit function of the underground safety and Quality Assurance groups. Quality control and assurance is more rigorous during a pattern bolting sequence. Work instructions for the sequence will require Quality Assurance to perform at least one random inspection to verify material requirements and hole construction specifications are met. Operations (construction) supervisors will also be responsible for monitoring the construction. Finally, before turnover or completion of the installation, Quality Assurance will review the work and certify their approval. Independently, MSHA inspectors also perform a Quality Assurance function during their frequent inspection visits to the WIPP, making certain that support construction is performed in accordance with 30 CFR 57, Subpart B.

Supplementary Support Systems

Similar to the plan for pattern bolting, any supplementary system will be designed using the best support technology available at the time. Should a supplementary support system be required, it is anticipated that, if not already in place, mesh will be installed over primary and pattern support. The mesh will be augmented either by cables (wire ropes) anchored near the ribs and suspended across the rooms or by steel mats. The cables or mats and, therefore, the mesh, will be further pinned to the roof by bolting. The use of either the cables or mats in conjunction with meshing and rebolting should be adequate in supporting even a highly fractured roof beam.

A cable system similar to others previously constructed at the WIPP can be utilized as supplementary support. It is constructed as follows. First, welded wire mesh is installed on the roof. Then the cables are installed by looping a cable (e.g. 5/8 in. (1.6 cm) wire rope 6x25 FW EIPS RRL IWRC) through cable shoes (e.g. Jenmar or Western Support Systems manufacture) located across a room or drift near each rib. The cable ends are then clipped together using cable thimbles to form a continuous loop equivalent to two single cable runs between the shoes. Then the shoes are adjusted to remove all slack from the cable. Finally, a row of bolts is installed between the two cables (inside the loop) with bearing plates over the cables to tie the system together. The cables are typically slung between existing rows of bolts. Therefore, cable slings would typically be no further than 5 ft (1.5 m) from each other. Bolts would be of like construction as those which will be used in pattern bolting and would be no further than 5 ft (1.5 m) apart. In areas where the potential for a ground fall extended to the clay/anhydrite interface, anchorage would necessarily be in the competent ground above.

Mats (e.g. Rocky Mountain Bolt, Western Support Systems, Jenmar manufacture) could be used in a similar manner. Welded wire mesh could be installed with mats placed over the mesh and bolted in place. Placement of the mats would be the same as the cable slings, across the entry splitting the existing support. The mats would be bolted through and held in place, tying the system together.

Support System Performance

Several distinct ground-support systems are installed in Panel 1. They can be generally grouped as rigid, non-yielding systems and yielding systems. Rigid, non-yielding systems are not designed to accommodate salt creep. However, they do respond to creep and continue to provide support during ductile behavior. Based on experience with Panel 1, if Panels 2-8 are excavated and filled within five to seven years each, these non-yielding systems should provide the necessary support. If pattern bolting is performed just prior to waste emplacement in each room or area, experience at the WIPP has shown that these rigid systems can certainly accommodate the salt creep that will occur during the one to two years of emplacement.

The ground support system installed in Room 1 Panel 1 is a yielding system only as long as access can be maintained. This is because of the necessity to manually detention the bolts. If the detensioning process is stopped, the system becomes a rigid, non-yielding system and will undergo the same ductile behavior as other rigid systems.

Other yielding systems are installed in the WIPP underground and each is still being evaluated. Each of these systems is designed to yield at predetermined loads. All are designed to work over their prescribed yield interval without maintenance. Some of the systems are designed to respond to the loading by salt creep and provide over one foot of yield without system degradation. A detailed evaluation of the adequacy of these systems is not possible at this time.

D-10d(1)(b)(ii) Panel 1 Ground Control Experience

The roof-support history of Panel 1 is important, because information on the age of the openings and when the ground support was installed is vital to making predictions about future ground-support requirements. The following describes the major events in Panel 1:

- Panel 1 was excavated in 1986-1988.
- Panel 1 was pattern-bolted in 1988-1989.
- Room 1 support system was installed for bin tests in 1991.
- Room 2 support system (variation of Room 1) was installed in 1991.
- Room 7 was rebolted in 1993.
- S-1600 drift was rebolted in 1994.

Based on experience and various monitoring activities, ground-support needs have been identified for Panel 1 as follows:

- Openings maintenance
- Ground-control system testing

Ground stability of Panel 1 is closely monitored, and all issues associated with the use of Panel 1 are reviewed at least annually.

D-10d(1)(c) Geomechanical Monitoring

The geomechanical monitoring program at the WIPP facility is an integral part of the ground-control program (See Figure D-40). HWMUs, drifts, and geomechanical test rooms will be monitored to provide confirmation of structural integrity. Geomechanical data on the performance of the repository shafts and excavated areas are collected as part of the geotechnical field-monitoring program. The results of the geotechnical investigations are reported annually. The report describes monitoring programs and geomechanical data collected during the previous year.

D-10d(1)(c)(i) Description of the Geomechanical Monitoring System

The Geomechanical Monitoring System (GMS) provides in situ data to support the continuous assessment of the design for underground facilities. Specifically, the GMS provides for:

- Early detection of conditions that could affect operational safety
- Evaluation of disposal room closure that ensures adequate access
- Guidance for design modifications and remedial actions
- Data for interpreting the behavior of underground openings, in comparison with established design criteria

The instrumentation in Table D-9 is available for use in support of the geomechanical program.

The minimum instrumentation for Panels 2 through 8 is one borehole extensometer installed in the roof at the center of each disposal room. The roof extensometers will monitor the dilation of the immediate salt roof beam and possible bed separations along clay seams. Additional instrumentation may be installed as conditions warrant.

Remote polling of the geomechanical instrumentation will be performed at least once every month. This frequency may be increased to accommodate any changes that may develop.

The results from the remotely read instrumentation will be evaluated after each scheduled polling. Documentation of the results will be provided annually in the Geotechnical Analysis Report.

Data from remotely read instrumentation are maintained as part of a geotechnical instrumentation system. The instrumentation system provides for data maintenance, retrieval, and presentation. The instrumentation system's cognizant engineer first retrieves the data from the instrumentation system and verifies their accuracy by assuring the measurements were taken in accordance with applicable instructions and that equipment calibration is known. Next, the cognizant engineer reviews the data after each polling to assess the performance of the instrument and of the excavation. Data which look anomalous are detected during this polling and are investigated to determine the cause (instrumentation problem, error in recording, changing rock conditions). The data are then processed to calculate various parameters such as the change between successive readings and deformation rates. The results of this assessment are reported to the cognizant ground control engineer and operations personnel. Unexpected deformation rates are investigated by Geotechnical Engineering to determine if remediation is needed.

The stability of an open panel excavation is generally determined by the rock deformation rate. The excavation may be considered unstable when there is a continuous increase in the deformation rate that cannot be controlled by the installed support system. The evaluation of the performance of the excavation is performed by Geotechnical Engineering. These evaluations will provide an assessment of the effectiveness of the roof support system and an estimate of the stand-up time of the excavation. If the trend is toward adverse (unstable) conditions then the results of these assessments are reported to the Operations Manager to determine if it is necessary to terminate waste disposal activities in the open panel.

D-10d(1)(c)(ii) System Experience

Much experience in the use of geomechanical instrumentation was gained as the result of performance monitoring of Panel 1, which began at the time of completion of the panel excavation in 1988. The monitoring system installed at that time involved simple measurements and observations (e.g., vertical and horizontal convergence rates, and visual inspections). Minimal maintenance of instrumentation is required, and the instrumentation is easily replaced if it malfunctions. Conditions throughout Panel 1 are well known. The monitoring program continues to provide data to compare the performance of Panel 1 with that established elsewhere in the underground. Panel 1 performance is characterized by the following:

- The development of bed separations and lateral shifts at the interfaces of the salt and the clays underlying the anhydrites "a" and "b."
- Room closures. A closure due only to the roof movement will be separated from the total closure.
- The behavior of the pillars.
- Fracture development in the roof and floor.
- Distribution of load on the support system.

Roof conditions are assessed from observation boreholes and extensometer measurements. Measurements of room closure, rock displacements, and observations of fracture development in the immediate roof beam are made and used to evaluate the performance of a panel. A description of the Panel 1 monitoring program was presented to the members of the Geotechnical Experts Panel (in 1991) who concurred that it was adequate to determine deterioration within the rooms and that it could provide early warning of deteriorating conditions.

The assessment and evaluation of the condition of WIPP excavations is an interactive, continuous process using the data from the monitoring programs. Criteria for corrective action are continually reevaluated and reassessed based on total performance to date. Actions taken are based on these analyses and planned utilization of the excavation. Because WIPP

excavations are in a natural geologic medium, there is inherent variability from point to point. The principle adopted is to anticipate potential ground control requirements and implement them in a timely manner rather than to wait until a need arises.

D-10d(1)(d) Environmental Monitoring Program

Establishment of environmental monitoring baselines for both radiological and nonradiological parameters was completed by compilation and publication of the baseline reports. These programs have been transitioned into the disposal phase. Pertinent data collection continues and is planned through the life of the project.

Historically, the Radiological Baseline Program and the Ecological Monitoring Program quantified environmental parameters of interest to the facility. These two programs, originating in 1985, have established the baseline of parameters against which future operational sampling programs will be evaluated. The final baseline reports are published as appendices in the Waste Isolation Pilot Plant Site Environmental Report for Calendar Year 1991 (Westinghouse, 1992).

Currently, an environmental monitoring program (see Appendix D5) is underway and is designed to detect hazardous chemical releases or increased radiological levels in the environment and to assess trends in environmental parameters that may be the result of WIPP Facility Operations. Radiological monitoring elements are described in the permit application for information only and comply with current DOE monitoring program requirements and objectives. Annual reports will be compiled with monitoring data and analyses during the Disposal Phase.

An assessment of the potential dose to the public will be made annually based on a statistical analysis of the results of the ongoing radiological monitoring programs. This annual assessment of the WIPP operation's contribution to the public dose will be presented in future site environmental reports. An example of the report is provided as Appendix D4.

D-10d(1)(d)(i) Air Monitoring

DOE Orders require the monitoring of potential sources of radioactive airborne emissions and also require that these monitoring programs be adequate to demonstrate compliance with applicable radiation dose limits for the protection of the public and the environment, such as those specified by the National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61, Subpart H). Analysis in the WIPP SAR (DOE, 1995) demonstrates that expected radiation doses are less than one percent of the NESHAPs dose limit. Therefore, monitoring is not required.

D-10d(1)(d)(ii) Aerosol Sampling Program

The WIPP has established an aerosol sampling program for determination of releases of radionuclides. Continuous aerosol samplers operate at seven locations, three within 3,280 ft (1,000 m) of the Site Boundary, three at local ranches and communities, and one at a

sample control site. The filters from these continuous air samplers are collected on a weekly basis and subsequently analyzed. The results of these analyses and a detailed description of the current programs are provided in Appendix D4.

D-10d(1)(d)(iii) Ambient Radiation Monitoring

The ambient radiation monitoring program, designed to monitor low levels of gamma radiation in the environment, employs a Reuter-Stokes high-pressure ionization chamber. This instrument is located at the WIPP Far-Field location, 3,280 ft (1,000 m) northwest (the principal downwind direction) of the Exhaust Shaft. This system has been used to establish baseline parameters for the WIPP facility. The results of the current monitoring program are presented in Appendix D4.

D-10d(1)(d)(iv) Radiological Soil Monitoring

Radiological soil monitoring has been implemented to establish baseline parameters. Samples have been collected and analyzed from a total of 37 locations within a 50 mi (80 km) radius of the WIPP facility. At each location, samples from three depths have been collected and either analyzed for 19 different radionuclides or archived for future reference.

The sampling activities have been divided into three geographic areas. These include the WIPP site group, which has the smallest scale and consists of eight locations at the cardinal compass directions from the center of the Property Protection Area. Because of the proximity to the WIPP facility, this group is perhaps of the most interest in identifying potential radiological releases from operations. The next area is the Five Mile Ring, at a radius of approximately 5 mi (8 km) from the center of the Property Protection Area with 16 locations. The last area is the Outer Sites, with 13 locations representing a variety of habitats, soil types, and land uses in southeastern New Mexico. The data and analytical results from each of these sampling locations have been presented in the Statistical Summary of the Radiological Baseline Program for the Waste Isolation Pilot Plant (in Westinghouse, 1992).

D-10d(1)(d)(v) Hydrologic Radioactivity Monitoring

The hydrologic radioactivity monitoring program has been designed to measure characteristic radiological levels in surface-water bodies, bottom sediments, and groundwater. Water samples have been collected and analyzed for 18 different radionuclides. The resulting data from the surface-water and groundwater sampling programs have been analyzed independently. Bottom sediments have been analyzed for 17 different radionuclides. The baseline results of these programs were presented in the Statistical Summary of the Radiological Baseline Program for the Waste Isolation Pilot Plant, (in Westinghouse, 1992).

D-10d(1)(d)(vi) Surface-Water and Sediment Monitoring

Much like the soil-sampling programs, the surface-water and sediment-monitoring programs serve as measures of confirmatory monitoring for the detection of atmospheric radionuclide releases. As a release to the atmosphere is the only release scenario considered credible for the operational life of the facility, data are compared to the previously established baseline. During the Disposal Phase, statistically significant changes will be studied to evaluate if the WIPP programs are a contributor to an increase in the radionuclides detected.

Because of the absence of surface waters in the vicinity of the WIPP facility, the geographic sampling group that could provide the data of most interest is the stock tanks. These are typically man-made catchment basins, five of which were chosen because of their location with respect to the WIPP facility. In addition to these five stock tanks, the WIPP effluent water (sewage lagoons) and influent water have been sampled and analyzed annually. The results are provided in Appendix D4.

D-10d(1)(d)(vii) Groundwater Characterization

All groundwater samples have been collected in accordance with DOE's Water Quality Sampling Program (WQSP) for the WIPP (Westinghouse, 1990). The primary objective to date has been to obtain representative and repeatable groundwater-quality data from selected wells under rigorous field and laboratory procedures and protocols. These procedures delineate the field programs that must be followed to ensure that all samples collected during any given period are comparable to previous sampling rounds.

The primary water-bearing units being evaluated by the WQSP have been the Culebra and the Magenta members of the Rustler. Background measurements are summarized in Appendix D17. These are currently being supplemented with background measurements from the seven new WQSP wells. In addition to the sampling in these formations, several wells that lie in the Dewey Lake have been sampled. The DOE intends to continue the groundwater surveillance program in accordance with the plan included in Appendix D18.

D-10d(1)(d)(viii) Biotic Radioactivity Surveillance

The biotic radioactivity surveillance program has characterized radiological levels in key organisms along possible food-chain pathways to man. Vegetation, rabbits, quail, beef, and fish have been sampled, and palatable tissues have been analyzed for concentrations of transuranics and common naturally occurring radionuclides.

D-10d(1)(d)(ix) Nonradiological Environmental Surveillance

The Nonradiological Environmental Surveillance (NES) programs were preceded by the WIPP biology programs (1975-1982), which combined scientific and technical expertise from six

universities to develop an extensive baseline of information describing the major components of the Los Medaños ecosystem prior to the initiation of WIPP construction activities. The principal functions of the NES have been:

- To detect and quantify the impacts of construction and operational activities at the WIPP on the surrounding ecosystem
- To continue the development of the ecological database for the Los Medaños area that was initiated by the WIPP biology program
- To investigate unusual or unexpected elements in the ecological databases
- To provide environmental data that are important to the mission of the WIPP Project but which have not or will not be acquired by other programs

Ecological monitoring has included five specific programs: 1) meteorological monitoring, 2) air-quality monitoring, 3) water-quality monitoring, 4) wildlife-population monitoring, and 5) surface-disturbance monitoring through the analysis of aerial photographs.

In addition to the ecological monitoring programs, the WIPP program has also conducted salt-impact studies, which consist of soil chemistry, soil microbial activity, and vegetation. The primary function of these studies has been to determine the impacts on the surrounding environment from the movement and storage of salt that results from the mining activities.

Like the radiological programs, the results of the ecological monitoring and the salt studies have been published in the Annual Site Environmental Report (ASER) (Appendix D4). The statistical baseline for all of the areas has been compiled and was published in the Statistical Summary of the Radiological Baseline Program for the Waste Isolation Pilot Plant (Westinghouse, 1992).

D-10d(1)(d)(x) Meteorological Monitoring

The primary purpose for on-site meteorological monitoring has been to provide the capability for assessing the impact of an accidental release using real-time data. Data are obtained from a meteorological station located just beyond the northeast corner of the Property Protection Area. The station includes measurements of wind speed, wind direction, and temperatures at 10, 33, and 131 ft (3, 10, and 40 m), respectively, and measures dew point and precipitation. These parameters are continuously measured, and the data are monitored real-time in the CMR and stored in the Central Monitoring System.

In addition to the meteorological monitoring station, the WIPP operates an atmospheric monitoring station that measures and records temperature and barometric pressure at 5 ft (1.5 m), with wind speed and wind direction measured at 33 ft (10 m) (Westinghouse, 1992).

D-10d(1)(d)(xi) Water-Quality Monitoring

The water-quality monitoring program has been conducted in conjunction with the hydrologic radioactivity monitoring as part of the WQSP. In accordance with the WQSP, groundwater samples have been collected from wells drilled and completed specifically for the WIPP studies. The program has been operational since January 1985, and groundwater-quality data generated since this time were used to establish the WIPP water-quality background characterization.

As a part of the environmental monitoring program, the WQSP has provided water-quality data on key environmental parameters for groundwater near the WIPP. Samples have been routinely analyzed for general chemical parameters, including metals and EPA-listed hazardous organic substances. The data collected by this program have been compiled and are presented in Appendix D17.

D-10d(1)(d)(xii) Wildlife-Population Monitoring

Population-density measurements of raptors, breeding birds, and small nocturnal mammals have been performed annually to assess the effects of WIPP activities on wildlife populations. Two permanent study plots adjacent to the WIPP facility have been used for each of these two classes of wildlife. The data from the study plots have been compared to two control plots to assess the effects of WIPP activities on wildlife populations.

Although not compiled as a baseline, the wildlife monitoring data have been presented on an annual basis in the ASER. Each year they have been compared to those of previous years and fluctuations in densities evaluated against a number of parameters.

D-10d(1)(d)(xiii) Aerial Monitoring

Aerial photographs of the WIPP have been taken and used to document surface disturbance, development, and reclamation activities at the WIPP and surrounding lands. This photography allows documentation of changes in the WIPP vicinity. Any unusual changes noted can be evaluated, and a determination can be made as to the cause and the potential role of WIPP activities in affecting these changes (See Appendix D5).

D-10d(1)(d)(xiv) Volatile Organic Compound Monitoring

The VOC monitoring program activities have focused on the air pathway since 1991. The airborne emission of VOCs is the only credible release pathway from the WIPP facility during disposal operations, and the final closure design basis requires this pathway to be eliminated upon final closure. With over two and one-half years of data, a credible basis for determining the WIPP's background levels of the targeted VOCs has been established.

The DOE has prepared a VOC monitoring plan which describes the aspects of a VOC monitoring strategy. The plan has been prepared so that the DOE can show that the assumptions and predictions used to demonstrate compliance to the environmental performance standards are valid. Validity is shown when observed emissions are equal to or less than those predicted. The VOC Confirmatory Monitoring Plan (VCMP) is provided in Appendix D20. The VCMP includes monitoring design, sampling and analysis procedures, and quality assurance objectives. This plan is submitted in compliance with 20 NMAC 4.1, Subpart V, §264.602 and §270.23(a)(2).

In this application, the DOE demonstrates the theoretical compliance with the environmental performance standards of 20 NMAC 4.1, Subpart V, §264.601(c). This VCMP describes a sampling and analysis program to confirm the theoretical calculations. The monitoring program is capable of quantifying VOC concentrations in the ambient mine air at the WIPP. The VCMP addresses the following information requirements:

- Rationale for the design of the monitoring program, based on possible pathways, operations, engineered and natural barriers, and monitoring locations optimized for detection.

- Descriptions of the specific elements of the monitoring program including the type of monitoring, the location of stations, the frequency of sampling, the target analytes, the schedule for implementation, the equipment used, the sampling and analytical techniques, and the data recording and reporting procedures.

The design of the VCMP used the results of background VOC monitoring activities at the WIPP. These data are presented in Appendix D21. These data represent the anticipated background levels of VOCs during operations at the WIPP.

The DOE's intent is to collect air samples upstream and down stream of Panel 1 beginning just prior to waste emplacement and proceeding until at least six months following completion of panel closure. The DOE will continue monitoring until the criterion for terminating monitoring are met. These criterion are established in Appendix D20 for each target analyte.

The current VOC monitoring program uses EPA Compendium Method TO-14. The DOE has had success with TO-14 at the WIPP if care is taken in placing samplers to avoid high dust and if stringent cleaning requirements are imposed for the clean canisters. This is necessary because of the extremely low concentrations that are being monitored. The DOE is evaluating the use of the Fourier Transform Infra-Red (FTIR) technique for monitoring VOCs at WIPP. This method is being used successfully at other locations and has recently been approved by the EPA for measuring the concentration of VOCs in the headspace gases of drums of TRU waste. If FTIR becomes viable, the monitoring plan will be revised and the revisions will be submitted to the NMED for approval prior to implementation.

The VCMP will be run under a Quality Assurance Plan that conforms to the document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations", (EPA 1994). Quality Assurance criteria for the target analytes are presented in Table D-10.

Definitions of these criteria are given in Appendix D20 along with a discussion of other aspects of the Quality Assurance Program including sample handling, calibration, analytical **procedures**, data reduction, validation and reporting, performance and system audits, preventive maintenance, and corrective actions.

D-10d(1)(d)(xv) Sampling Schedules

Tables D-11 and D-12 summarize typical environmental monitoring sampling and analysis schedules. The tables list the sample types, the number of sampling stations, the approximate sampling schedule, and the environmental/ecological parameters to be monitored or analyzed. Additional or different types of samples will be collected and analyzed as necessary to investigate and explain trends or anomalies that may have a bearing on the environmental impacts of the WIPP Project. The environmental monitoring program will be reviewed annually by WIPP facility personnel. The scope and intensity of the program will be adjusted in response to changing facility processes, environmental parameters, and program results.

Sampling and related activities (record keeping, packaging, and shipping) will be conducted in accordance with written procedures and instructions. Upon request, the State of New Mexico may obtain duplicate samples for independent verification of the DOE environmental surveillance program. Quality assurance/quality control will be established within the framework of the WIPP Quality Assurance Program.

D-10d(2) Inspection

As required in 20 NMAC 4.1, Subpart V, §§264.15 and 264.33, the WIPP facility and systems are inspected on a regular basis and in accordance with written procedures to assure their integrity, maintenance, and safe operation. Inspections focus on identifying malfunctions, signs of deterioration, operator errors, and discharges or spills. Inspections are undertaken on a regular schedule based on the likelihood of component failure and associated consequences.

Chapter F of this permit application describes the inspection program at the WIPP facility. Monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment related to TRU mixed waste management activities will be inspected to ensure that human health and the environment will be protected.

D-10d(3) Reporting

D-10d(3)(a) Biennial Report

In accordance with 20 NMAC 4.1, Subpart V, §264.75, a biennial report on facility activities will be prepared and submitted to the Secretary of the NMED and to the EPA Region 6 Administrator. The report will be prepared and submitted to cover facility activities during the previous two years. The EPA identification number and the name and address of the facility will be included in the report. A description and the quantity of each RCRA-regulated TRU mixed

waste received at the facility will be listed by the EPA identification number of each TRU mixed waste generator from whom the WIPP facility received the TRU mixed waste. The report will also describe both the efforts undertaken at the WIPP facility during the reporting period to reduce the volume and toxicity of hazardous waste generated on site and the effectiveness of those efforts in comparison with prior years. Reports will be submitted in even numbered years by March 1 of that year.

D-10d(3)(b) Unmanifested Waste Report

The WIPP facility will not accept unmanifested hazardous waste. All TRU mixed waste shipments will be accompanied by a hazardous waste manifest that satisfies all the requirements of 20 NMAC 4.1, Subpart V, Manifest System, Recordkeeping, and Reporting. The manifest will be reviewed upon receipt of the shipment. Discrepancies in the hazardous waste manifest will be resolved with generators before TRU mixed waste will be emplaced. If discrepancies cannot be resolved within 30 working days the DOE will return the waste to the generator site.

D-10d(3)(c) Additional Reports

In compliance with 20 NMAC 4.1, Subpart V, §264.56(j), and 20 NMAC 4.1, Subpart VI, §265.56(j), any release, fire, explosion, or other unusual occurrence that results in the implementation of the contingency plan will be noted in the WIPP facility operating record and will be reported in writing within 15 days to the Secretary of the NMED and the Administrator, EPA Region 6. Details of unusual occurrence reporting, as required by the DOE, are in Chapter G of this permit application.

Final closure of the site will be reported within 60 days of completion, in accordance with 20 NMAC 4.1, Subpart V, §264.115, and as described in the WIPP Closure Plan (Chapter I of this permit application).

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TABLES

TABLE D-1
LIST OF DRAWINGS IN APPENDIX D3, DETAILED PLANS AND DRAWINGS

Drawing Number[1]	Title
23-C-001-022	Project Location Maps
24-C-022-W	WIPP Site Facility Master Plan
24-C-028-W1	WIPP Site Finish Grading and Paving
24-C-028-W2	Site Work Finish Grading and Paving - Sections and Details
25-J-020-W6	WIPP Site Primary Power Distribution - One Line Selected Load System Interrupter Lineup Surface and Underground
41-F-087-014	Waste Handling Building 411, Firewater Collection System, Flow Diagram
41-S-003-W1	Waste Handling Building 411, Fire Protection Sprinkler System P&ID
41-S-003-W2	Waste Handling Building 411, Fire Protection Sprinkler System P&ID
41-S-003-W3	Waste Handling Building 411, Fire Protection Sprinkler System P&ID
41-S-003-W4	Waste Handling Building 411, Fire Protection Sprinkler System P&ID
53-J-039-W	Underground Utilities, Fire Panel 534-FP-0320 (Panel Area)
53-J-042-W	Underground Utilities, Fire Panel 534-FP-00601 (Waste Shaft Area)
41-E-003-014	Waste Handling Building No. 411, Architectural, C.H. Area-Plan at El. 100'0"
41-E-005-014	Waste Handling Building No. 411, Architectural, RH Area - Plan at El. 100'-0"
41-E-006-014	Waste Handling Building No. 411, Architectural, Mech. Equip. Rm. Plan at El. 123'-0"
41-E-063-014	Waste Handling Building 411, Architectural, Plans at Tower
41-M-001-W	Waste Handling Facilities TRUPACT Dock Equipment Arrangement
41-B-010-W1	Waste Handling Building 411, CH Area HVAC Flow Diagram
41-F-021-014	Waste Handling Bldg 411, RH Area HVAC Flow Diagram
41-F-033-014	Waste Handling Bldg 411, Miscellaneous HVAC Flow Diagram
31-R-001-01D	Waste Shaft 311, Shaft Development Sections
31-R-002-01D	Waste Shaft 311, Shaft Lining and Key Section and Details
165-F-001-W	TRUPACT II Standard Waste Box Assembly
54-W-001-W	Underground Mine, Ventilation System
54-W-009-W	Underground Mine Plan, Shaft and Drift Dimensions
73-E-001-W1	Underground Utilities, Plant Communications Evacuation Warning Layout Arrangement
73-J-010-W1	Underground Utilities Public Address System Arrangement
73-J-011-W1	Underground Utilities Plant Communications Mine Page Phones Plan View
73-J-411-W1	Waste Handling Building 411, First Floor EL 100'-0" Plant Communications Arrangement
73-J-411-W2	Waste Handling Building 411, EL 123'-0" and Above, Plant Communications Arrangement
51-W-214-W	Underground Facilities Typical Disposal Panel

[1]The most current version available at the time of permit application submittal will be contained in Appendix D3.

TABLE D-2
AVERAGE-STOICHIOMETRY GAS GENERATION MODEL PARAMETER VALUES

Parameter (units)	Values Used in Calculation[a]
Inundated Corrosion Rate for Steel without CO_2 Present (m/s)	7.94×10^{-15}
Inundated Corrosion Rate for Steel with CO_2 Present (m/s)	1.03×10^{-13}
Humid Corrosion Rate for Steel	0
Gas Generation Rate for Microbial Degradation Under Humid Conditions (mol/kg * s)	6.34×10^{-10}
Gas Generation Rate for Microbial Degradation under Brine-Inundated Conditions (mol/kg * s)	4.92×10^{-9}
Factor β for Microbial Reaction Rates (unitless)	0.5
Anoxic Corrosion Stoichiometric Factor X (unitless)	1.0
Average Density of Cellulosics in CH Waste (kg/m^3)	54.0
Average Density of Cellulosics in RH Waste (kg/m^3)	17.0
Average Density of Iron-Based Materials in CH Waste (kg/m^3)	170.0
Average Density of Iron-Based Materials in RH Waste (kg/m^3)	100.0
Average Density of Plastics in CH Waste (kg/m^3)	34.0
Average Density of Plastics in RH Waste (kg/m^3)	15.0
Average Density of Rubber in CH Waste (kg/m^3)	10.0
Average Density of Rubber in RH Waste (kg/m^3)	3.3
Bulk Density of Iron Containers, CH Waste (kg/m^3)	139.0
Bulk Density of Iron Containers, RH Waste (kg/m^3)	2.59×10^3
Bulk Density of Plastic Liners, CH Waste (kg/m^3)	26.0
Bulk Density of Plastic Liners, RH Waste (kg/m^3)	3.1
BIR Total Volume of RH Waste (m^3)	7.08×10^3
BIR Total Volume of CH Waste (m^3)	1.69×10^5
Wicking Saturation (unitless)	0.5

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, §D16-5.

TABLE D-3
SALADO FORMATION HALITE PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
Permeability (m^2)	3.16×10^{-23}
Effective Porosity (%)	1.0
Threshold Pressure, P_t (Pa)[b]	3.41×10^{7}
Residual Brine Saturation, S_{br} (unitless)[c]	0.3
Residual Gas Saturation, S_{gr} (unitless)[c]	0.2
Pore Distribution, λ (unitless)[c]	0.7
Maximum Capillary Pressure (Pa)	10^{8}
Rock Compressibility[d] (1/Pa)	9.75×10^{-11}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section D16-6.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model used in this simulation.

[d] Pore compressibility = Rock compressibility/effective porosity.

TABLE D-4
SALADO FORMATION ANHYDRITE INTERBEDS A AND B AND MARKER BEDS 138 AND 139 PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
Permeability (m^2)	1.29×10^{-19}
Effective Porosity (%)	1.1
Threshold Pressure, P_t (Pa)[b]	9.74×10^5
Residual Brine Saturation, S_{br} (unitless)[c]	0.084
Residual Gas Saturation, S_{gr} (unitless)[c]	0.077
Pore Distribution, λ (unitless)[c]	0.644
Maximum Capillary Pressure (Pa)	10^8
Rock Compressibility[d] (1/Pa)	8.26×10^{-11}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section D16-6.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model used in this simulation.

[d] Pore compressibility = Rock compressibility/effective porosity.

TABLE D-5
SHAFT MATERIALS PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
All Shaft Materials	
Residual Brine Saturation, S_{br} (unitless)[c]	0.2
Residual Gas Saturation, S_{gr} (unitless)[c]	0.2
Pore Distribution, λ (unitless)[c]	0.94
Maximum Capillary Pressure (Pa)	10^8
Clay Shaft Materials	
Permeability (m^2) - Rustler Compacted Clay (T = 0 - 10,000 yrs.)	5.00×10^{-19}
Permeability (m^2) - Upper Salado Compacted Clay (T = 0 - 10 yrs.)	7.65×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 10 - 25 yrs.)	5.02×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 25 - 50 yrs.)	3.02×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 50 - 100 yrs.)	1.16×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T > 100 yrs.)	5.00×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 0 - 10 yrs.)	9.32×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 10 - 25 yrs.)	1.74×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 25 - 50 yrs.)	7.07×10^{-19}
Permeability (m^2) - Lower Salado Compacted Clay (T > 50 yrs.)	5.00×10^{-19}
Permeability (m^2) - Bottom Clay (T = 0 - 10,000 yrs.)	5.00×10^{-19}
Thickness (m) - Rustler Compacted Clay	94.3
Thickness (m) - Upper Salado Compacted Clay	104.85
Thickness (m) - Lower Salado Compacted Clay	23.9
Thickness (m) - Bottom Clay	9.24
Effective Porosity (%) - Rustler Compacted Clay	24.0
Effective Porosity (%) - Upper and Lower Salado Compacted Clays and Bottom Clay	24.0
Threshold Pressure P_t (Pa) - All Clays[b]	2.0×10^5 to 1.20×10^6
Pore-Volume Compressibility (1/Pa) - Rustler Compacted Clay	1.96×10^{-9}
Pore-Volume Compressibility (1/Pa) - Upper Salado Compacted Clay	1.81×10^{-9}
Pore-Volume Compressibility (1/Pa) - Lower Salado Compacted Clay and Bottom Clay	1.59×10^{-9}
Salt Shaft Material	
Permeability (m^2) - Salt (T = 0 - 10 yrs.)	1.74×10^{-15}
Permeability (m^2) - Salt (T = 10 - 25 yrs.)	1.66×10^{-15}
Permeability (m^2) - Salt (T = 25 - 50 yrs.)	1.65×10^{-15}
Permeability (m^2) - Salt (T = 50 - 100 yrs.)	6.83×10^{-18}
Permeability (m^2) - Salt (T = 100 - 200 yrs.)	5.27×10^{-20}
Permeability (m^2) - Salt (T > 200 yrs.)	5.35×10^{-21}
Thickness (m) - Salt	171.37

TABLE D-5
SHAFT MATERIALS PARAMETER VALUES
(CONTINUED)

Parameter (units)	Value Used in Calculation[a]
Effective Porosity (%) - Salt	5.0
Threshold Pressure P_t (Pa) - Salt (T = 0 - 10 yrs.)[b]	7.16×10^4
Threshold Pressure P_t (Pa) - Salt (T = 10 - 25 yrs.)[b]	7.28×10^4
Threshold Pressure P_t (Pa) - Salt (T = 25 - 50 yrs.)[b]	7.29×10^4
Threshold Pressure P_t (Pa) - Salt (T = 50 - 100 yrs.)[b]	4.87×10^5
Threshold Pressure P_t (Pa) - Salt (T = 100 - 200 yrs.)[b]	2.62×10^6
Threshold Pressure P_t (Pa) - Salt (T > 200 yrs.)[b]	5.78×10^6
Pore-Volume Compressibility (1/Pa) - Salt	1.60×10^{-9}
Concrete Shaft Materials	
Permeability (m^2) - Concrete (T = 0 - 400 yrs.)	1.78×10^{-19}
Permeability (m^2) - Concrete (T > 400 yrs.) and Concrete Monolith (T = 0 - 10,000 yrs.)	10^{-14}
Thickness (m) - Concrete	45.72
Thickness (m) - Concrete Monolith	9.08
Effective Porosity (%)	5.00
Threshold Pressure P_t (Pa) - Concrete (T = 0 - 400 yrs.)[b]	1.72×10^6
Threshold Pressure P_t (Pa) - Concrete (T > 400 yrs.)[b] and Concrete Monolith (T = 0 - 10,000 yrs.)	3.91×10^4
Pore-Volume Compressibility (1/Pa) - Concrete and Concrete Monolith	2.64×10^{-9}
Asphalt Shaft Material	
Permeability (m^2) - (T = 0 - 10,000 yrs.)	1×10^{-20}
Thickness (m)	37.28
Effective Porosity (%)	1.00
Threshold Pressure P_t (Pa)[b]	0.00
Pore-Volume Compressibility (1/Pa)	2.97×10^{-8}
Earthen Fill Material Above Rustler	
Permeability (m^2) (T = 0 - 10,000 yrs.)	10^{-14}
Thickness (m)	165.06
Effective Porosity (%)	32.0
Threshold Pressure P_t (Pa)[b]	3.91×10^4
Maximum Capillary Pressure (Pa)	10^8
Pore-Volume Compressibility (1/Pa)	3.1×10^{-8}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section 16-8.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model is used in this simulation.

TABLE D-6
MAXIMUM ESTIMATED OCCUPATIONAL AND PUBLIC EXPOSURE FROM UNDERGROUND WASTE VOC EMISSIONS

Indicator Volatile Organic Compounds (ppmv)	Worker Receptor Concentration		OSHA 8 Hour TWA[b] (ppmv)	Estimated Risk for Carcinogens and Hazard Quotients for Non-Carcinogens for Public Exposure to Waste Emissions	Acceptable Level of Risk[f]
	Surface	Underground			
Carbon Tetrachloride	3.0E-04	1.2E-02	10	3E-08	1E-06
Chlorobenzene[a]	6.9E-04	2.9E-02	75	4E-06[e]	1
Chloroform	2.7E-04	1.0E-02	50[c]	2E-09	1E-06
1,1-Dichloroethylene	1.2E-03	4.7E-02	5[d]	2E-09	1E-05
1,2-Dichloroethane	3.8E-04	1.5E-01	100	8E-10	1E-06
Methylene Chloride	4.5E-03	1.6E-02	500	6E-10	1E-06
1,1,2,2-Tetrachloroethane	3.2E-04	1.3E-02	5	3E-09	1E-05
Toluene[a]	1.6E-03	6.7E-02	200	3E-07[e]	1
1,1,1-Trichloroethane	4.0E-03	1.6E-01	350	2E-08	1E-05

a. Non-Carcinogen (all others are class B2 or C carcinogens)
b. 8 hour time weighted averages (TWA) except for chloroform
c. TWA for up to a 10 hour day in a 40 hour workweek
d. TWA from ACGIH
e. Non-Carcinogen hazard quotient
f. Acceptable level of risk for carcinogens is the probability of developing cancer, and for non-carcinogens is a hazard quotient less than or equal to 1

TABLE D-7
BASIC DESIGN REQUIREMENTS, PRINCIPAL CODES, AND STANDARDS

	STRUCTURE/SUPPORTS			LIQUID AND PROCESS AIR HANDLING PROCESSING AND STORAGE EQUIPMENT							AIR HDLG DUCTING & FANS	HVAC FILTERS		MECHANICAL HANDLING EQUIPMENT			INSTRUMENTATION AND ELECTRICAL			QUALITY ASSURANCE PROGRAM	
					PIPING & VALVES																
	DBE DBT ACI-318 AISC	ANSI A58.1	SITE-SPECIFIC REQUIRE-MENTS	VESSEL ASME VIII NFPA[a]	ANSI B31,1 NFPA[a]	UPC	PUMPS API-610 NFPA[a]	STORAGE TANKS API-650 OR API-620	HEAT EXCHGRS ASME VIII TEMA	ALL OTHER EQUIPMENT MFRs STD	ARI SMACNA AMCA	PRE-FILTERS ASHRAE 52.68	HEPA FILTERS MIL F 51068C ANSI N 509 ANSI N 510	CRANE AND RELATED EQUIPMENT CMAA	CMAA AISC AWS	ALL OTHER EQUIP-MENT MFRs STD	IEEE-NE	ANSI STDS OR NAT'L ELEC-TRICAL CODE	ISA/ MFRs STD	ANSI/ASME NQA-1 AND SUPPLE-MENTS	COMM. AND INDUSTRY PRACTICES
DESIGN CLASS I	X		a	X f			X	X	X		X c	X c,d	X c	X	X		X	X		X	
DESIGN CLASS II	a,b	X	a	X	X		X	X	X		X c	X c	X c	X	X			X	X	X	
DESIGN CLASS IIIA	a	X	a	a	X		a			X	X c	X c	X c	a	a	X		X	X	X	
DESIGN CLASS IIIB		X	g		a	X				X	X	X	X			X		X	X		X

X = Minimum Requirements
[a]Requirements to be determined on a case-by-case basis.
[b]Required for structure and supports needed for confinement and control of radioactivity.
[c]Except structures and supports that are designed to withstand a design-basis earthquake (DBE)/design-basis tornado (DBT) when specified in column 1 of this table.
[d]Underwriter's Laboratory (UL) Class I Listed.
[e]For fire-protection systems.
[f]American Society for Mechanical Engineers (ASME) III for other Class I vessels.
[g]Design of underground structures, mining equipment, and facilities are basically governed by the MSHA and experience in local mines.

ACI = American Concrete Institute
AISC = American Institute of Steel Construction
AMCA = Air Moving and Conditioning Association
ANSI = American National Standards Institute
API = American Petroleum Institute
ARI = Air Conditioning and Refrigeration Institute
ASHRAE = American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.
ASME = American Society of Mechanical Engineers
AWS = American Welding Society
CMAA = Crane Manufacturers Association
DBE = Design-basis earthquake
DBT = Design-basis tornado
HEPA = High-efficiency particulate air
HVAC = Heating, Ventilation, and Air-Conditioning
IEEE = Institute of Electronics and Electronic Engineers
ISA = Instrument Society of America
MFR = Manufacturer
MIL = Military (specification)
MSHA = Mine Safety and Health Administration
NFPA = National Fire Protection Association
NQA = Nuclear Quality Assurance (Standard)
SMACNA = Sheet Metal and Air Conditioning Contractors National Association, Inc.
STD = Standard
TEMA = Tubular Exchanger Manufacturers Association
UPC = Uniform Plumbing Code

TABLE D-8
WASTE HANDLING EQUIPMENT CAPACITIES

CAPACITIES FOR EQUIPMENT	
CH Bay overhead bridge crane	10,000 lbs.
CH Bay forklifts	26,000 lbs.
Facility Pallet	25,000 lbs.
Conveyance Loading Car	36,000 lbs.
Underground transporter	28,000 lbs.
Underground forklift	6 tons
RH bay bridge crane	140 tons
Road cask transfer car	25 tons
Facility cask rotation fixture	no specific load rating.
Grapple Hoist	6.25 tons
Hot cell crane	15 tons
Cask handling forklift	41 tons
Horizontal Emplacement Equipment handling forklift	20 tons
Adjustable center-of-gravity lift fixture	5 tons
MAXIMUM GROSS WEIGHTS OF CONTAINERS	
Seven-pack of 55-gallon drums	7,000 lbs.
Four-pack of 85-gallon drums	4,500 lbs.
Ten-drum overpack	7,000 lbs.
Standard waste box	4,000 lbs.
RH Canister	8,000 lbs.
Over packed RH Canister	10,000 lbs.
MAXIMUM NET EMPTY WEIGHTS OF EQUIPMENT	
TRUPACT-II	13,140 lbs.
Adjustable center of gravity lift fixture	2,500 lbs.
Facility pallet	4,120 lbs
RH-72B shielded road cask	34,710 lbs.
Facility cask	67,700 lbs.

TABLE D-9
INSTRUMENTATION USED IN SUPPORT OF THE GEOMECHANICAL MONITORING SYSTEM

INSTRUMENT TYPE	FEATURES	PARAMETER MEASURED	RANGE
Borehole Extensometer	The extensometer provides for monitoring the deformation parallel to the borehole axis. Units suitable for up to 5 measurements anchors in addition to the reference head. Maximum borehole depths shall be 50 feet.	Cumulative Deformation	0-2 inches
Borehole Television Camera	Closed circuit television may be used for monitoring areas otherwise inaccessible, such as boreholes or shafts.	Video Image	N/A
Convergence Points and Tape Extensometers	Mechanically anchored eyebolts to which a portable tape extensometer is attached.	Cumulative Deformation	2-50 feet
Convergence Meters	Includes wire and sonic meters. Mounted on rigid plates anchored to the rock surface.	Cumulative Deformation	2-50 feet
Inclinometers	Both vertical and horizontal inclinometers are used. Traversing type of system in which a probe is moved periodically through casing located in the borehole whose inclination is being measured.	Cumulative Deformation	0-30 degrees
Rock Bolt Load Cells	Spool type units suitable for use with rock bolts. Tensile stress is inferred from strain gauges mounted on the surface of the spool.	Load	0-300 kips
Earth Pressure Cells	Installed between concrete keys and rock. Preferred type is a hydraulic pressure plate connected to a vibrating wire transmitter.	Lithostatic Pressure	0-1000 psi
Piezometer Pressure Transducers	Located in shafts anf of robust designand construction. Periodic checks on operability required.	Fluid Pressure	0-500 psi
Strain Gauges	Installed within the concrete shaft key. Suitably sealed for the environment. Two types used--surface mounted and embedded.	Cumulative Deformation	0-3000 μin/in (embedded) 0-2500 μin/in (surface)

TABLE D-10
DATA QUALITY OBJECTIVES FOR ACCURACY, PRECISION, SENSITIVITY, AND COMPLETENESS

Compound	Accuracy (Percent Recovery)	Precision (RPD)	Required MRL (ppbv)	Completeness (Percent)
1, 1-Dichloroethylene	60 to 140	25	5	≥90
Carbon tetrachloride	60 to 140	25	2	≥90
Methylene chloride	60 to 140	25	5	≥90
Chloroform	60 to 140	25	2	≥90
1, 1, 2, 2-Tetrachloroethane	60 to 140	25	2	≥90
1, 1, 1-Trichloroethane	60 to 140	25	5	≥90
Chlorobenzene	60 to 140	25	2	≥90
1, 2-Dichloroethane	60 to 140	25	2	≥90
Toluene	60 to 140	25	5	≥90

These data quality objectives are based on control criteria proposed by the EPA as presented in the Contract Laboratory Program Statement of Work for the Analysis of Ambient Air in Canisters (EPA, 1991).

EPA U.S. Environmental Protection Agency
MRL Method reporting limit
ppbv Parts per billion by volume
RPD Relative percent difference

TABLE D-11
TYPICAL SAMPLING SCHEDULE

Type of Sample	Sampling Locations[a]	Sampling Frequency
Liquid influent	1	Annually
Liquid effluent	1	Annually
Airborne effluent	3	Continuously
Meteorology	2	Continuously
Exposure rate meter	1	Continuously
Atmospheric particulate	7	Weekly
Vegetation radioanalysis	7[b]	Annually
Beef radioanalysis	2	Annually[b]
Game bird radioanalysis	1	Annually
Rabbit radioanalysis	2	Annually
Deer radioanalysis	2	Annually
Fish radioanalysis	2	Annually
Soil radioanalysis	6	Annually
Surface-water radioanalysis	12	Annually
Groundwater	7	Annually[c]
Sediments radioanalysis	10	Annually
Aerial photography	1	Annually
Soil chemistry	7	Annually
Wildlife survey	4	Annually

[a]Sampling locations are shown in the Site Environmental Report (Appendix D4).
[b]If available.
[c]Semiannual sampling will be conducted on wells WQSP 1-6 and 6a until 3 samples are collected
for establishing baseline conditions. Annual samples will be taken subsequently.

TABLE D-12
TYPICAL ENVIRONMENTAL SURVEILLANCE ANALYSIS SCHEDULE

Type of Sample	Analysis
Liquid influent	Radionuclides
Liquid effluent	Specific radionuclides, chemical constituents
Airborne effluent	Gross β, specific radionuclides
Meteorology	Temperature, wind speed, wind direction, precipitation, dewpoint, barometric pressure
Exposure rate meter	Penetrating radiation
Air quality	Total suspended particulates
Vegetation radionuclides	Specific radionuclides
Beef radioanalysis	Specific radionuclides
Game bird radioanalysis	Specific radionuclides
Rabbit radioanalysis	Specific radionuclides
Fish radioanalysis	Specific radionuclides
Deer radioanalysis	Specific radionuclides
Soil radioanalysis	Specific radionuclides
Surface-water radioanalysis	Specific radionuclides
Groundwater analysis	Specific radionuclides, chemical constituents
Sediments radioanalysis	Specific radionuclides
Aerial photography	Area of land disturbed
Wildlife survey	Bird and small mammal population densities
Salt impact study: Soil chemistry	pH, electrical conductivity, sodium, chloride, magnesium, calcium, potassium

Specific radionuclides = Pu^{238}, Pu^{239}, Pu^{240}, Pu^{242}, U^{233}, Am^{241}, Am^{243}, Cm^{244}, Th^{232}, Np^{237}, Ra^{226}, Cs^{137}, Sr^{90}, Co^{60}, U_{nat}, and Th_{nat}.

Chemical constituents = chloride; iron; manganese; phenols; sodium; sulfate; pH; specific conductance; total organic carbon; total organic halogen; Table D-10 constituents; antimony; arsenic; barium; beryllium; cadmium; chromium; fluoride; lead; mercury; nickel; nitrate; selenium; silver; thallium zinc; endrin; methoxychlor; toxaphene; 2,4-D; 2,4,5-TP silvex; radium; turbidity; coliform bacteria. Additional analytes may be specified in the WIPP facility hazardous waste permit.

[a]For the purposes of establishing baseline values in wells WQSP 1-6 and 6a, the analyses will include all 40 CFR 264 Appendix IX constituents.

FIGURES

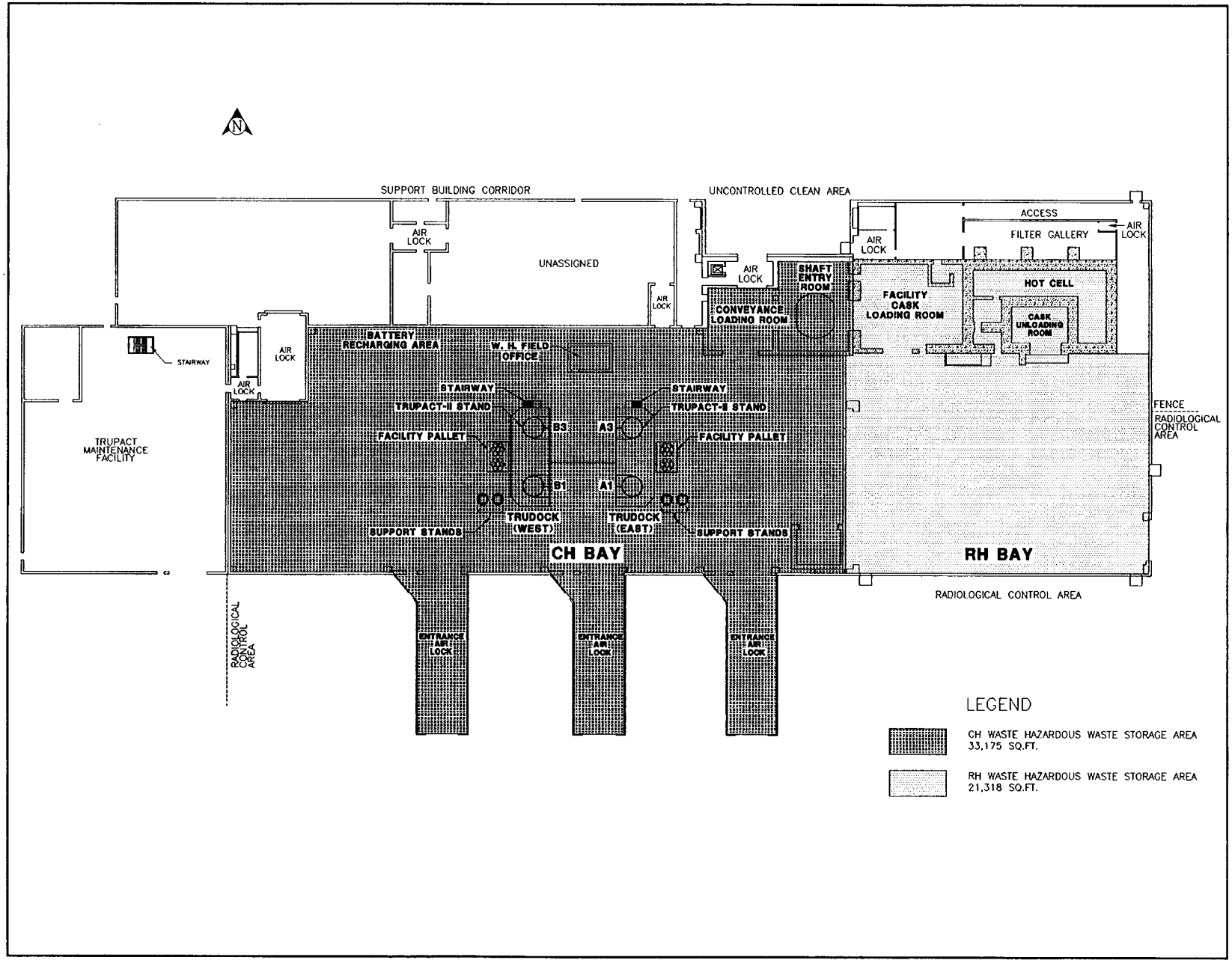

Figure D-1

Waste Handling Building - Container Storage Unit

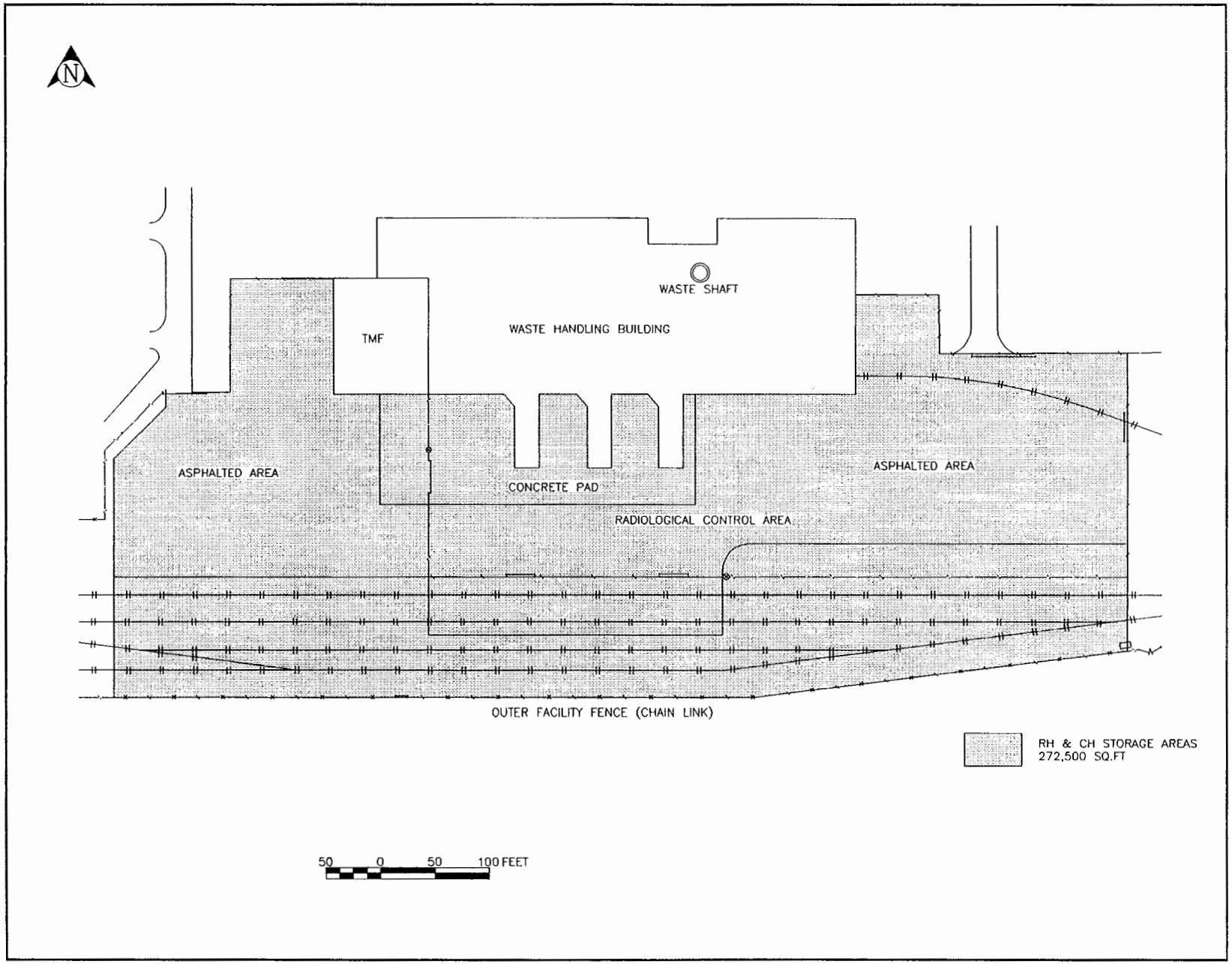

Figure D-2
Parking Area - Container Storage Unit

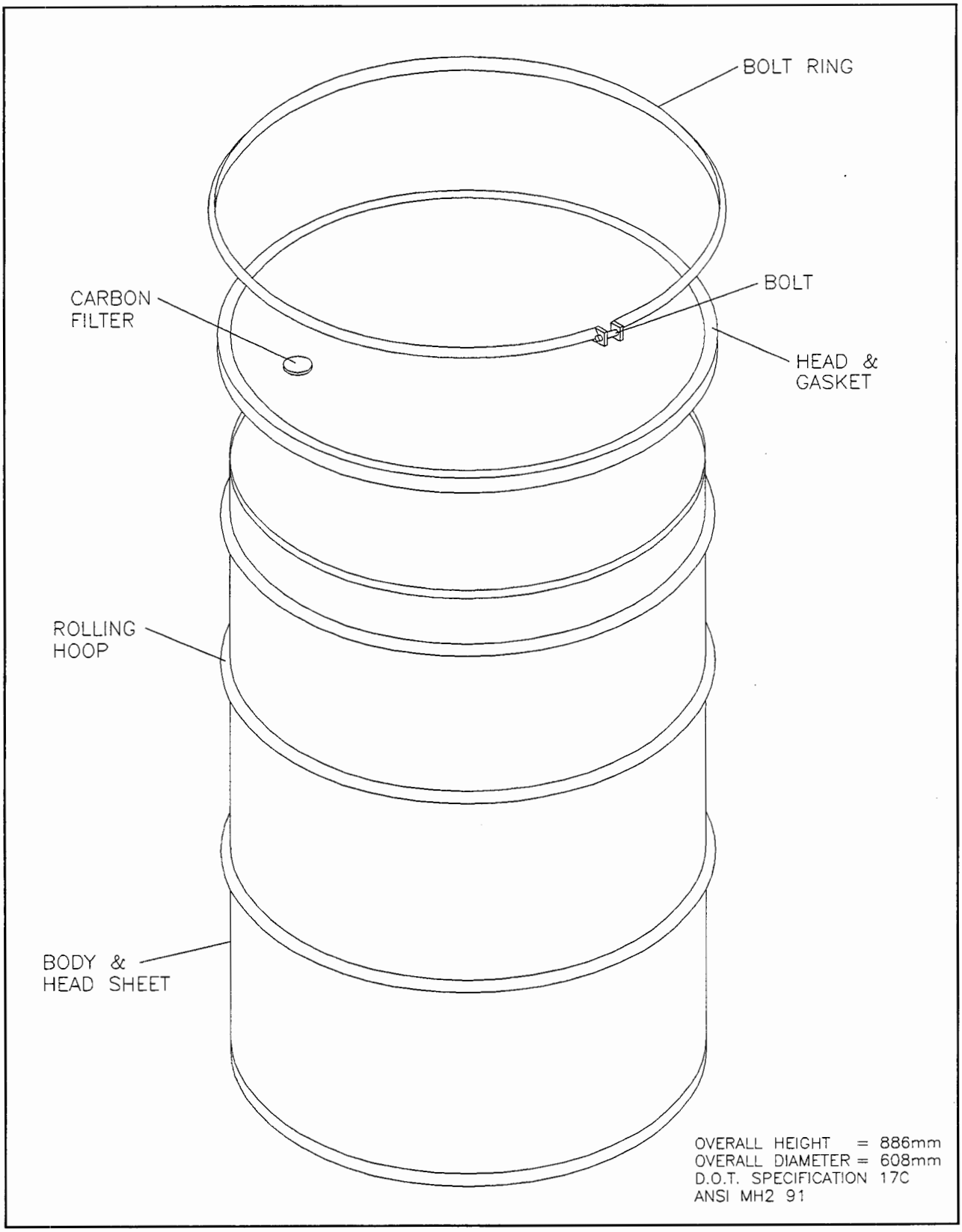

Figure D-3
Standard 55-Gallon Drum (Typical)

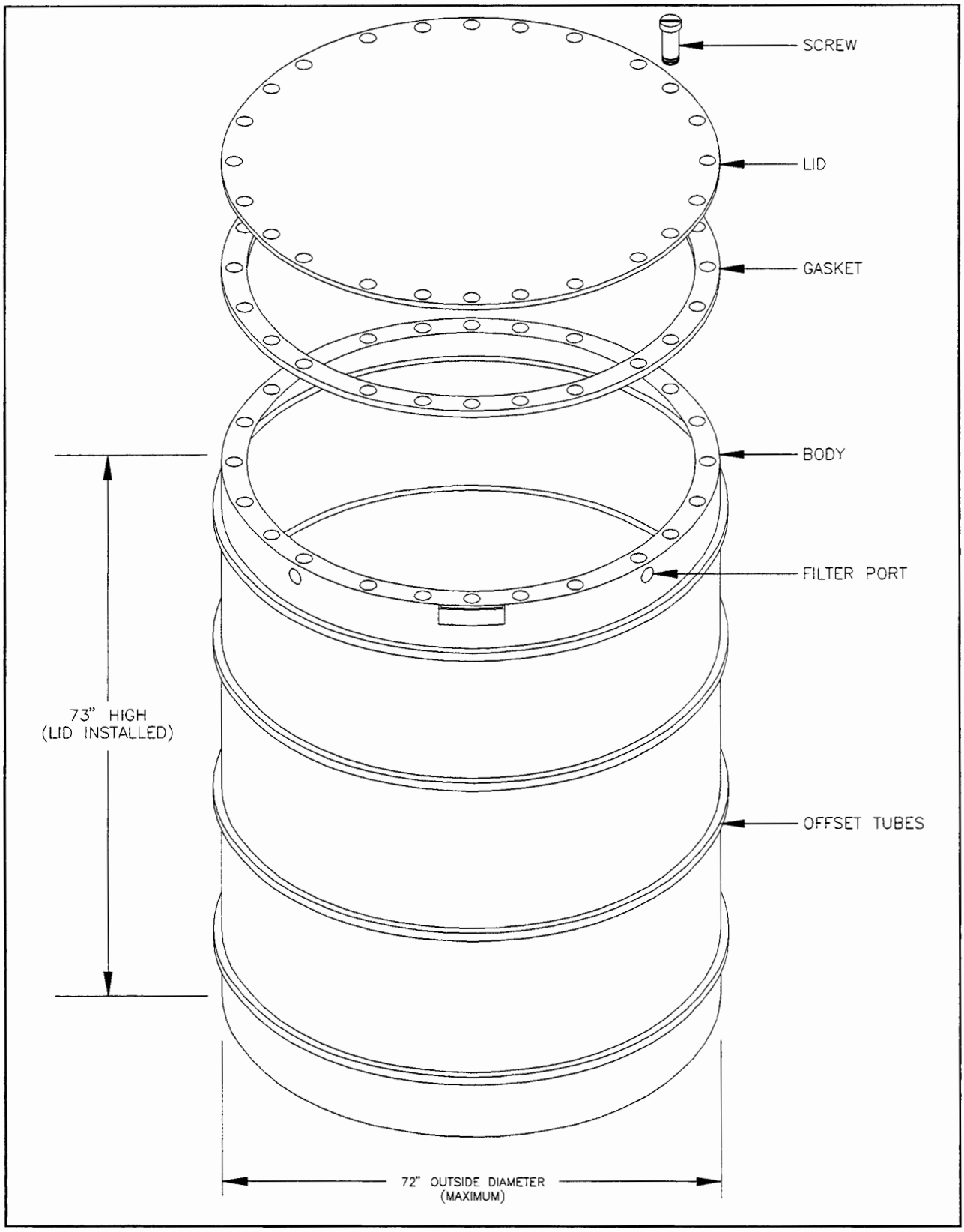

Figure D-4
Ten-Drum Overpack

RCRAD4

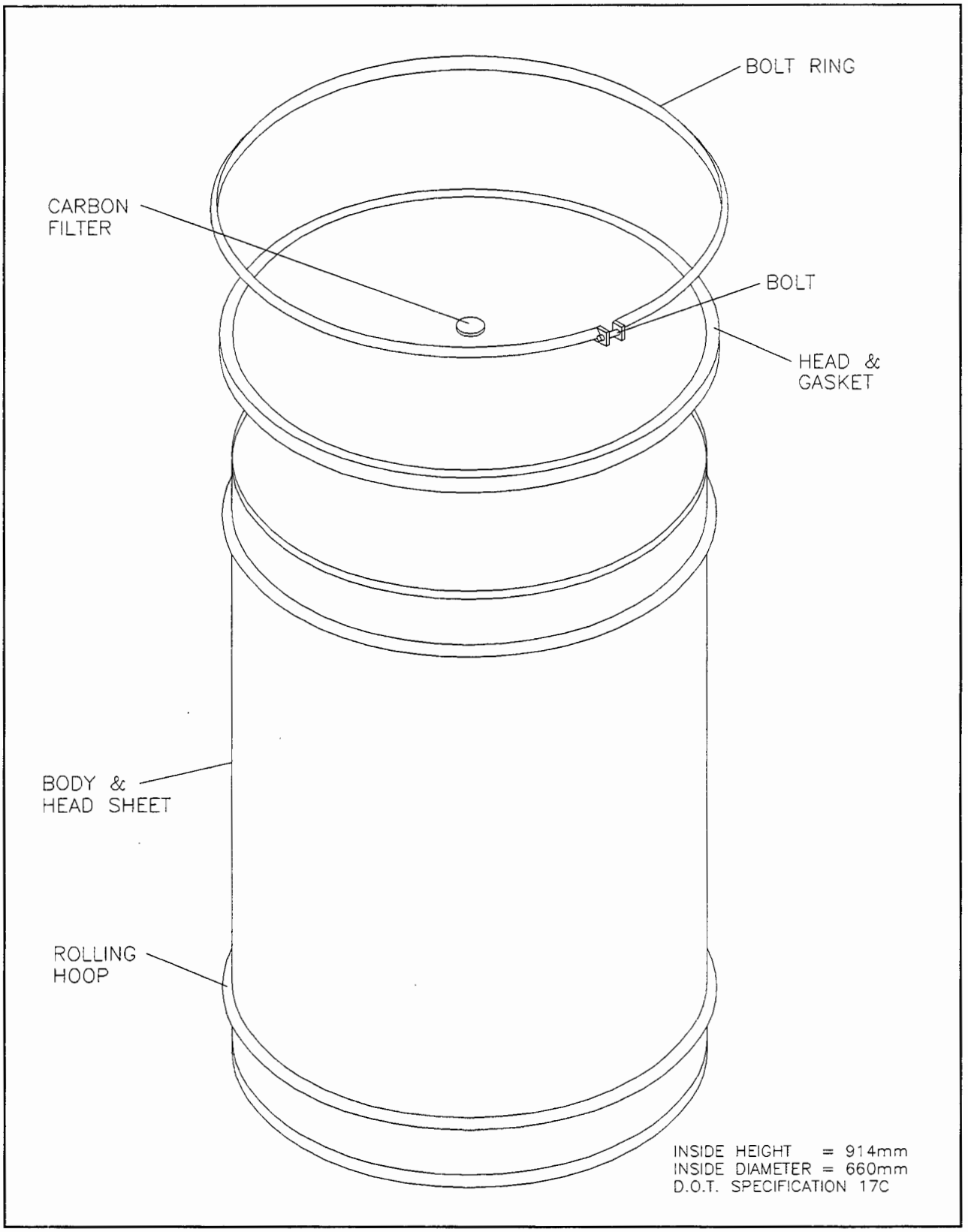

Figure D-5
85-Gallon Overpack

RCRAD30A

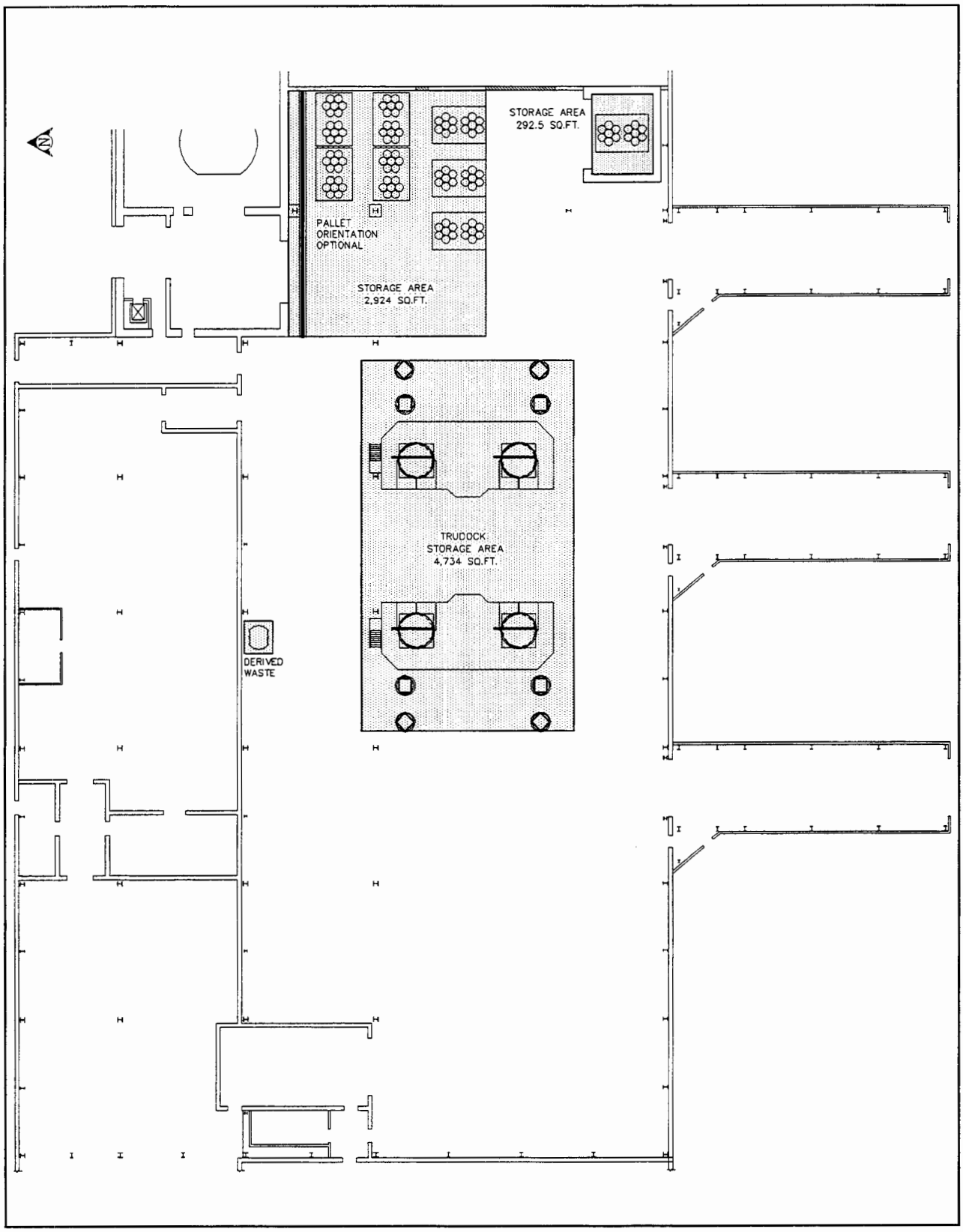

Figure D-6
Waste Handling Building - Facility Pallet Temporary Storage Area

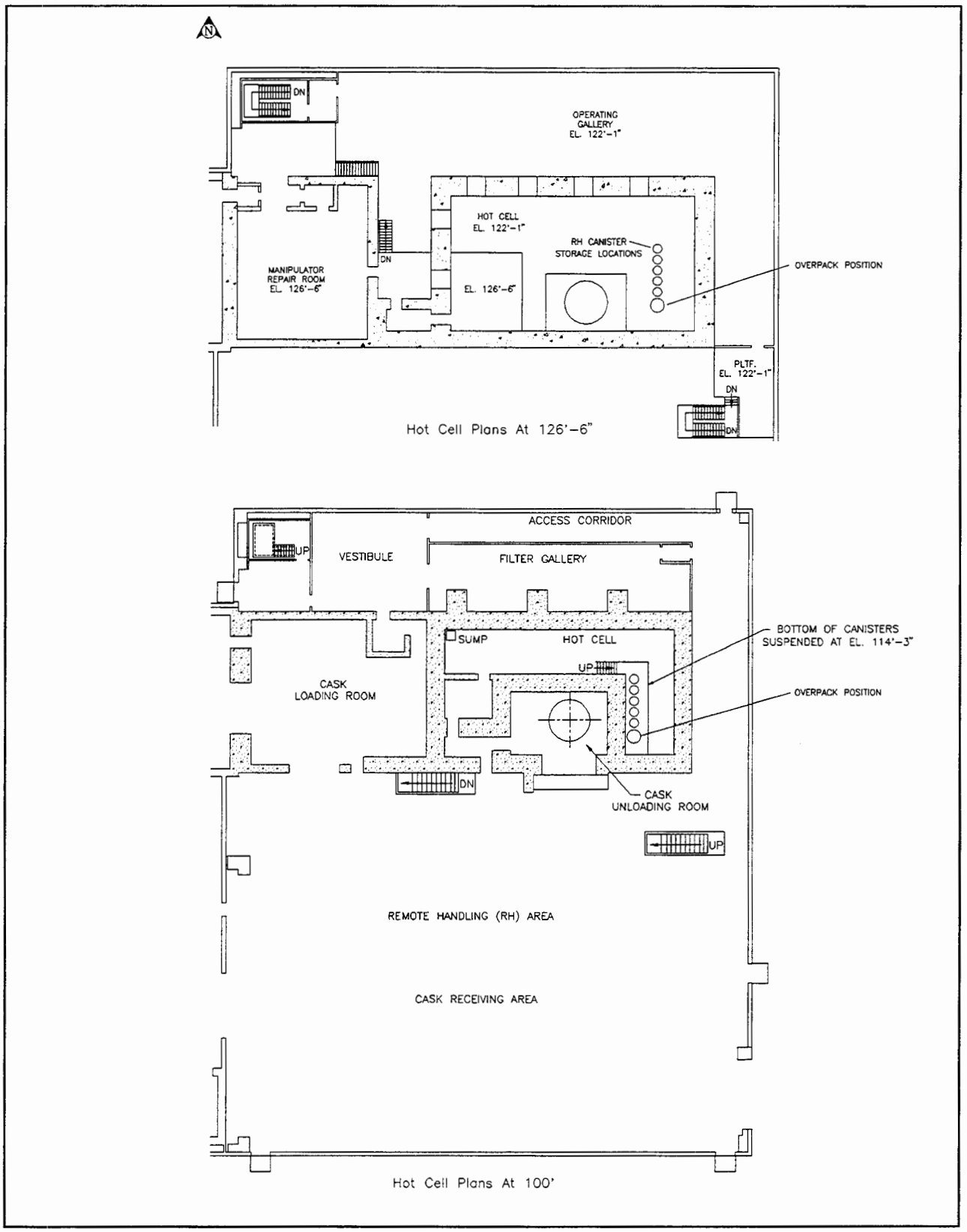

Figure D-7
Hot Cell Plans at Elevations 100' and 126'-6"

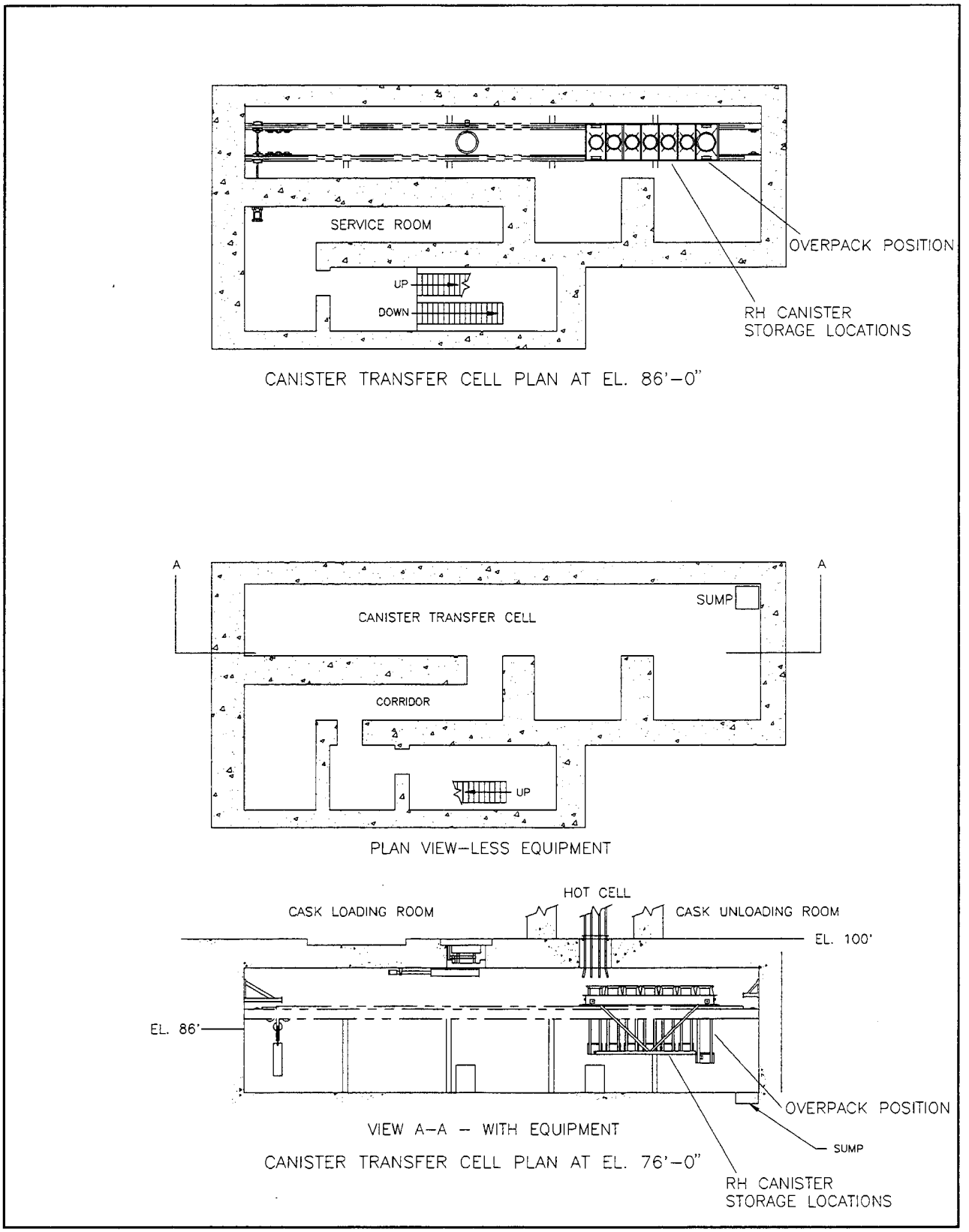

Figure D-8
Canister Transfer Cell at Elevations 76' and 86'

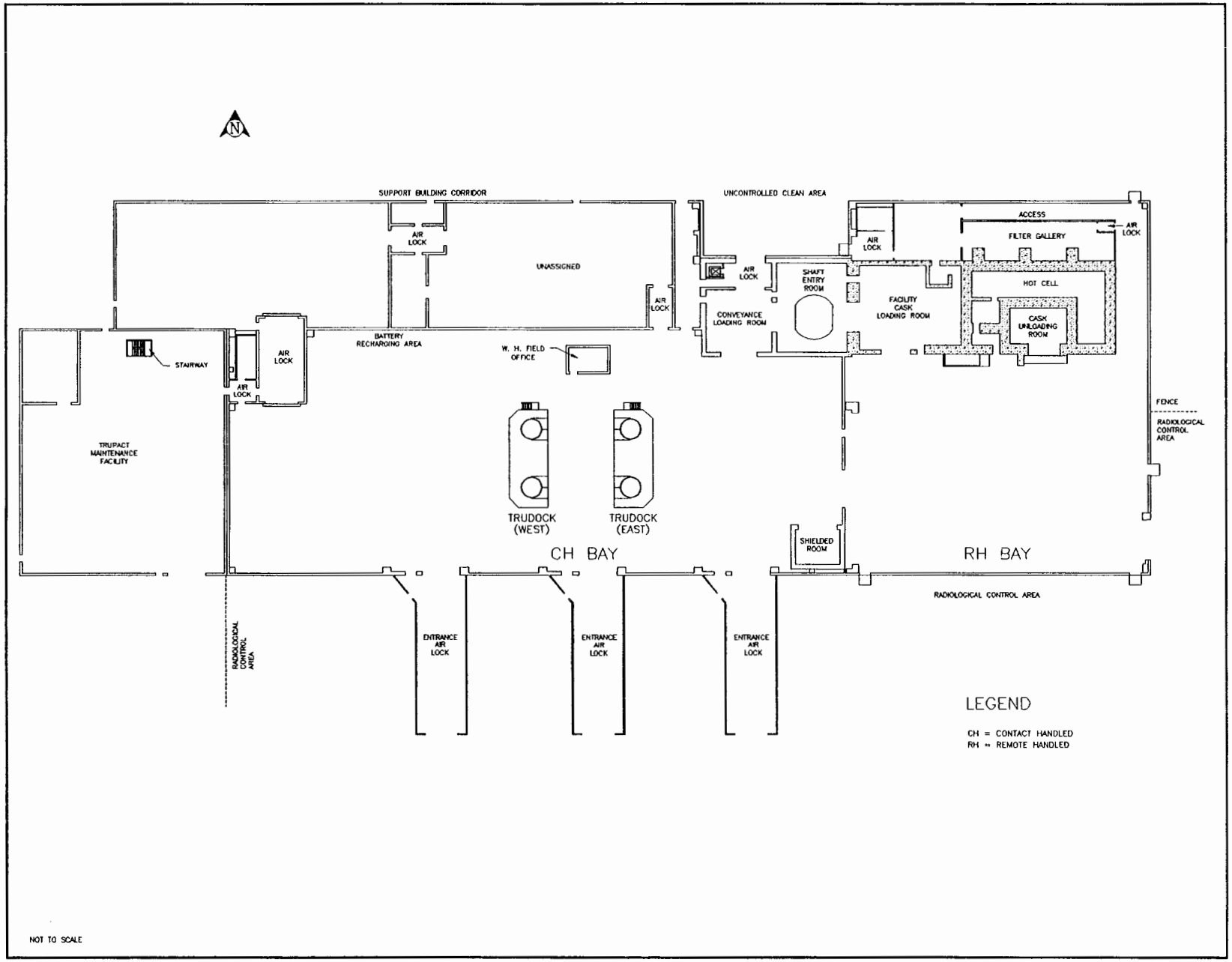

Figure D-9
Waste Handling Building Plan (Ground Floor)

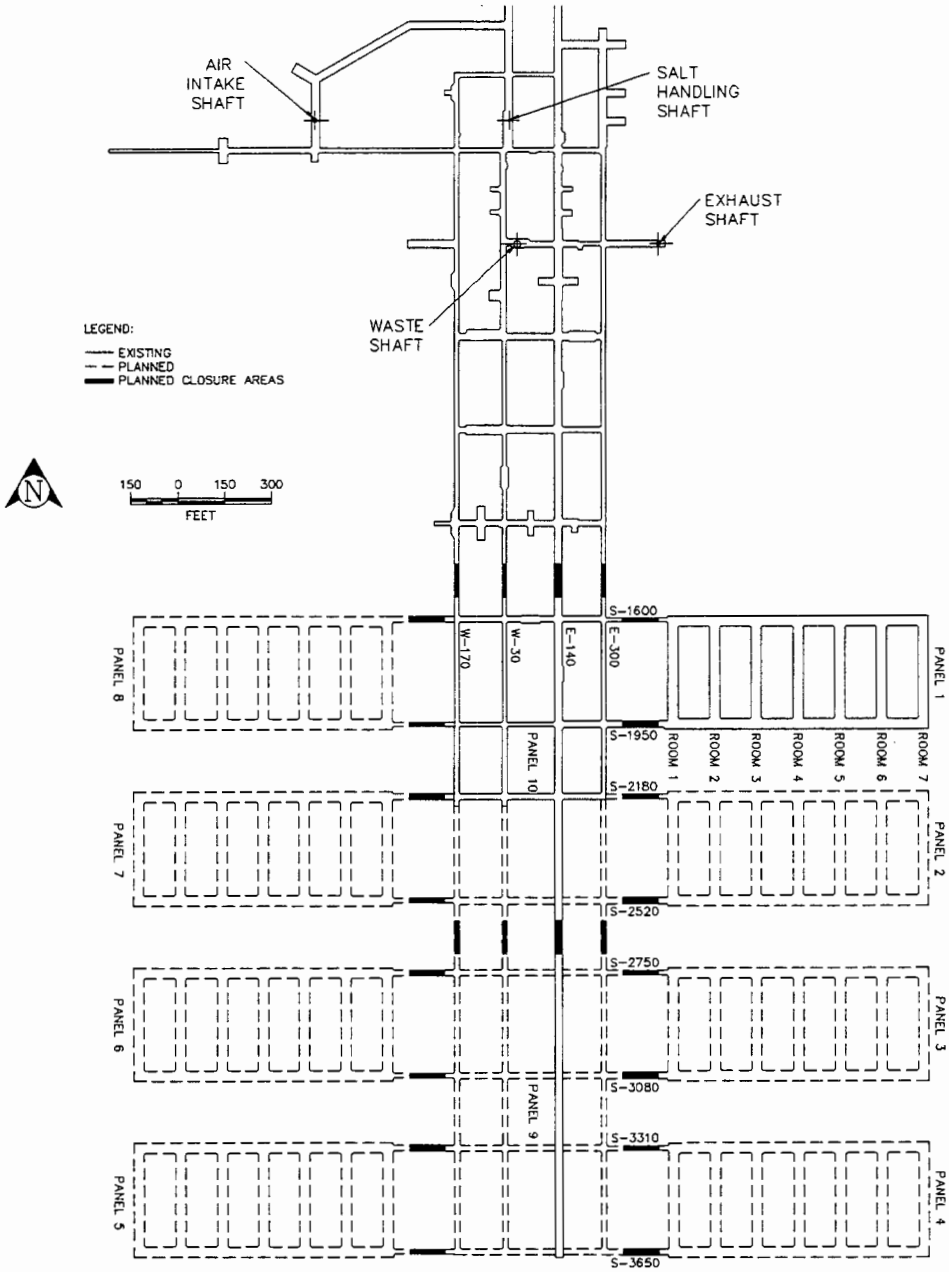

Figure D-10
Repository Horizon

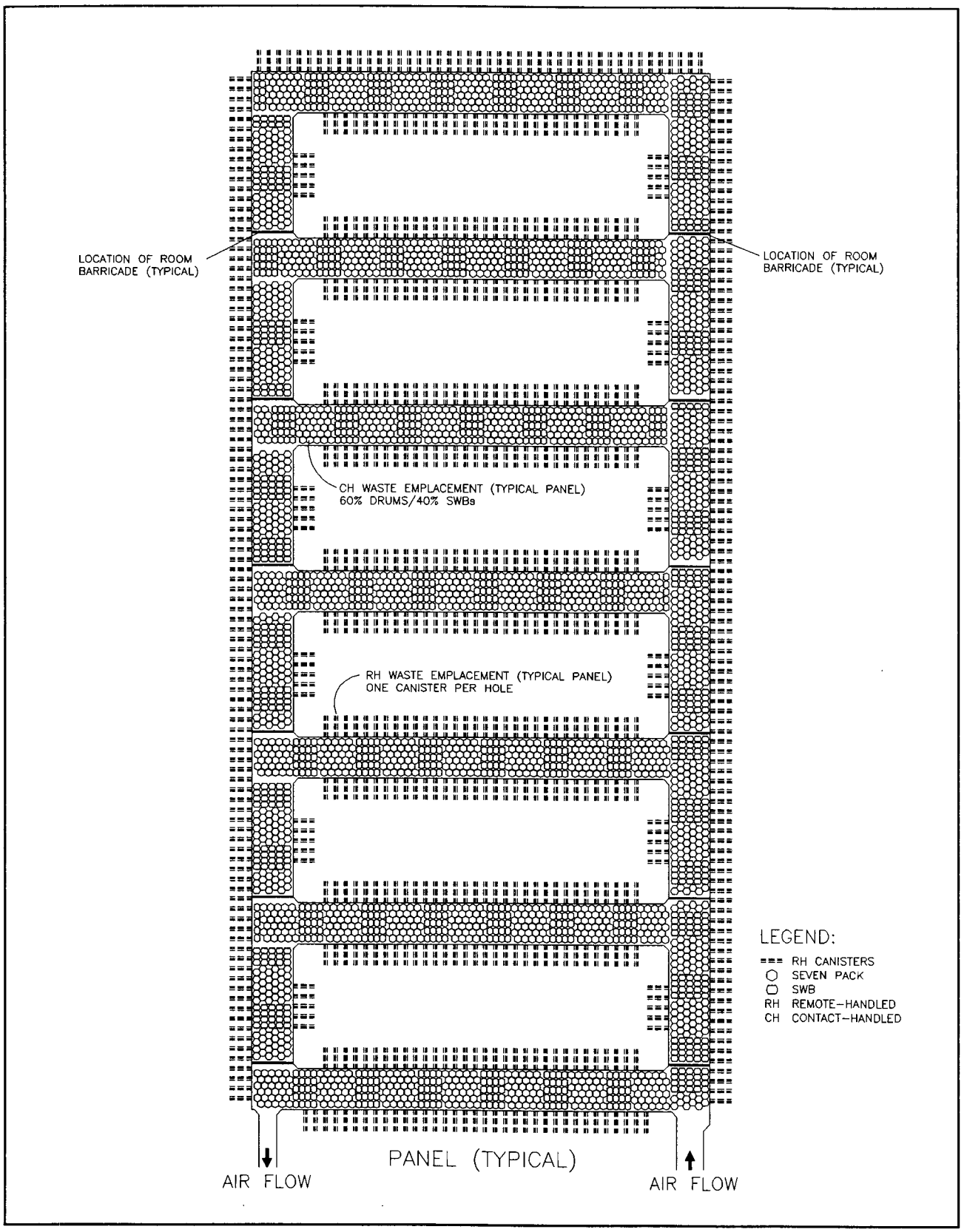

Figure D-11

Typical RH and CH Transuranic Mixed Waste Container Disposal Configuration

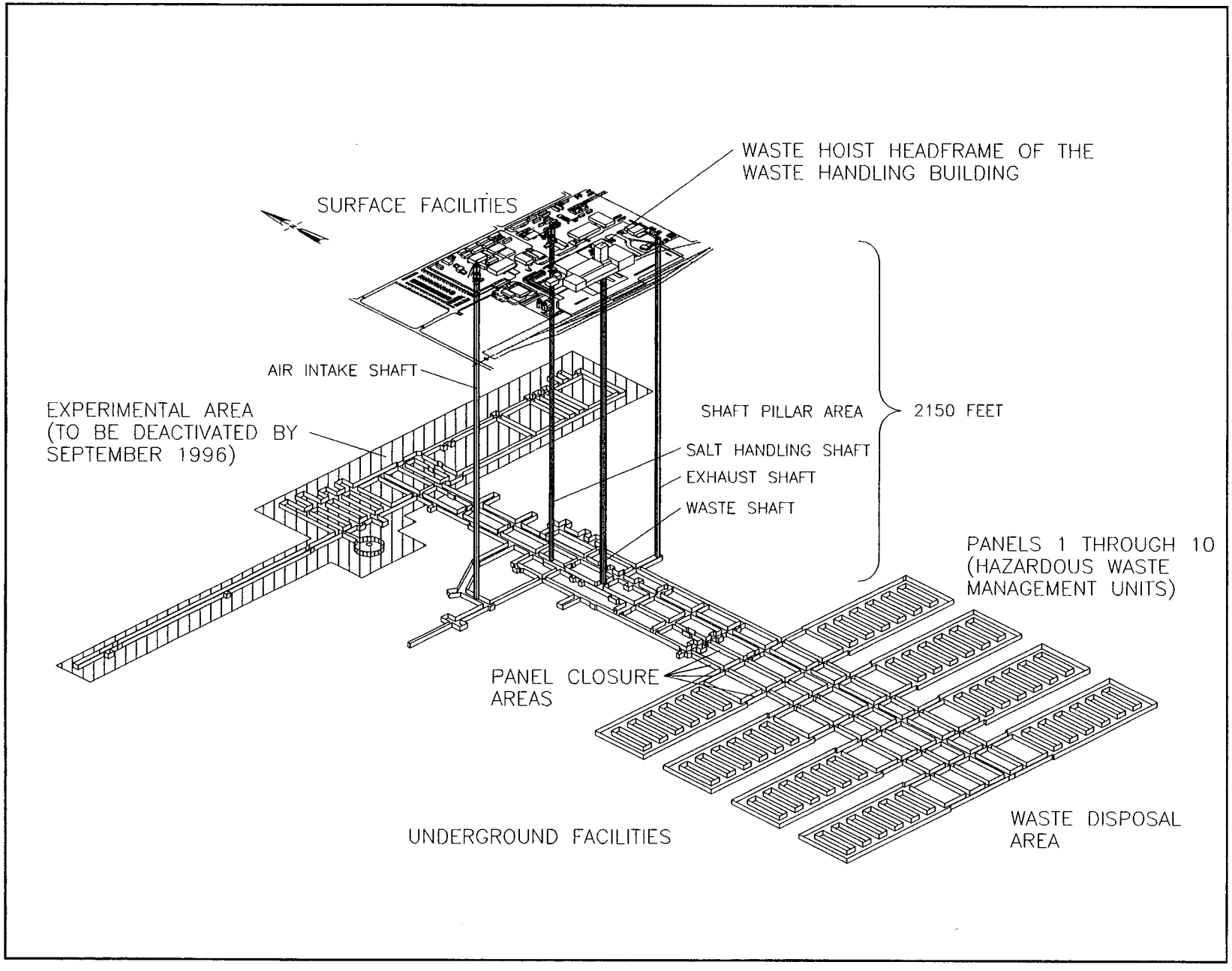

Figure D-12
Spatial View of the Miscellaneous Unit and Waste Handling Facility

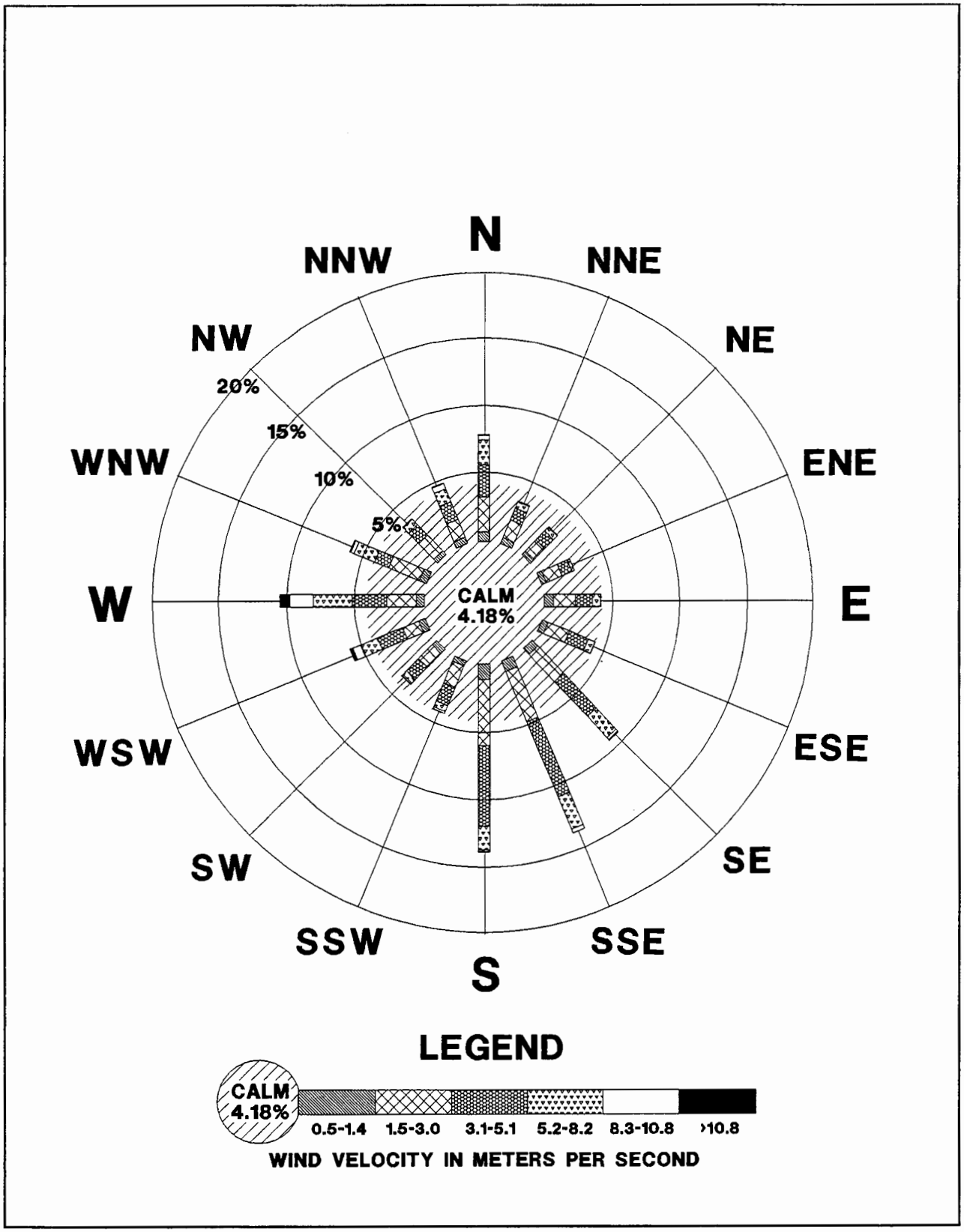

Figure D-13
Windrose Diagram - Carlsbad, NM, Airport - Jan. 1, 1990 to Oct. 31, 1994

SYSTEM	SERIES	GROUP	FORMATION	MEMBER
RECENT	RECENT		SURFICIAL DEPOSITS	
QUATERN-ARY	PLEISTO-CENE		MESCALERO CALICHE	
			GATUNA	
TERTIARY	MID-PLIOCENE		OGALLALA	
TRIASSIC		DOCKUM	SANTA ROSA	
PERMIAN	OCHOAN		DEWEY LAKE	
			RUSTLER	Forty-niner
				Magenta Dolomite
				Tamarisk
				Culebra Dolomite
				Unnamed
			SALADO	Upper
				McNutt Potash Zone
				Lower
			CASTILE	
	GUADALUPIAN	DELAWARE MOUNTAIN	BELL CANYON	
			CHERRY CANYON	
			BRUSHY CANYON	

Figure D-14

Geologic Column Representative of WIPP Facility Area

RCRAD14

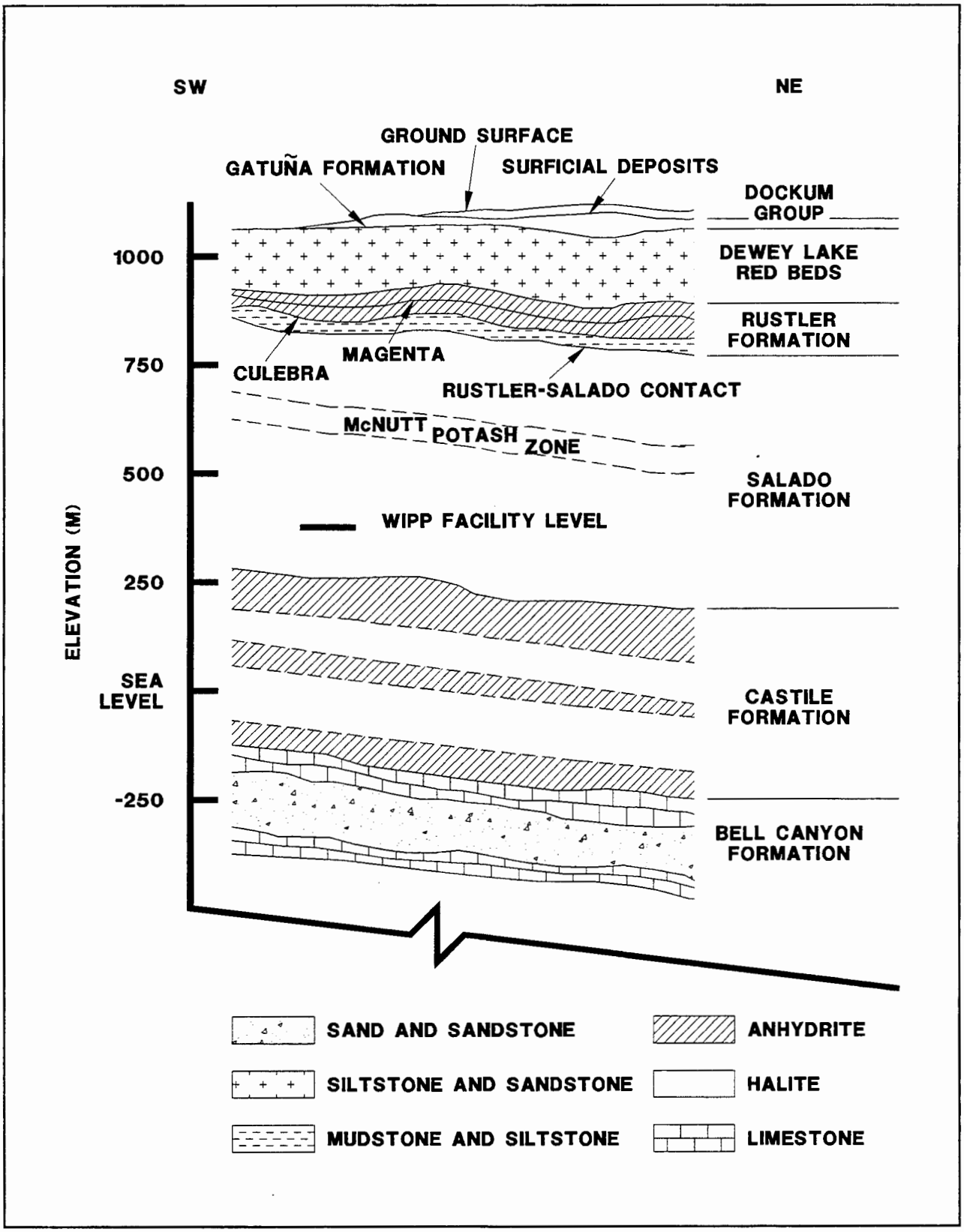

Figure D-15
Generalized Stratigraphic Cross Section

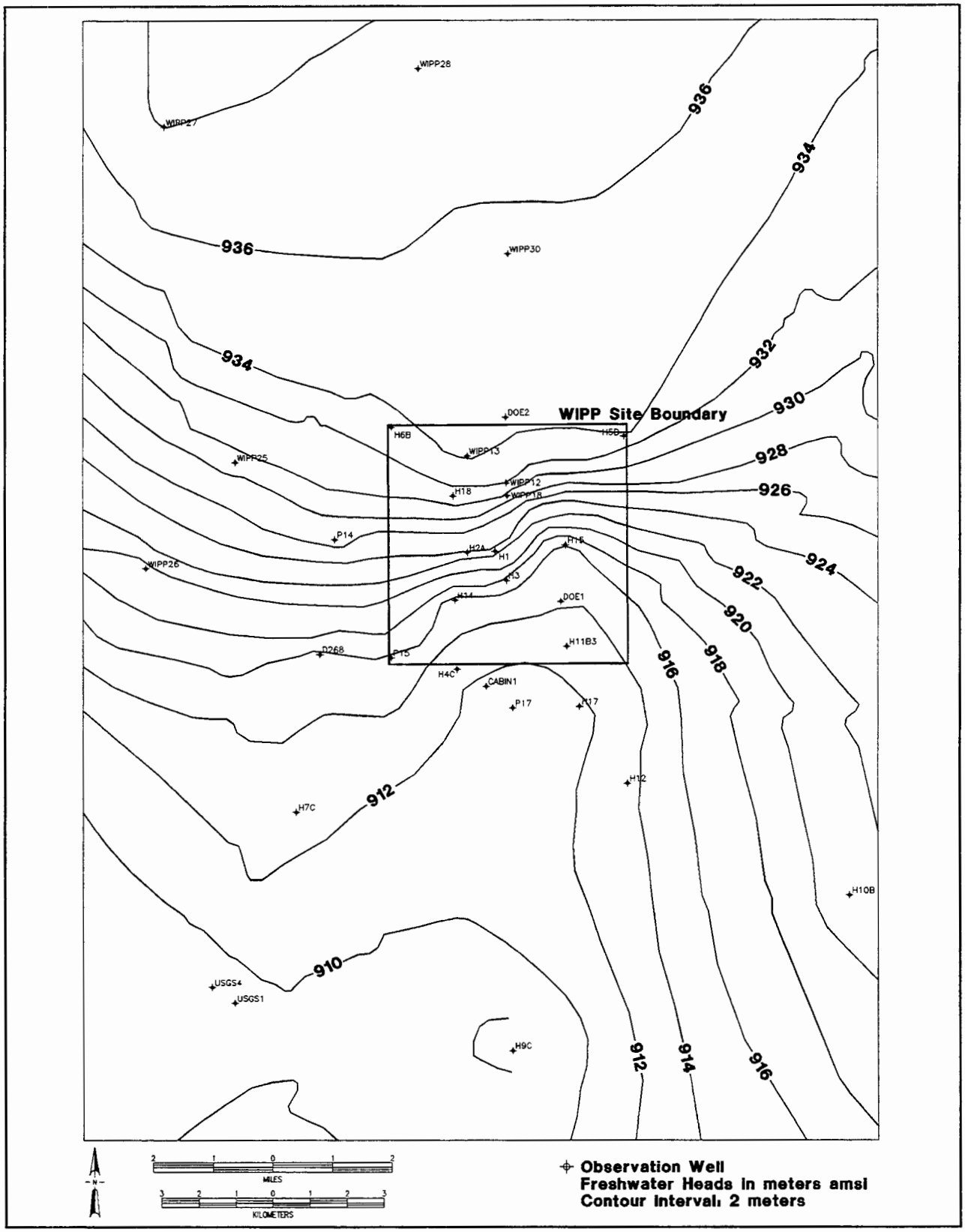

Figure D-16
Culebra Freshwater Head Potentiometric Surface

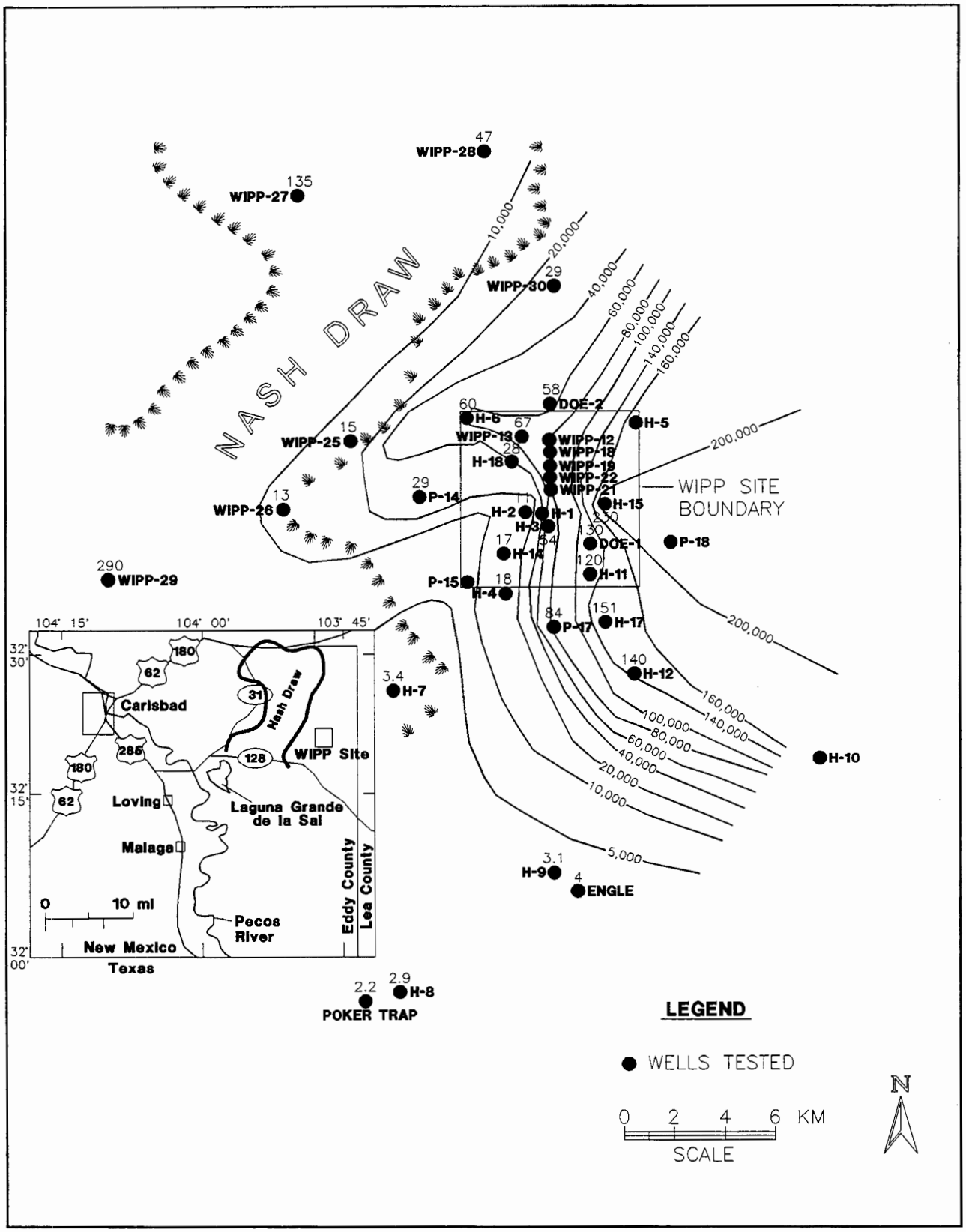

Figure D-17
Total Dissolved Solids Distribution in the Culebra

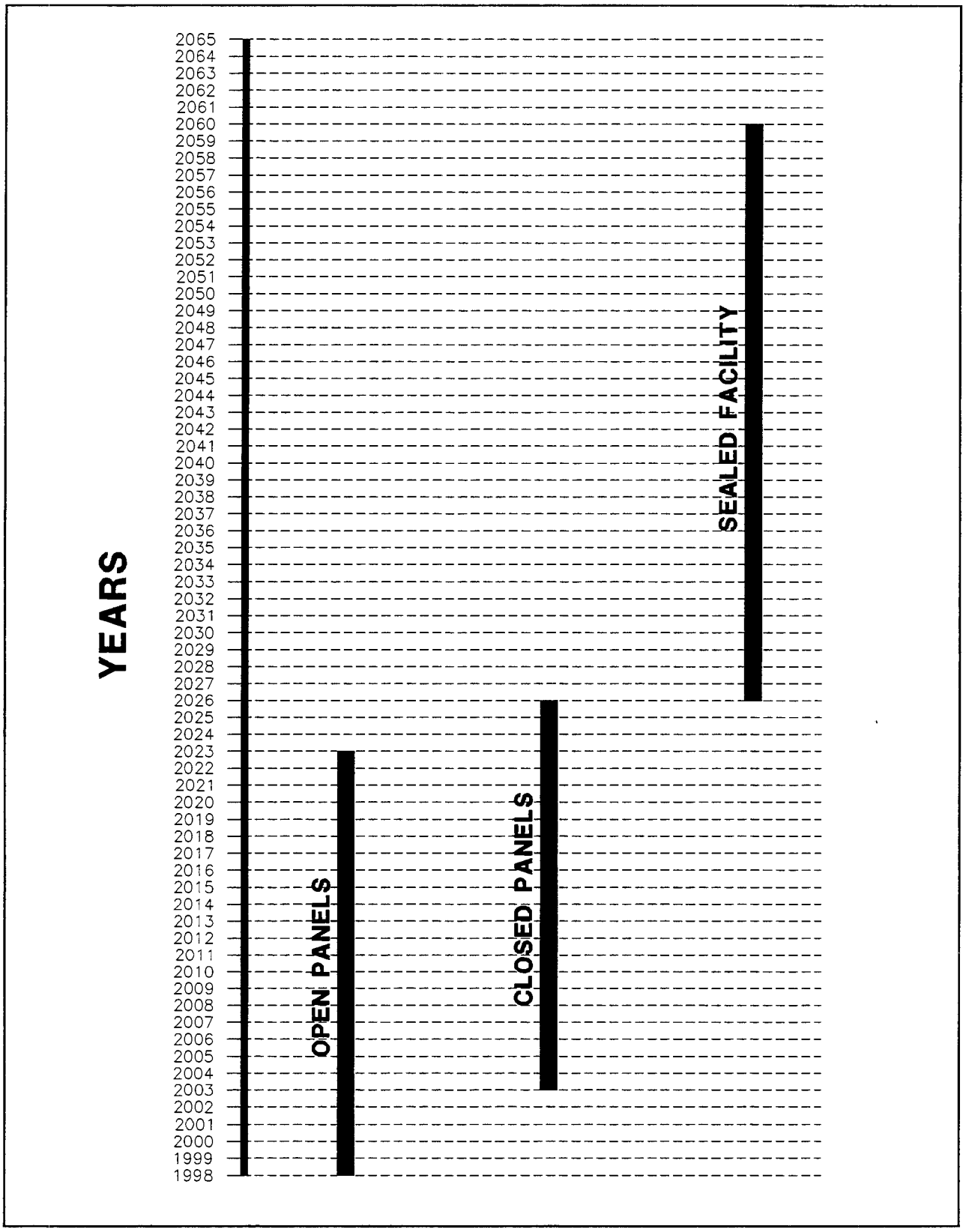

Figure D-17A
Time and Duration of Disposal System Modeling Configurations

RCRAD17A

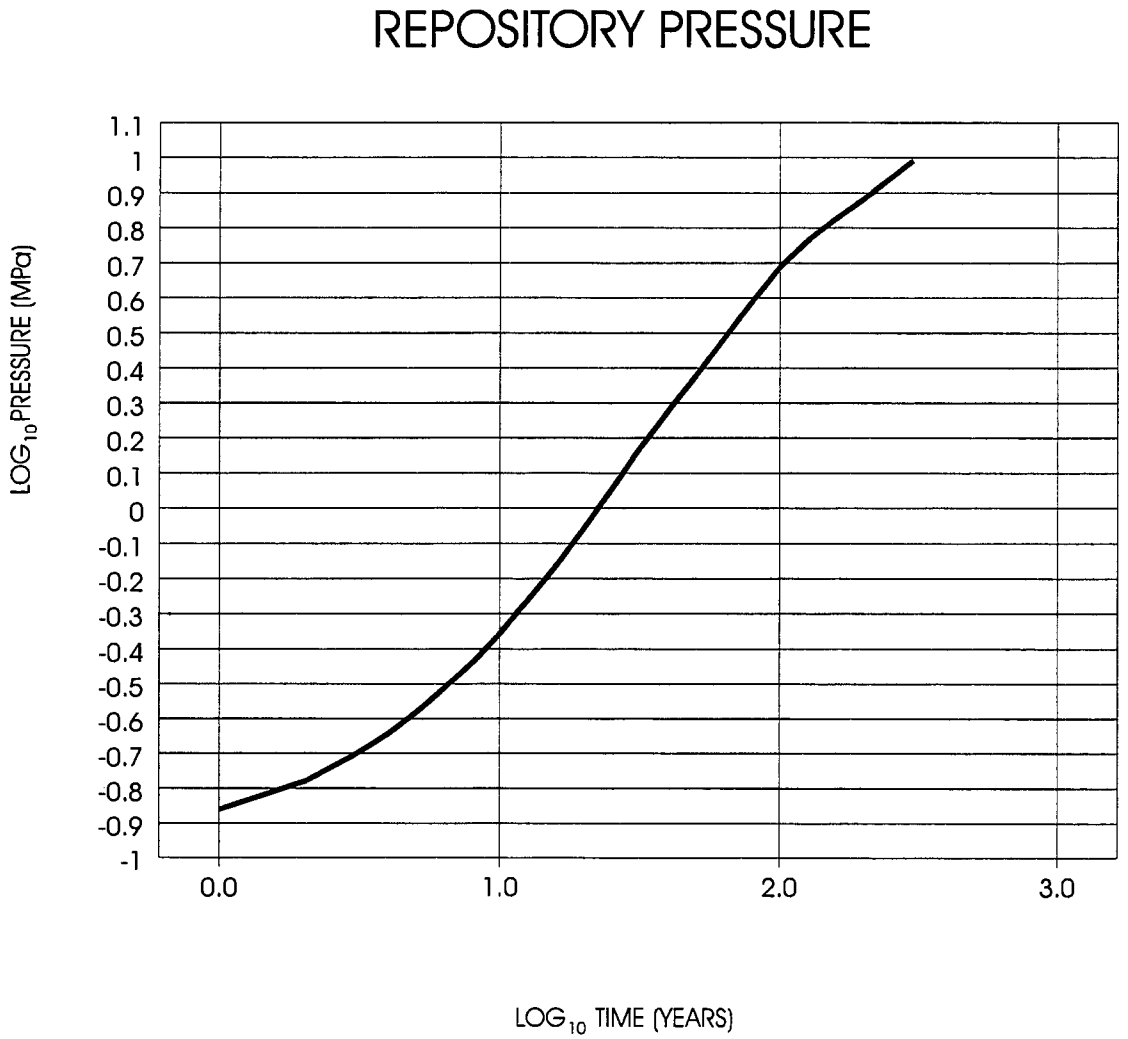

Figure D-17B
Predicted Change in Disposal Region Pressure Following Shaft Sealing

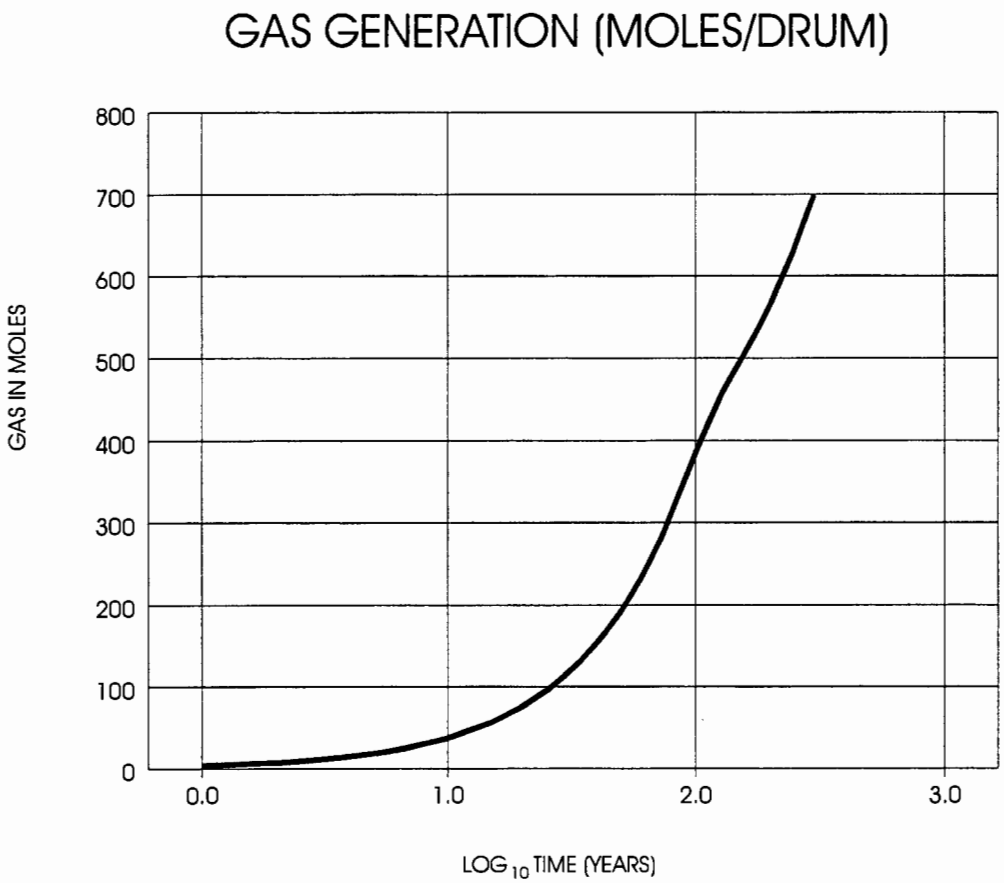

Figure D-17C

Predicted Cumulative Volume of Gas Generated Per Drum of Waste

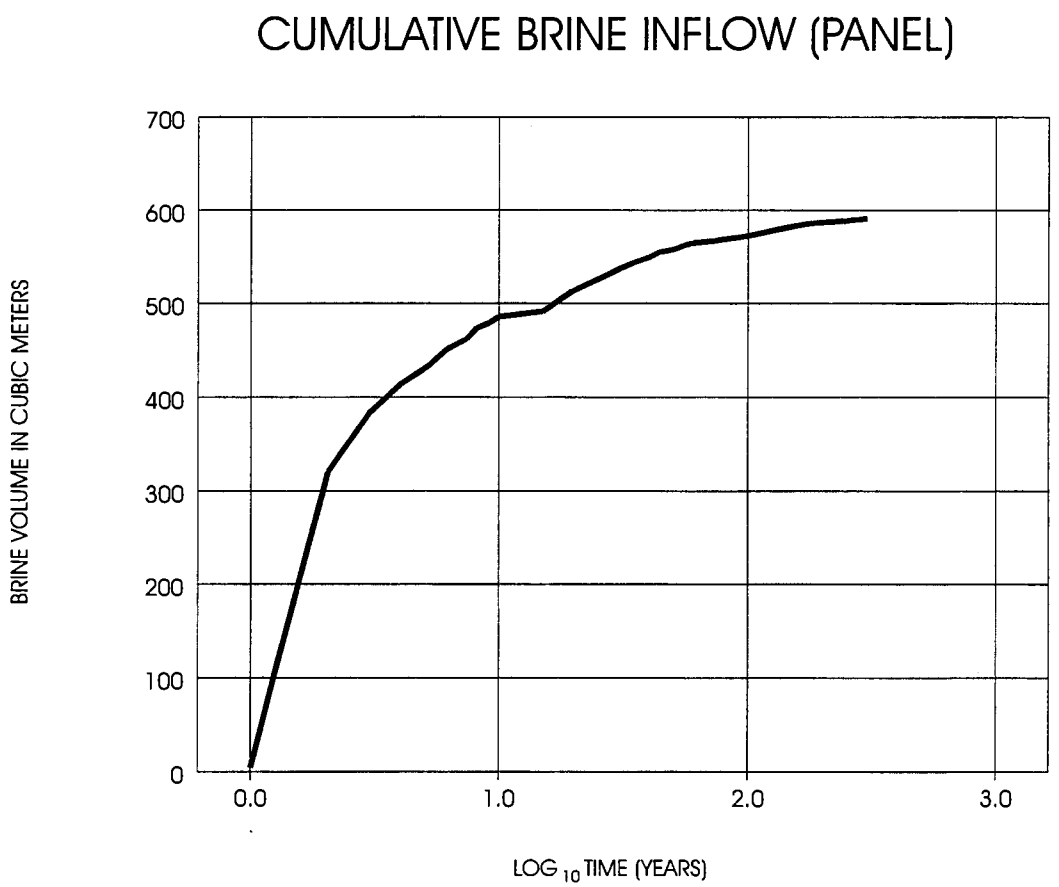

Figure D-17D

Predicted Cumulative Brine Inflow into a Closed Waste Panel

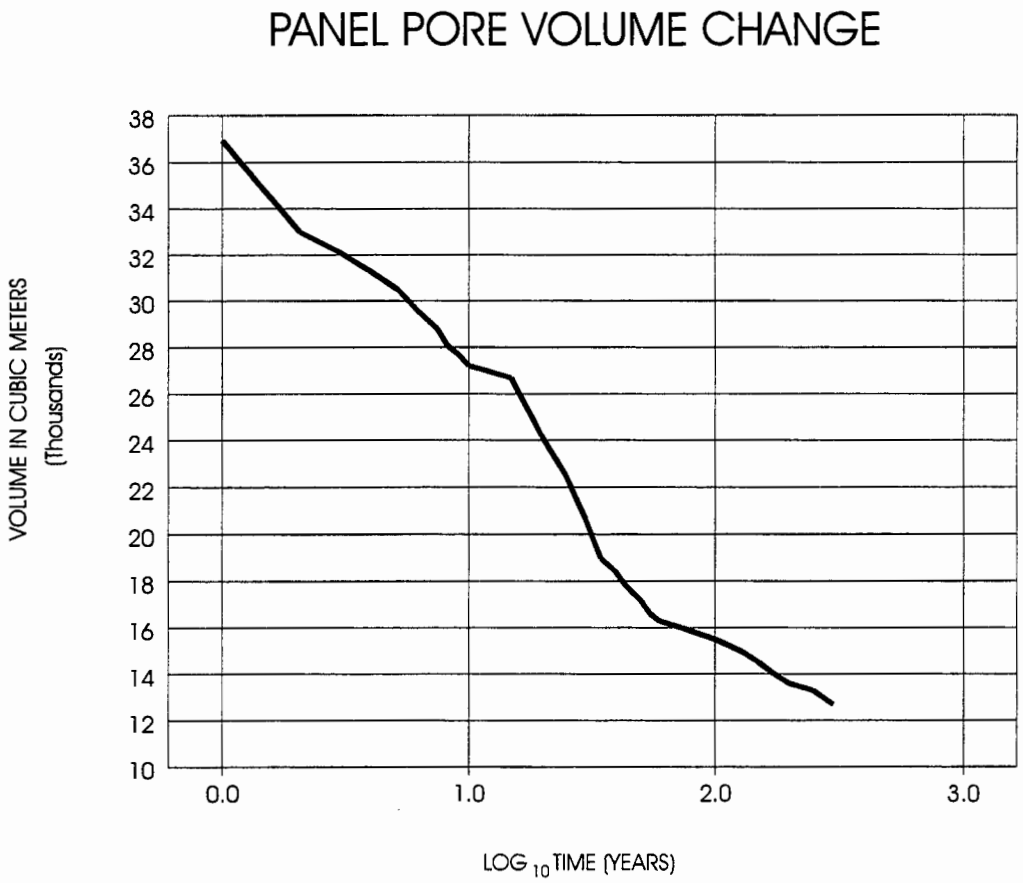

Figure D-17E

Predicted Change in Panel Pore Volume Due to Creep Closure

RCRAD-JJ

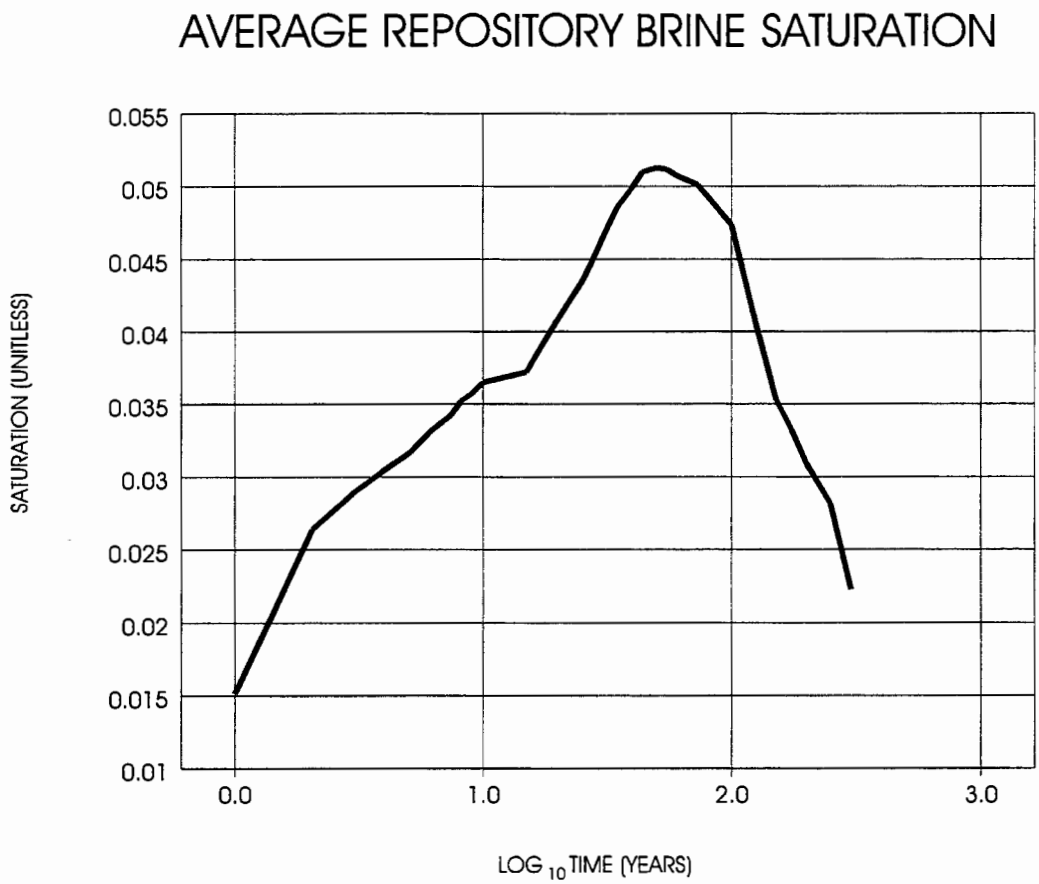

Figure D-17F

Predicted Average Brine Saturation Within the Repository

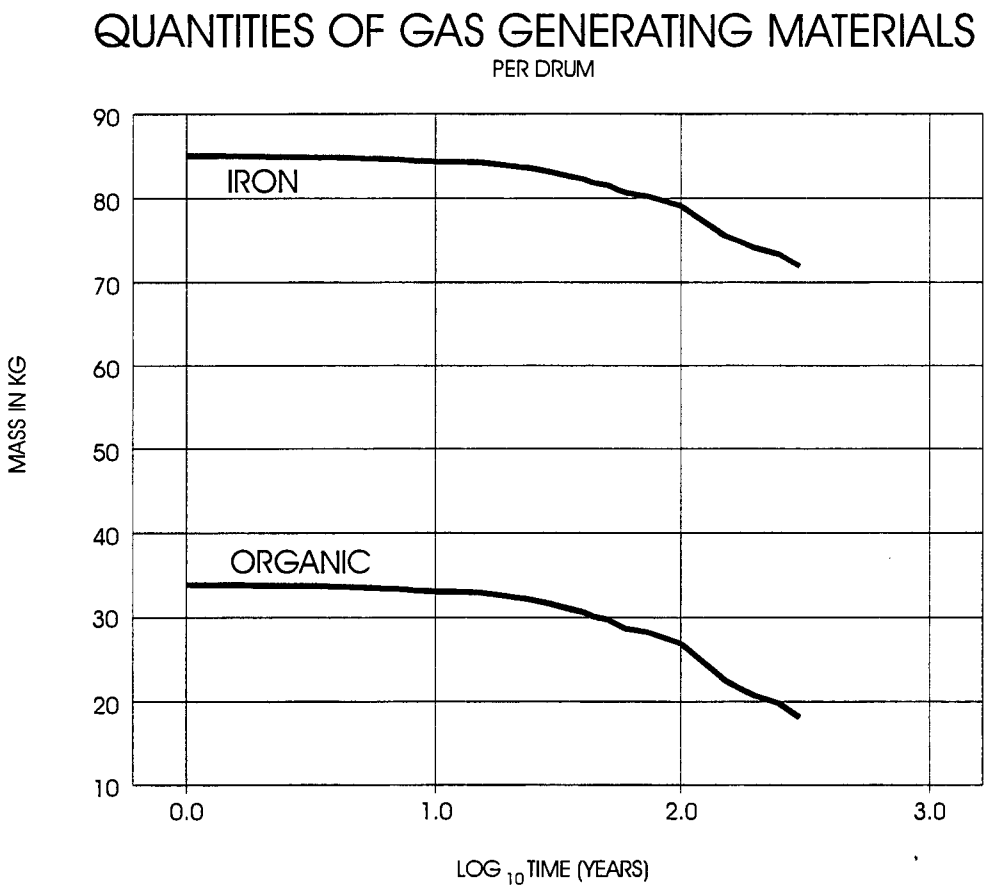

Figure D-17G

Predicted Change in the Quantity of Gas Generating Material In Each Drum

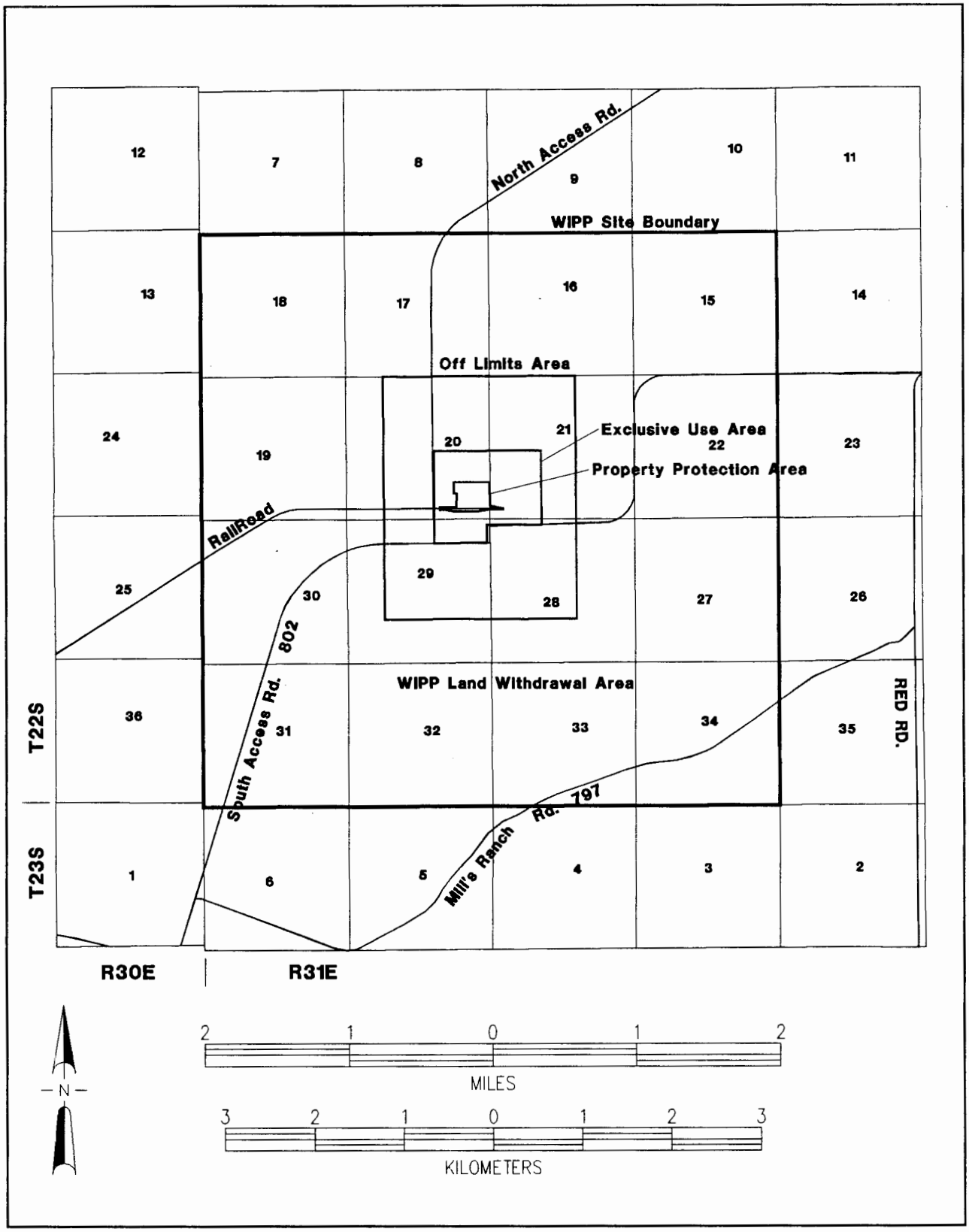

Figure D-17H
Security Zones Within the WIPP Site Boundary

RCRAD-EE

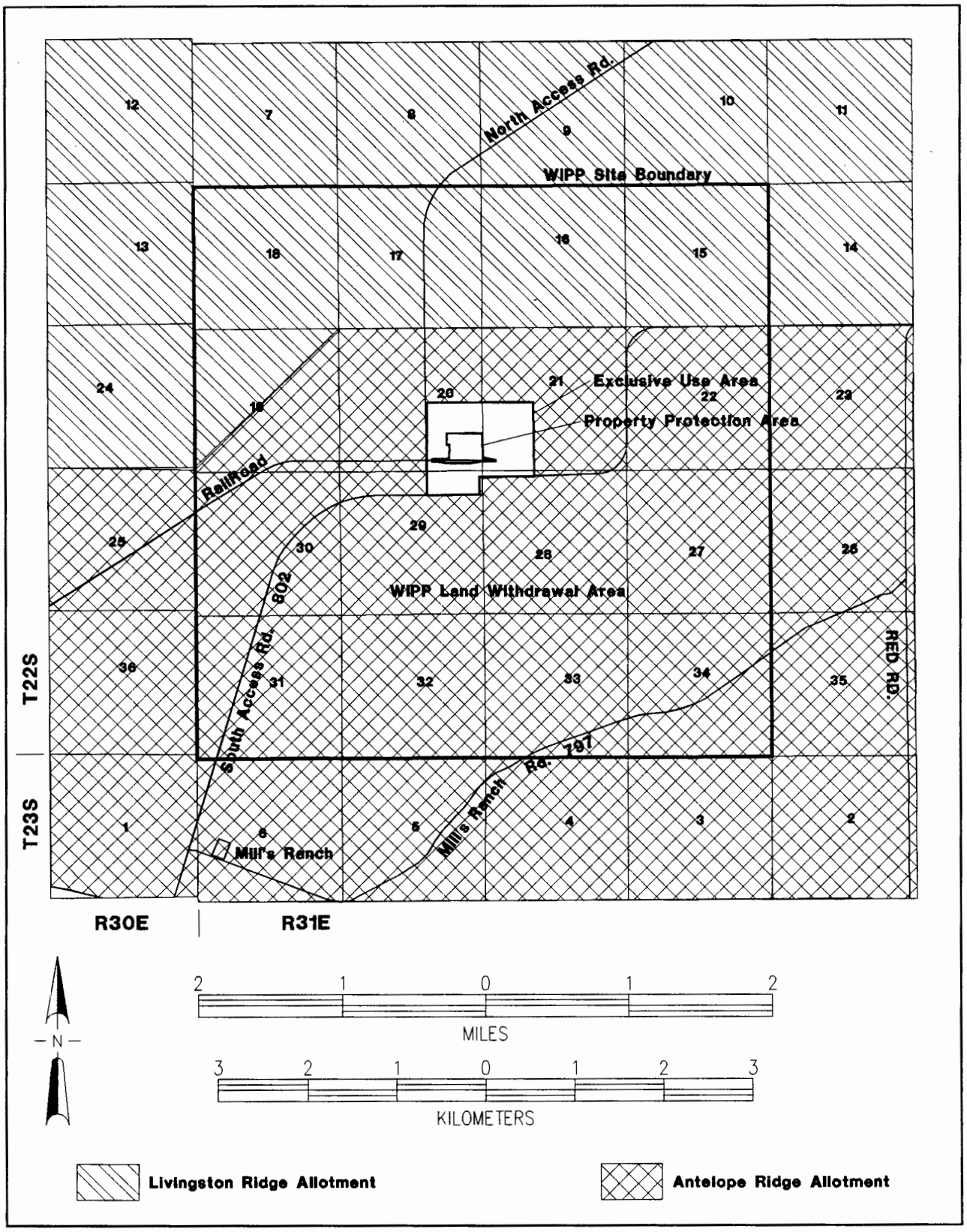

Figure D-171
Grazing Allotments in the Vicinity of the WIPP Land Withdrawal Area

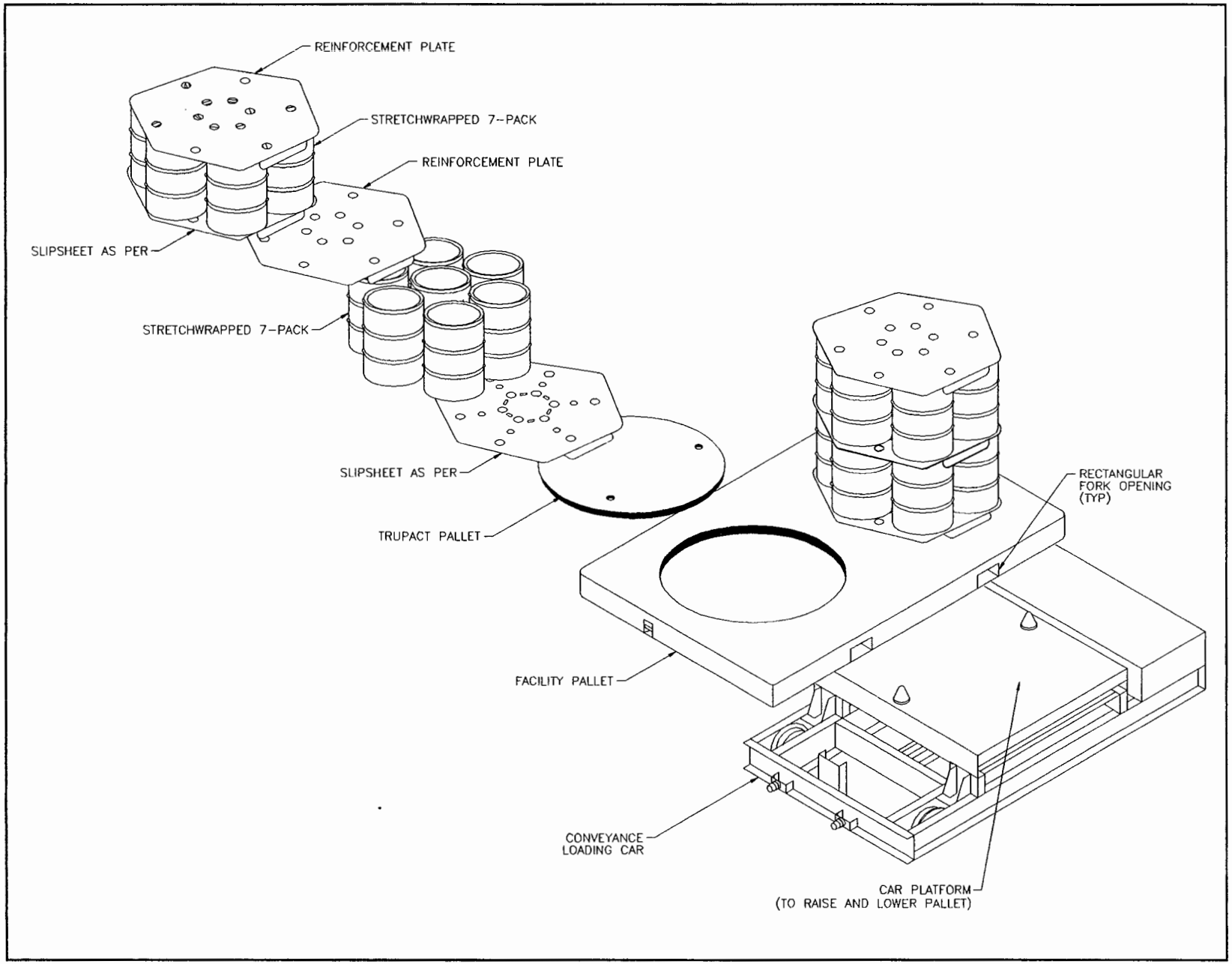

Figure D-18
Conveyance Loading Car with Seven-Packs and Facility Pallet

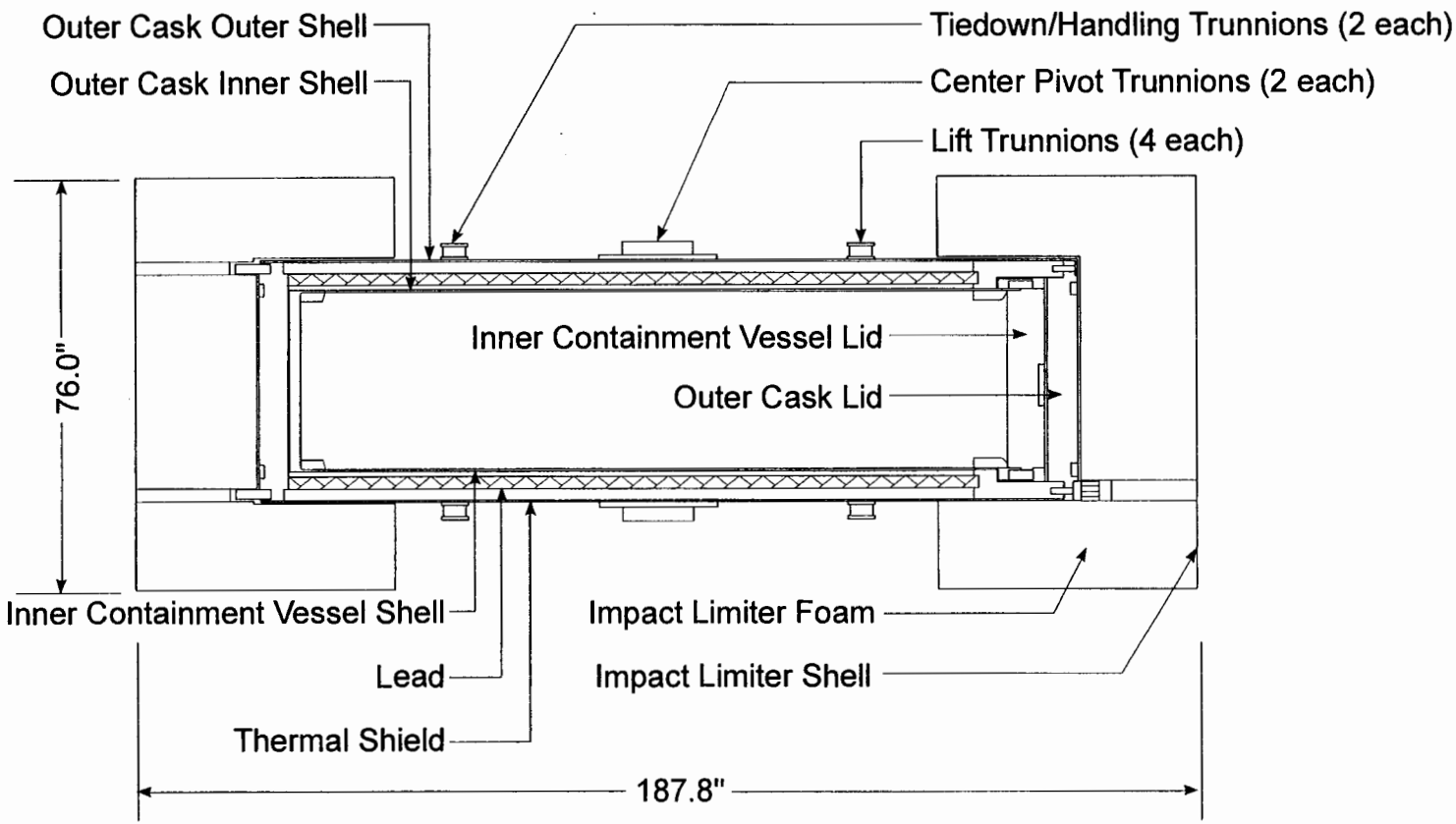

Figure D-19

RH-72B Shielded Road Cask for RH Transuranic Mixed Waste (Schematic)

RCRAD19

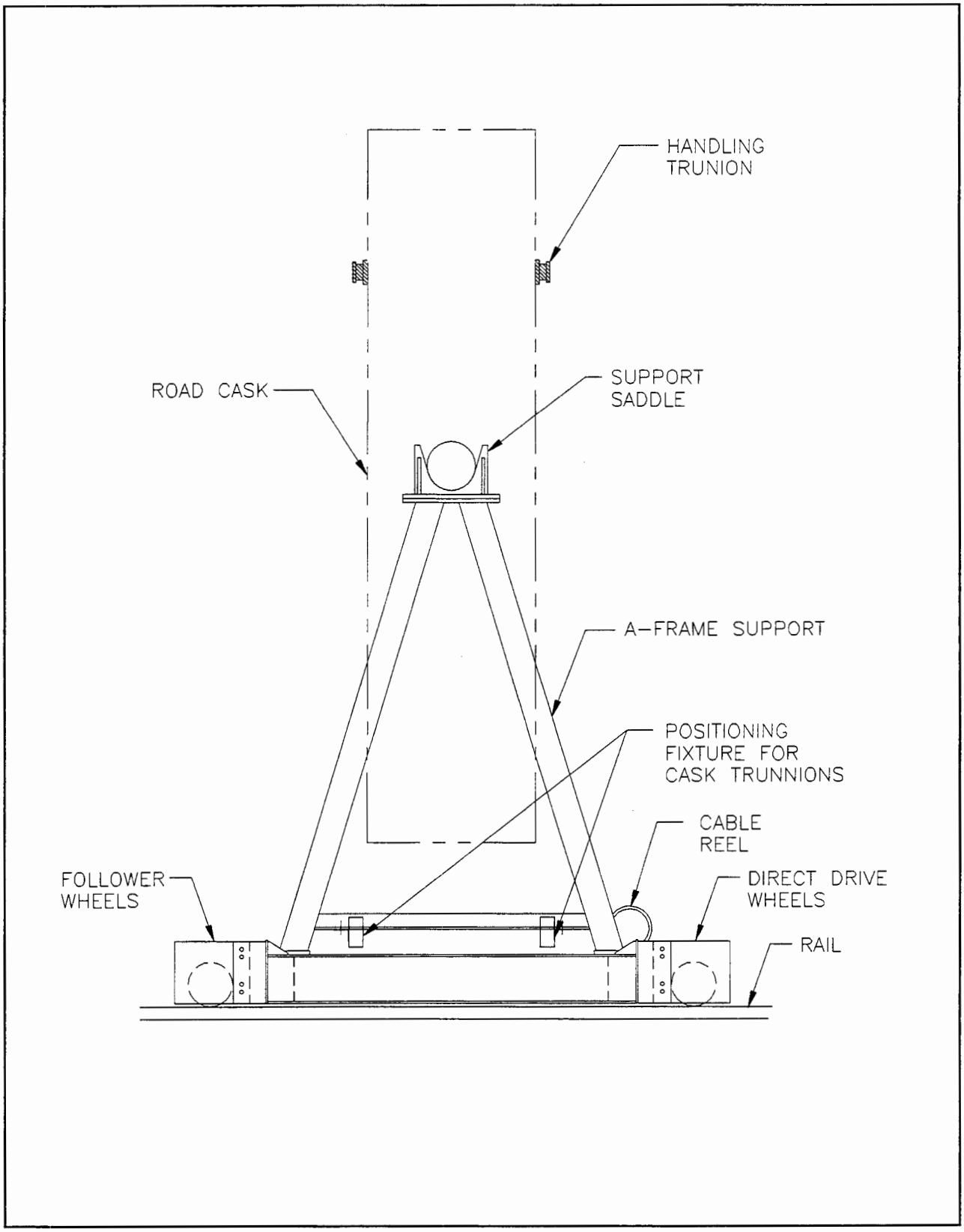

Figure D-20
Road Cask Transfer Car (Side View)

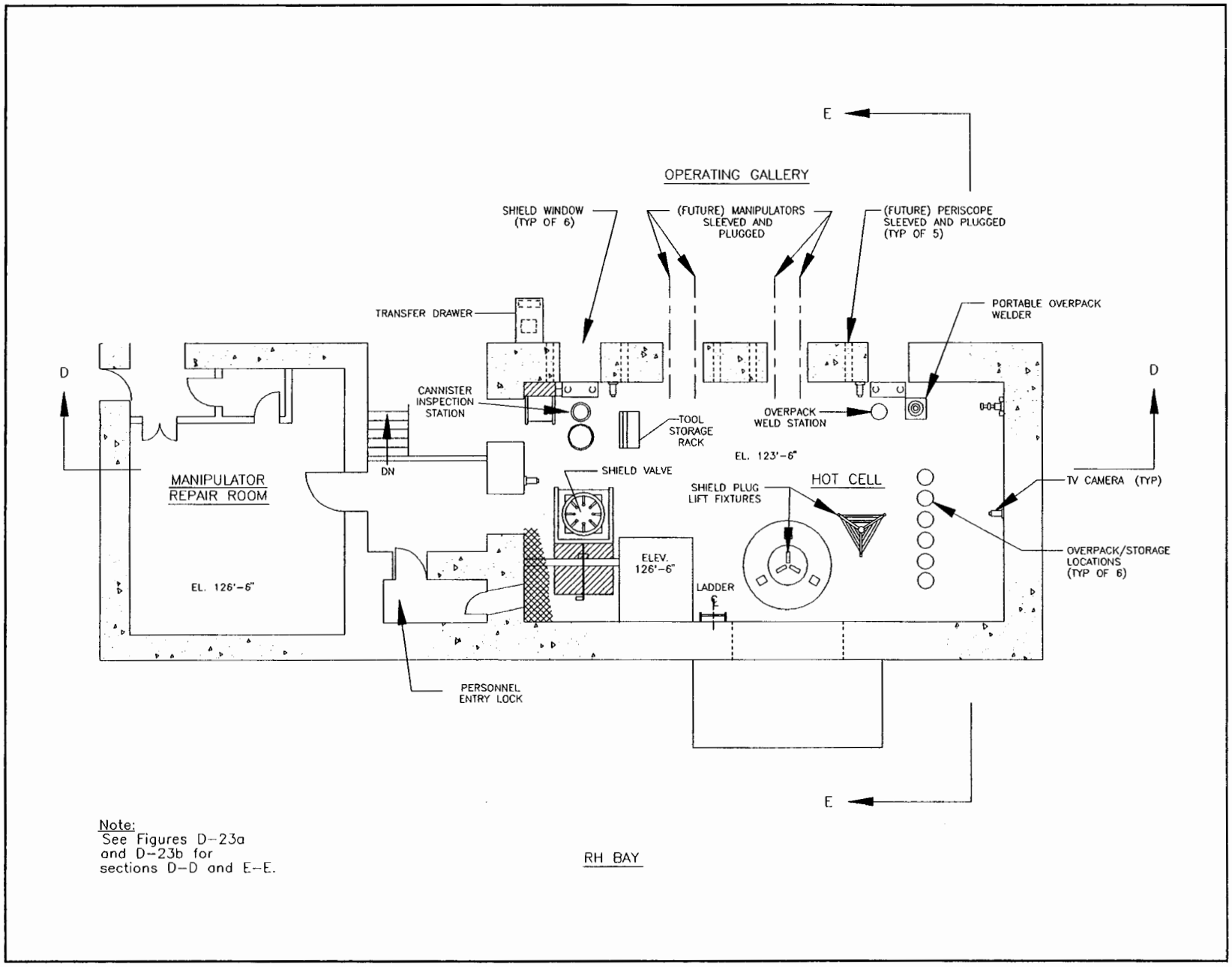

Figure D-21
Hot Cell Floor Arrangement

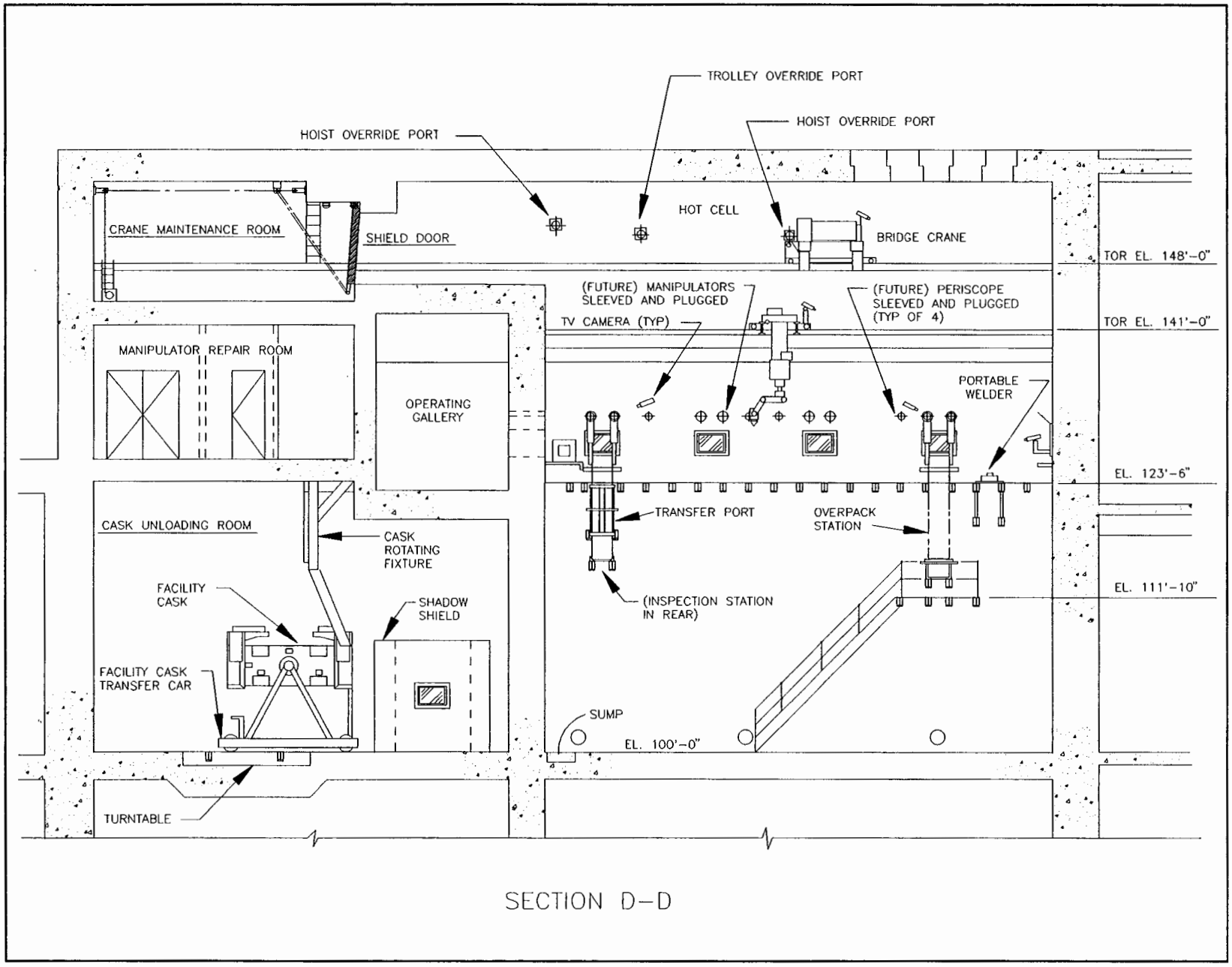

Figure D-22
East-West Cross Section of the Hot Cell Complex

RCRAD23A

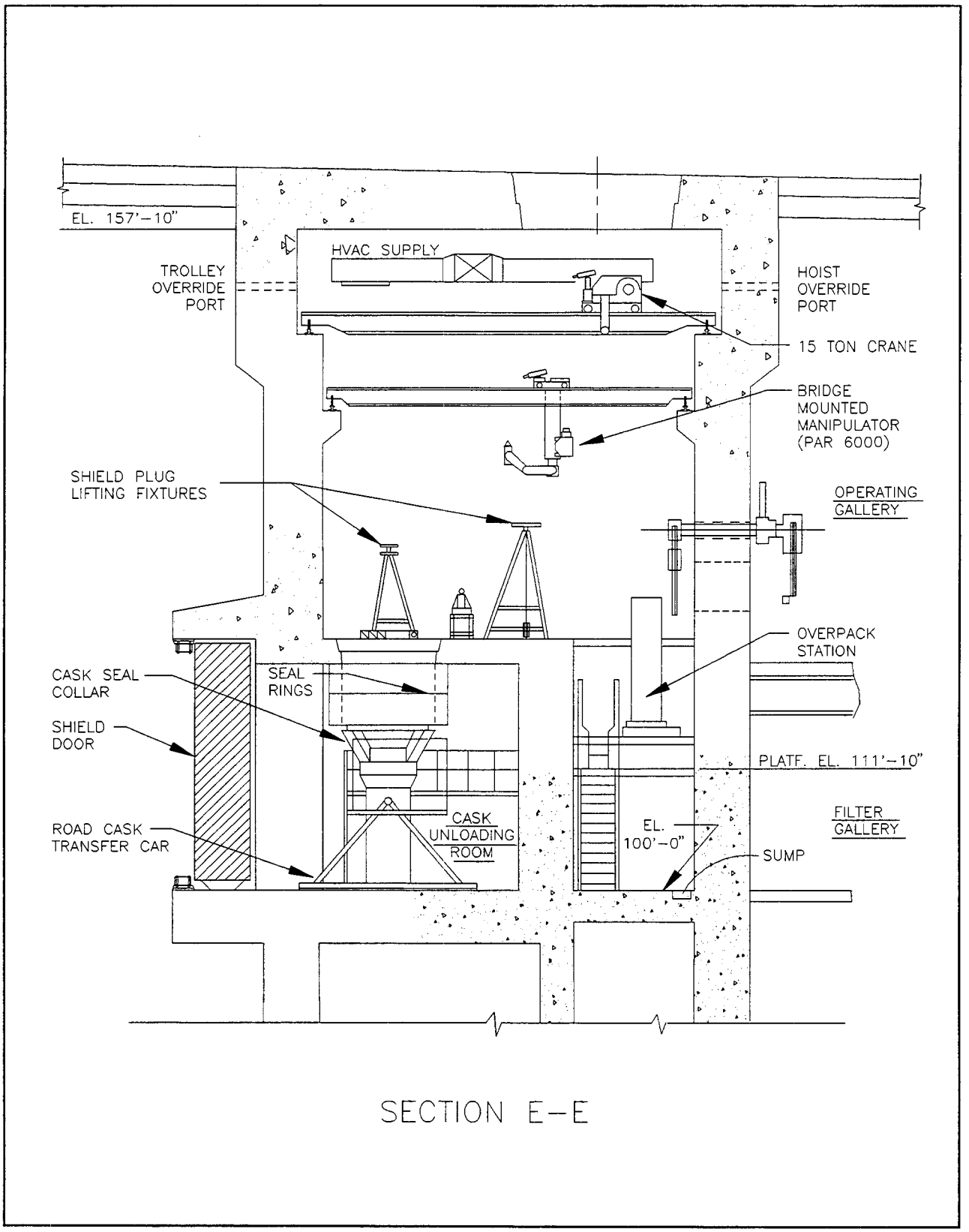

Figure D-23
North-South Cross Section of the Hot Cell Complex

RCRAD23B

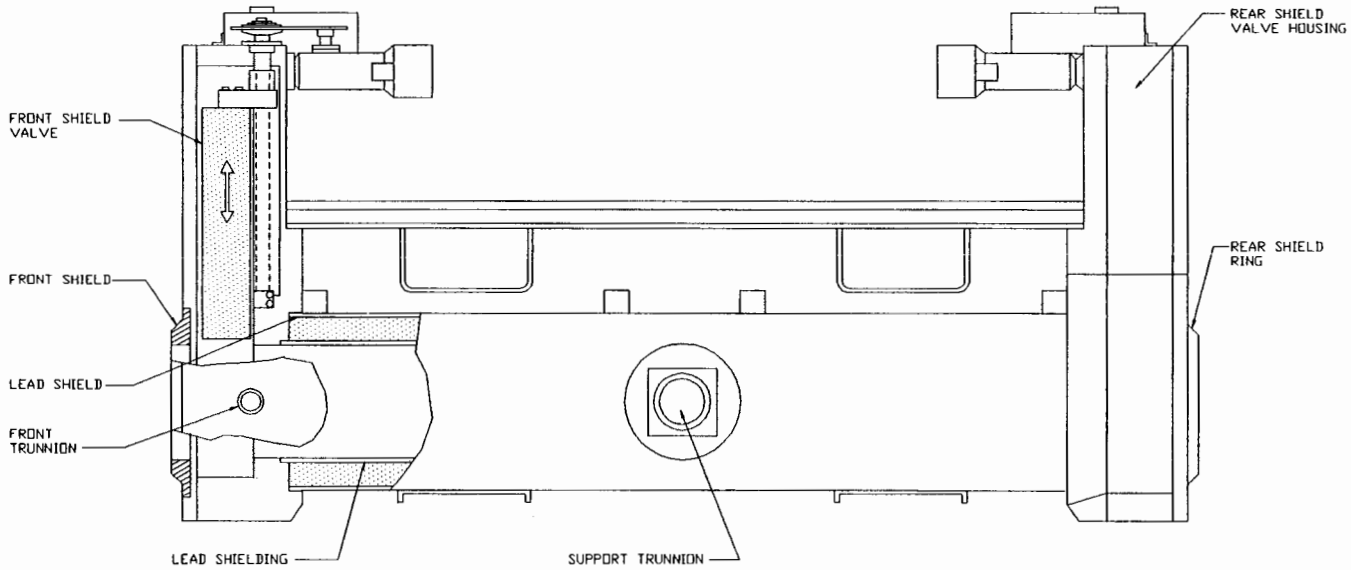

Figure D-24
Facility Cask

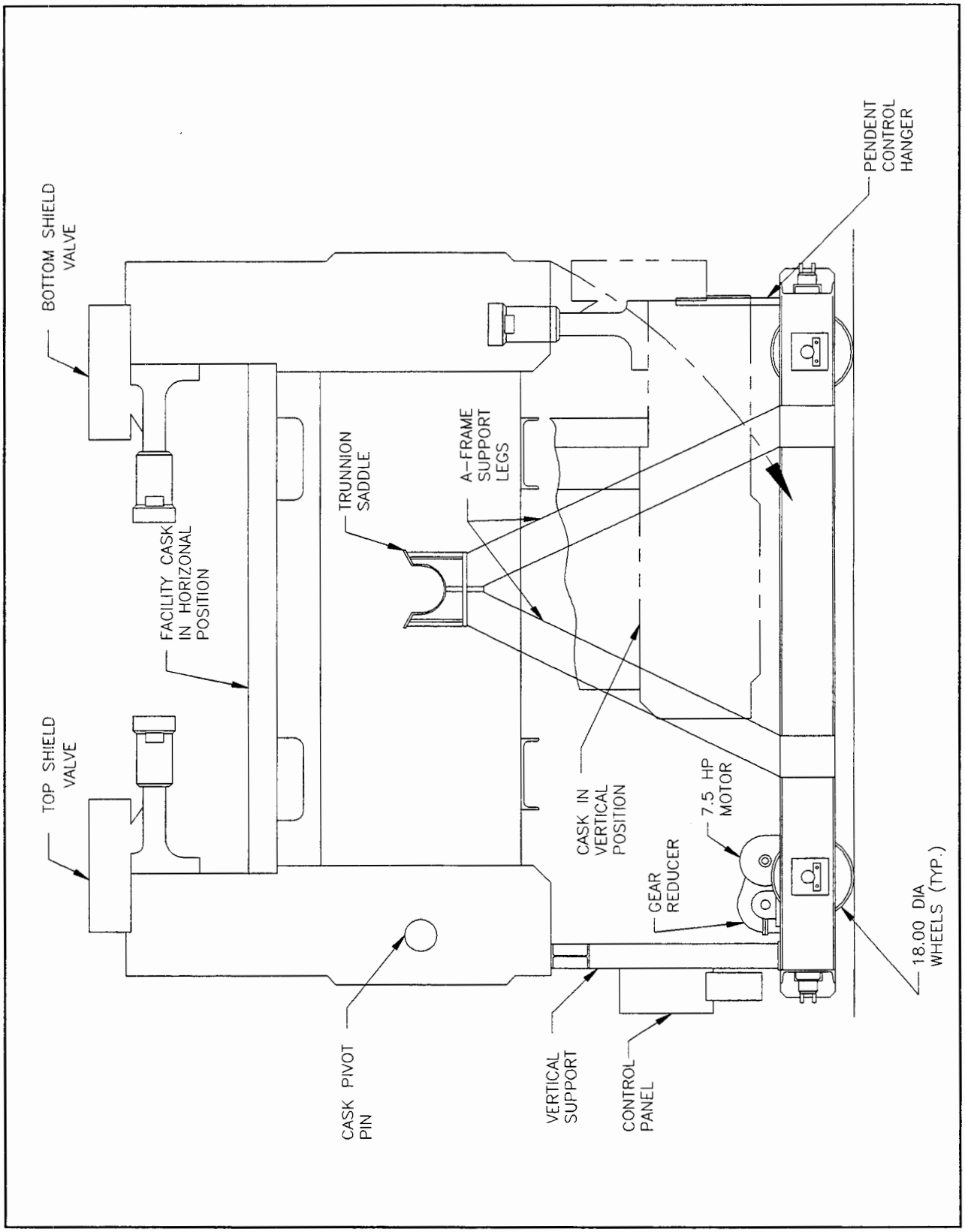

Figure D-25
Facility Cask Transfer Car (Side View)

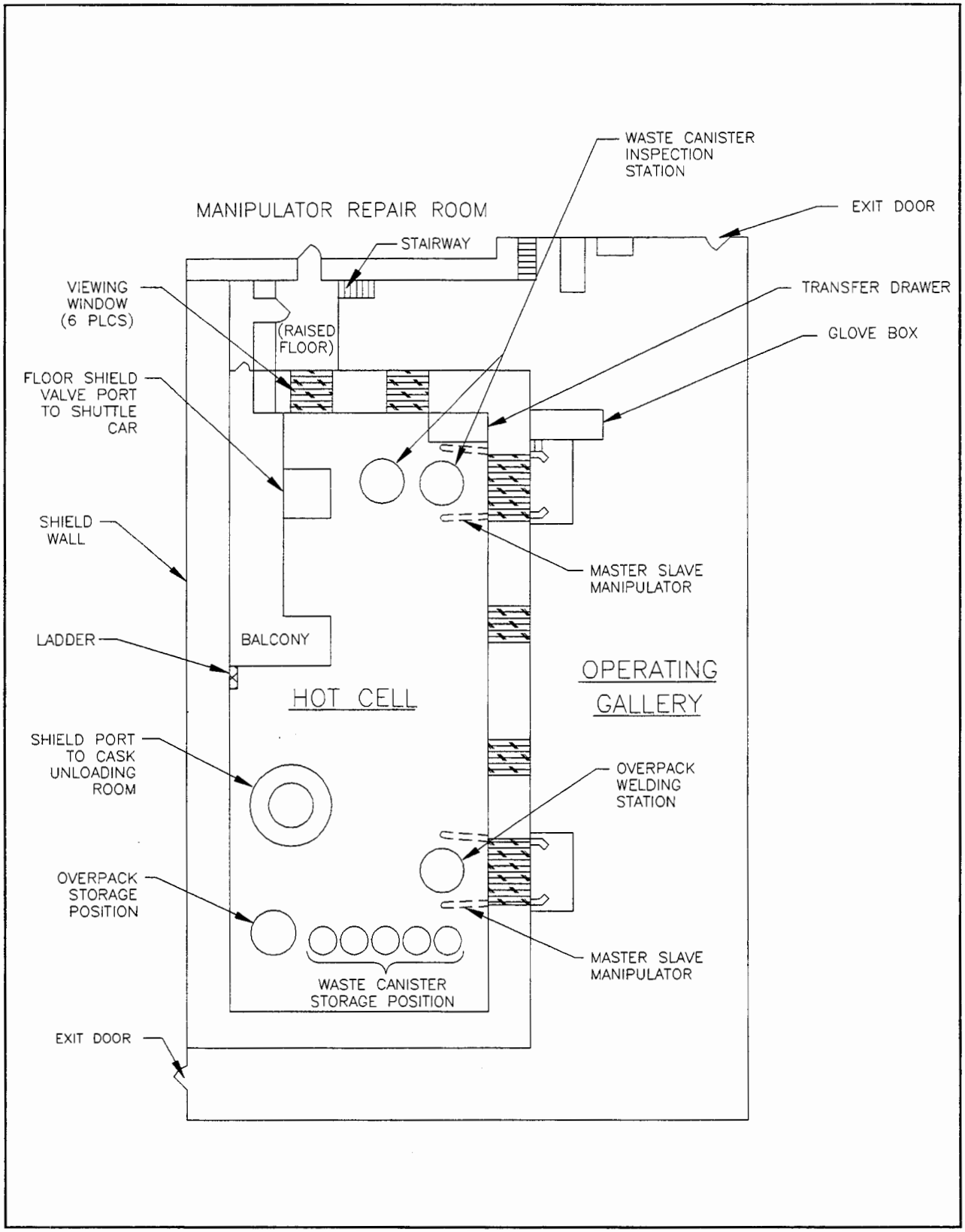

Figure D-26
RH Transuranic Mixed Waste Support Facilities

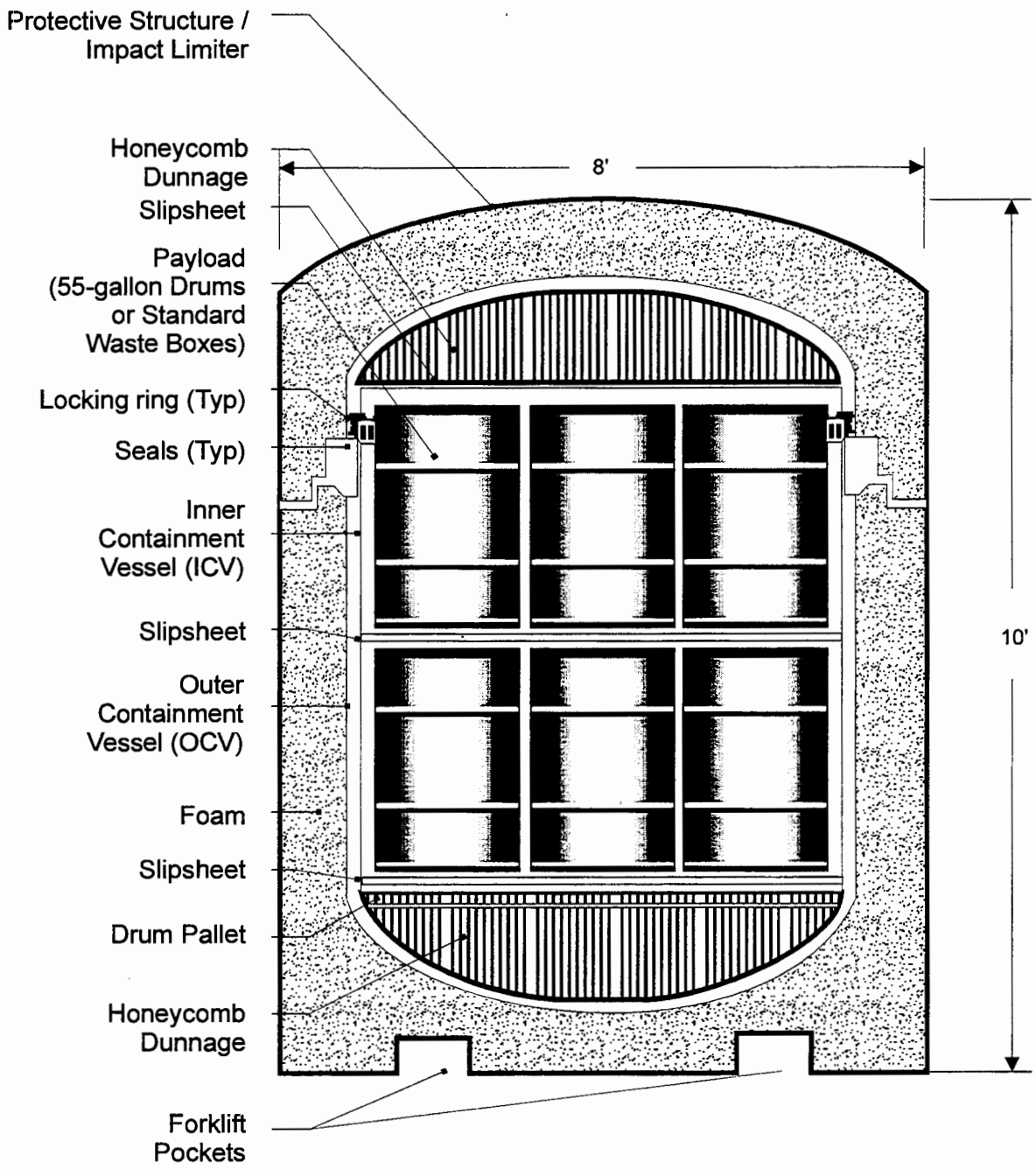

Figure D-27

TRUPACT-II Shipping Container for CH Transuranic Mixed Waste (Schematic)

RCRAD27

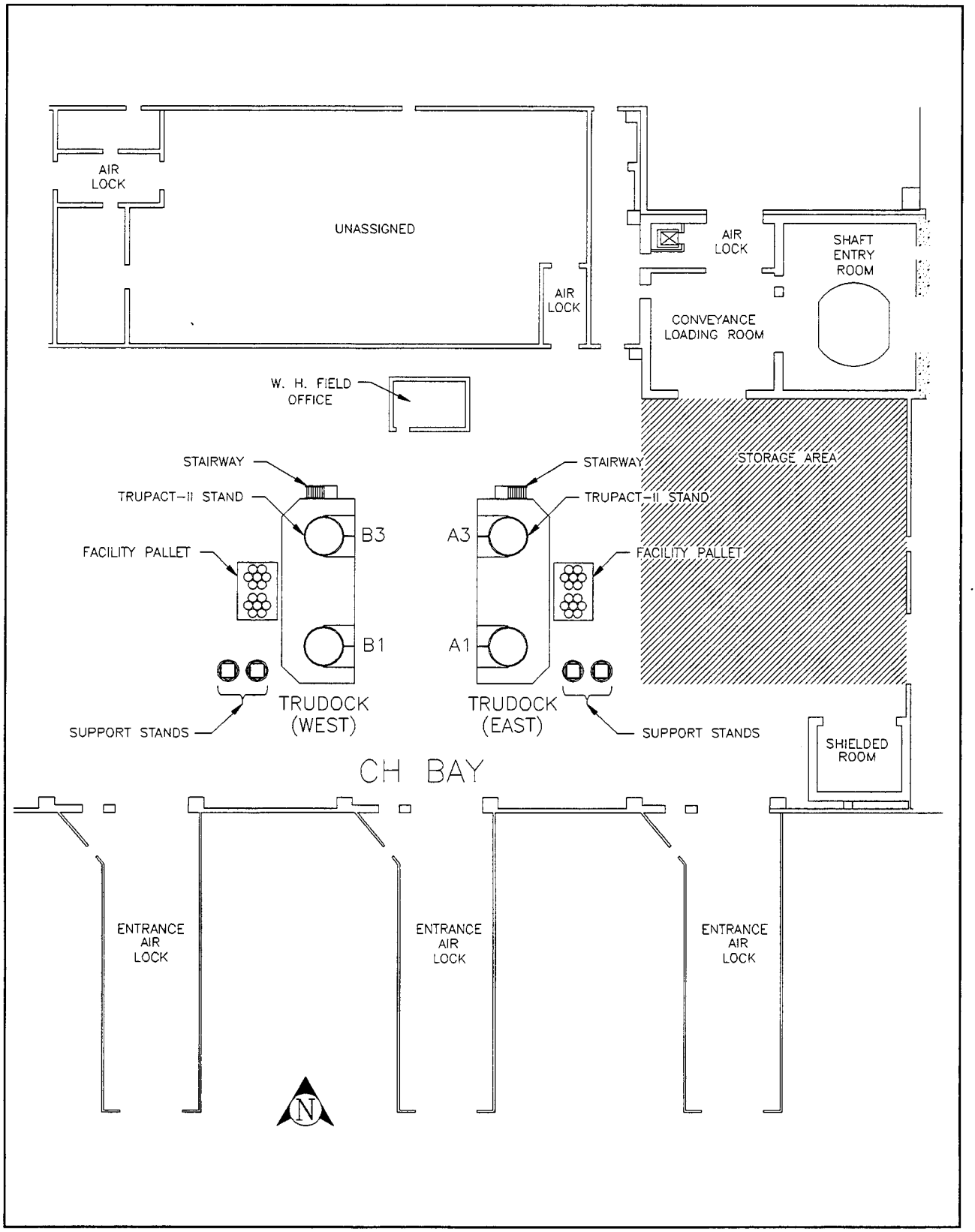

Figure D-28
Configuration of Contact-Handled Transuranic Mixed Waste Unloading Docks in the Waste Handling Building

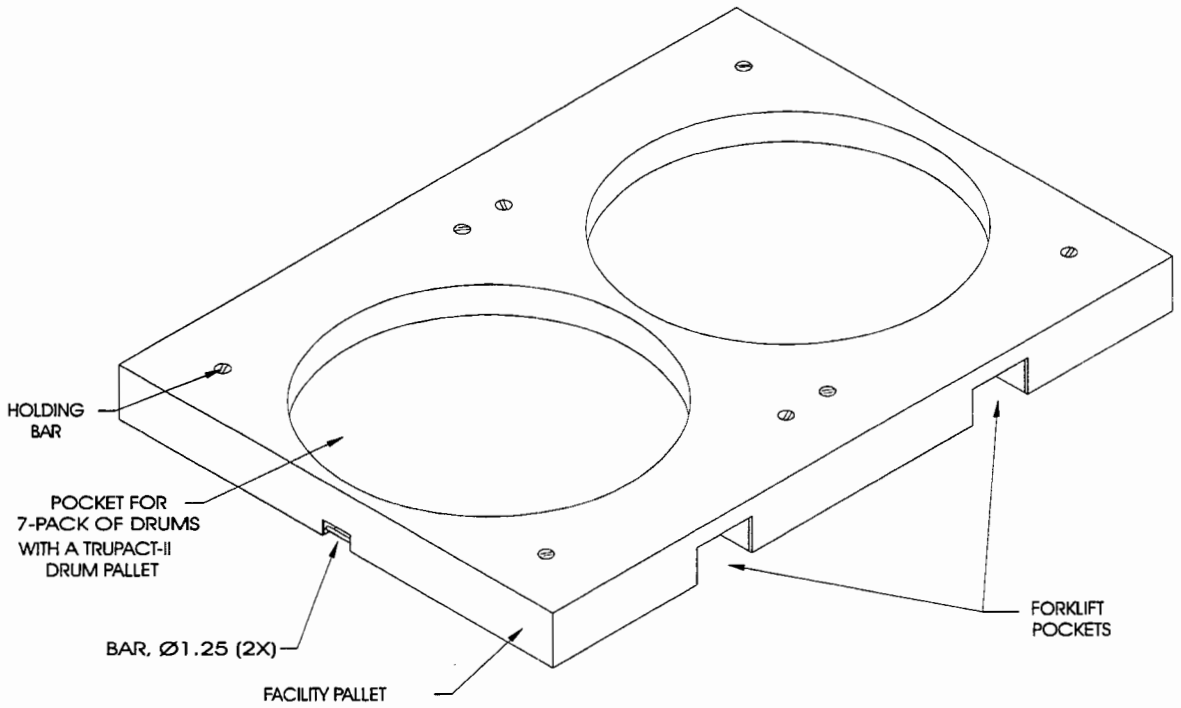

Figure D-29

Facility Pallet for Seven-Pack of Drums

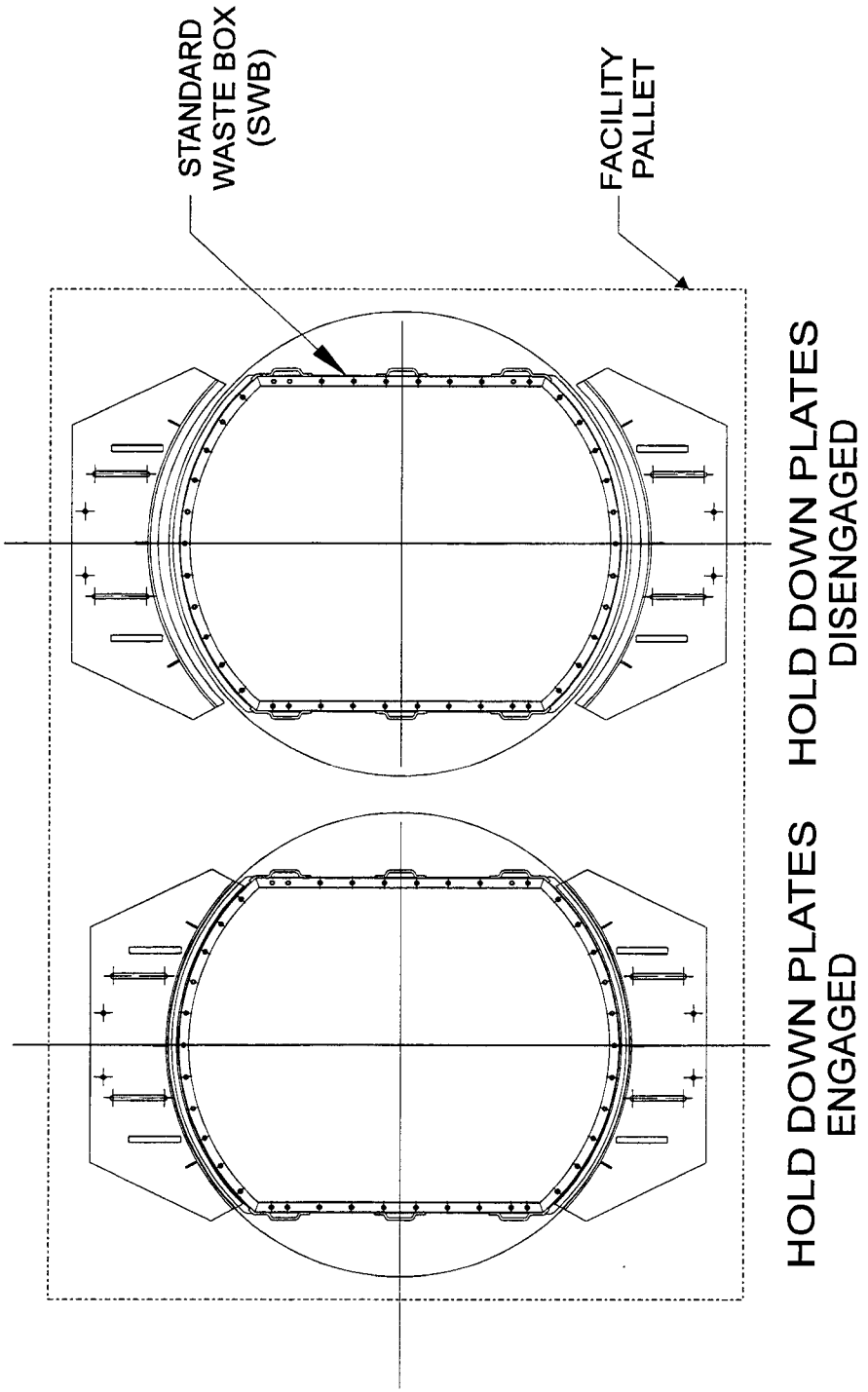

Figure D-30

Facility Pallet for the Standard Waste Box

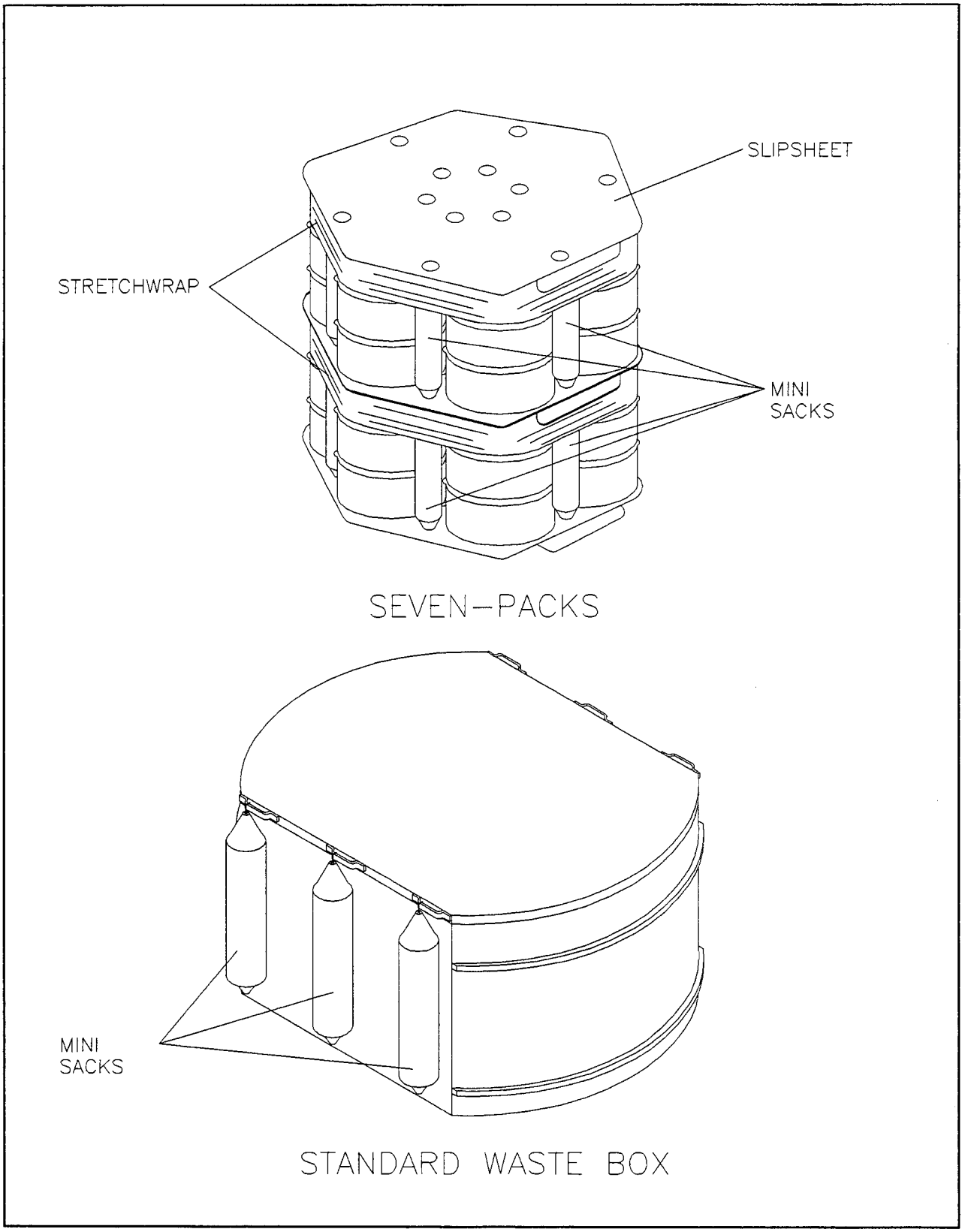

Figure D-30A
Waste Containers with Mini Sacks Attached

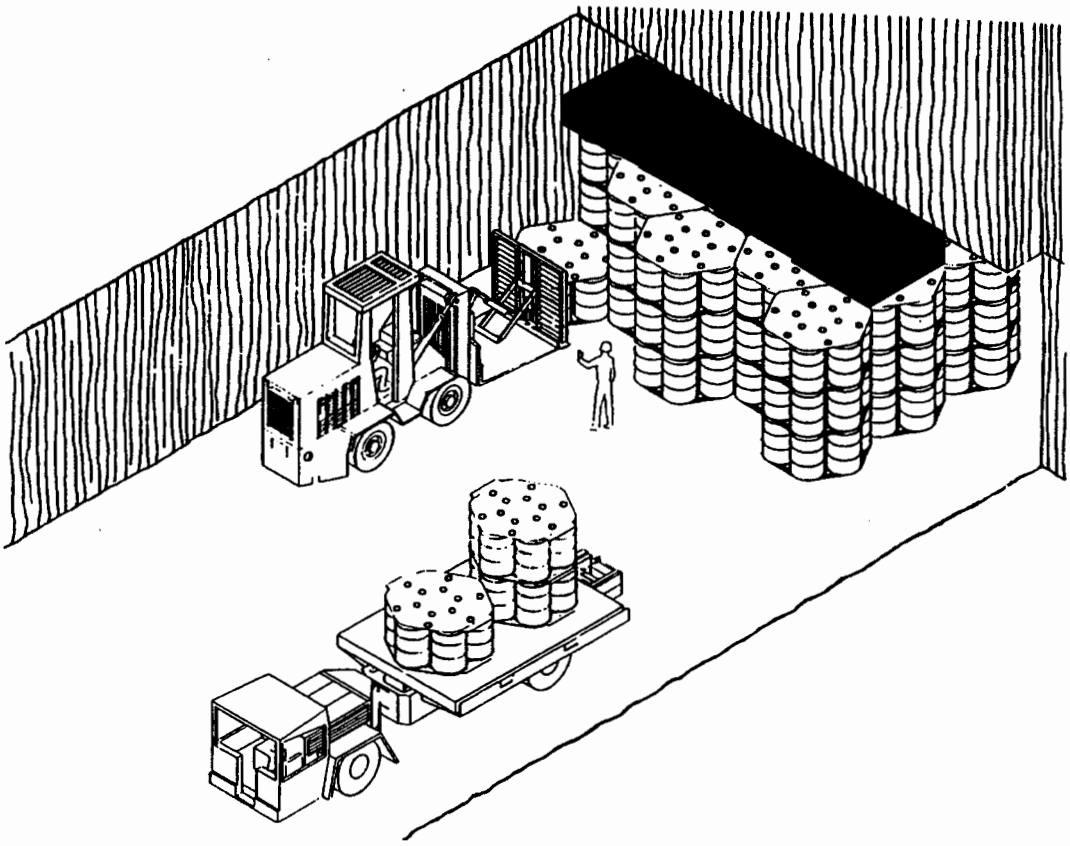

Figure D-30B

Backfill Sacks Emplaced in a Room

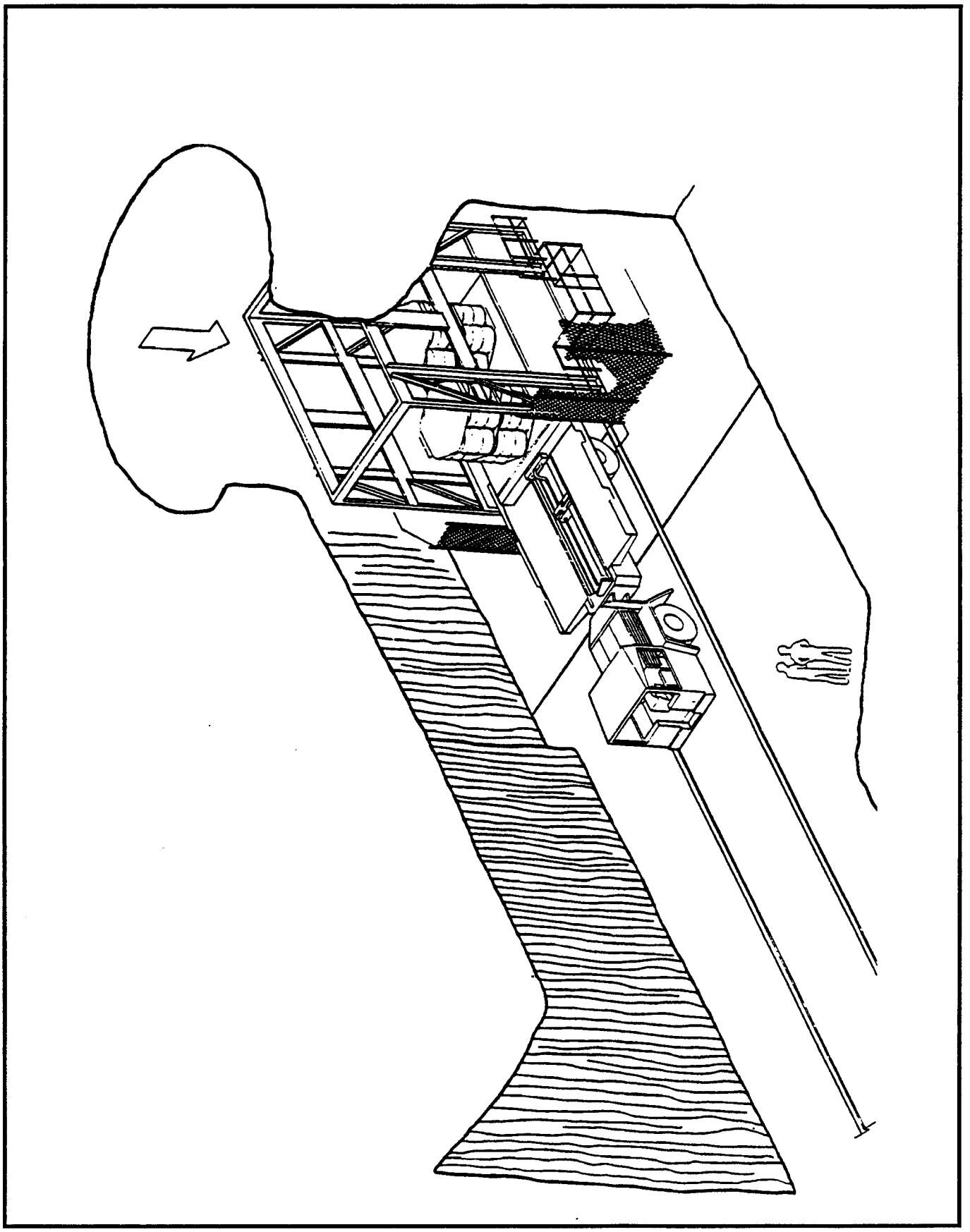

Figure D-31

Waste Transfer Cage to Transporter

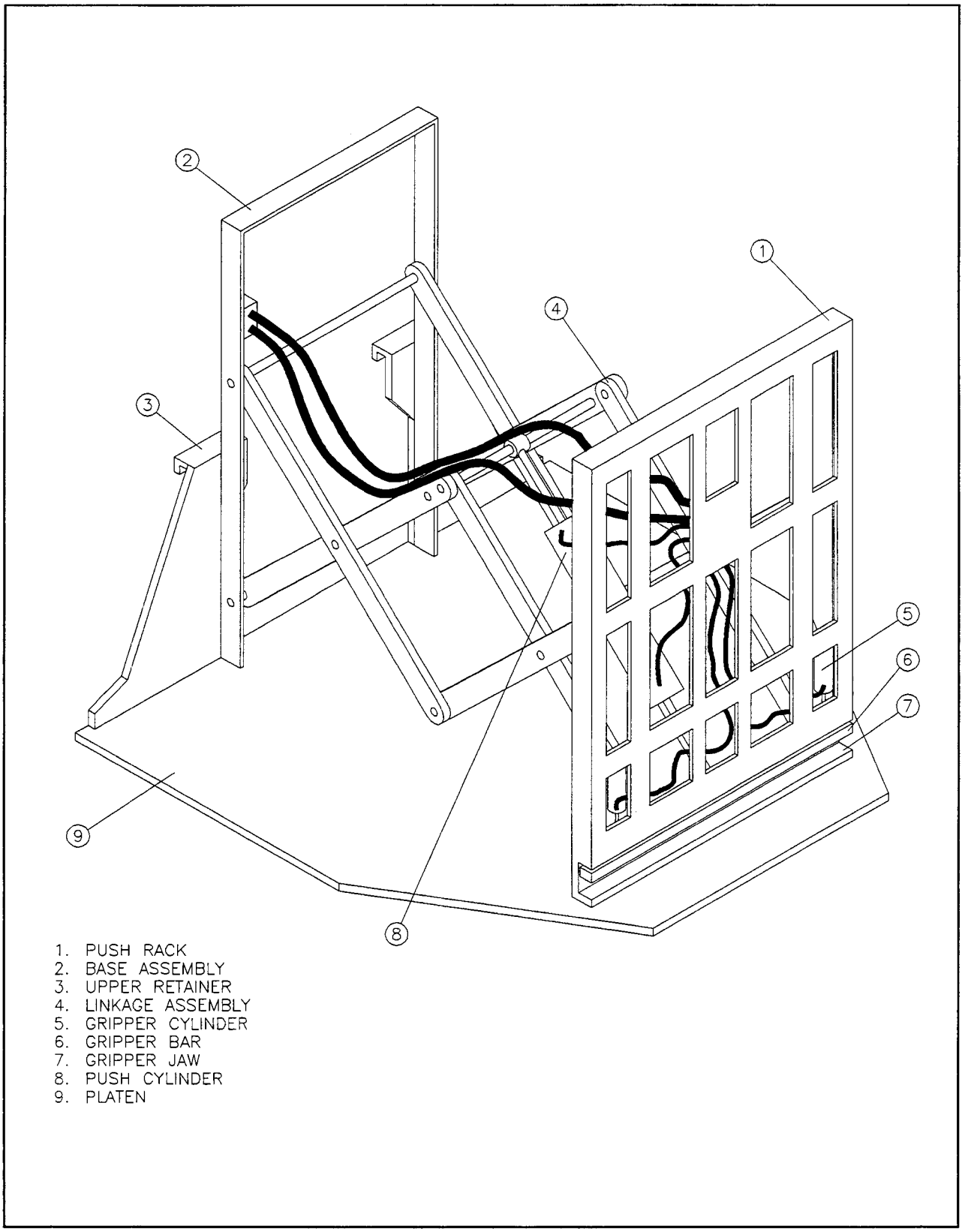

Figure D-32
BRUDI Attachment to Forklift to Allow Handling of Waste Containers

RCRAD14A

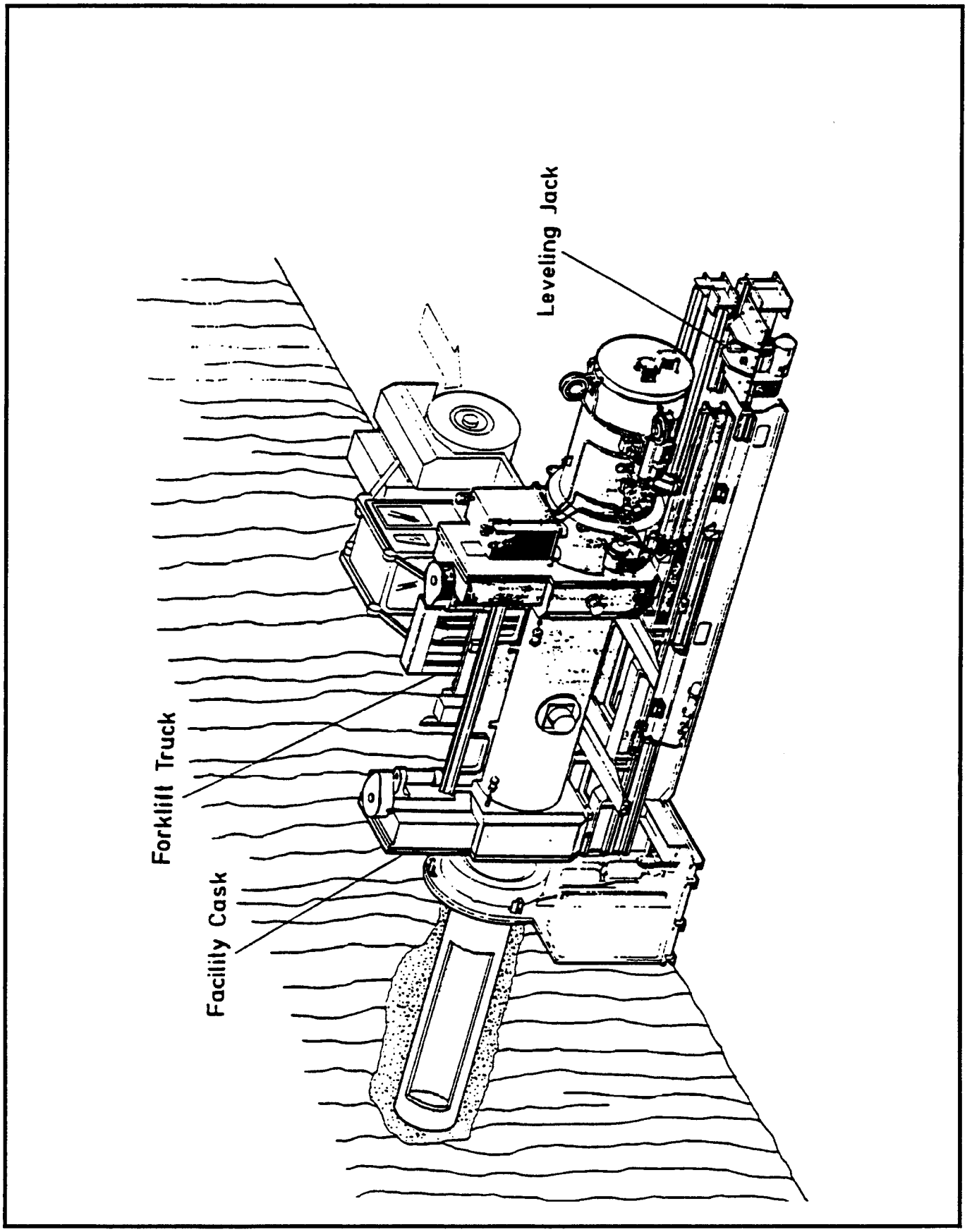

Figure D-33

Facility Cask Installed on Horizontal Emplacement Equipment

RCRAD33

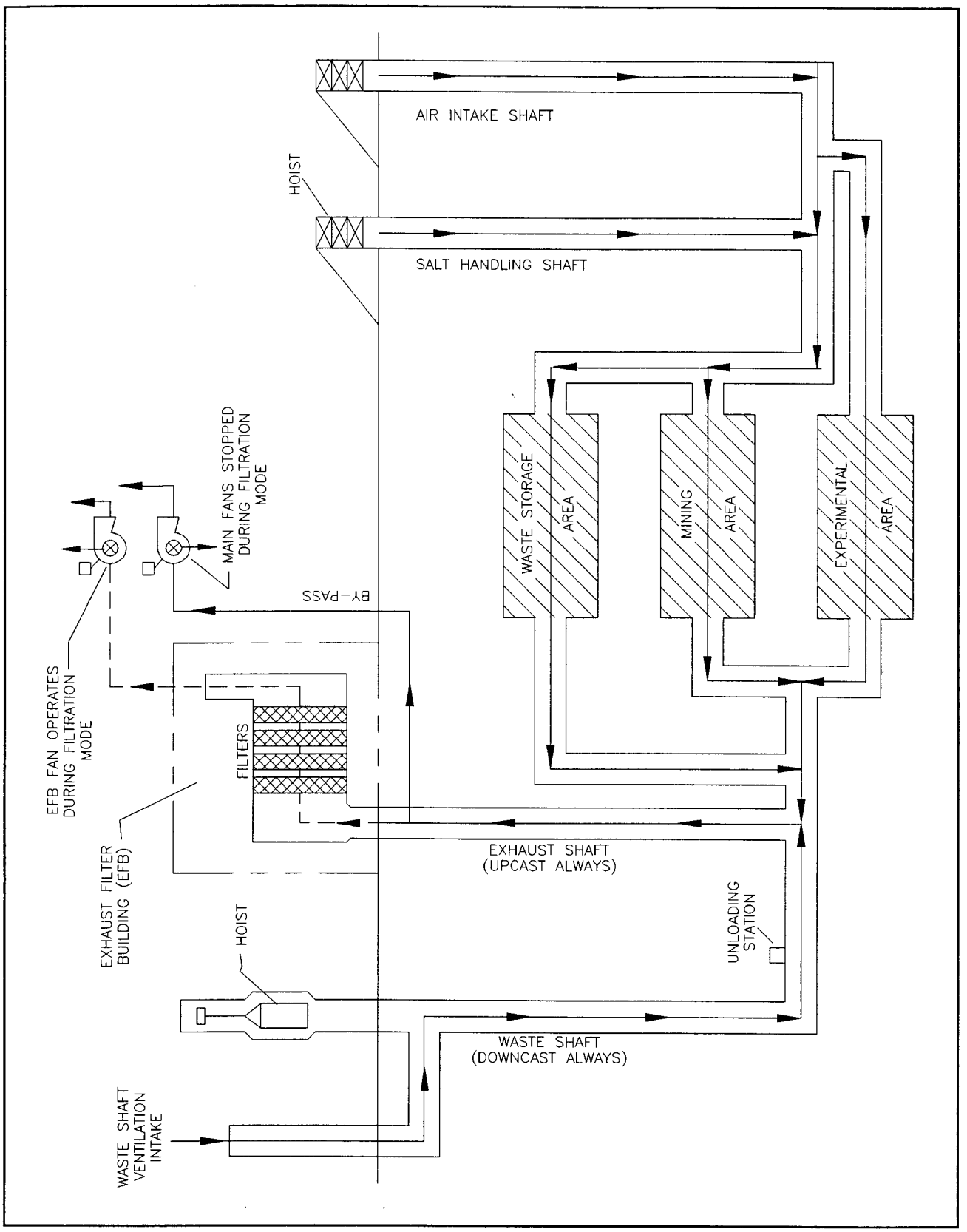

Figure D-34
Underground Ventilation System Airflow

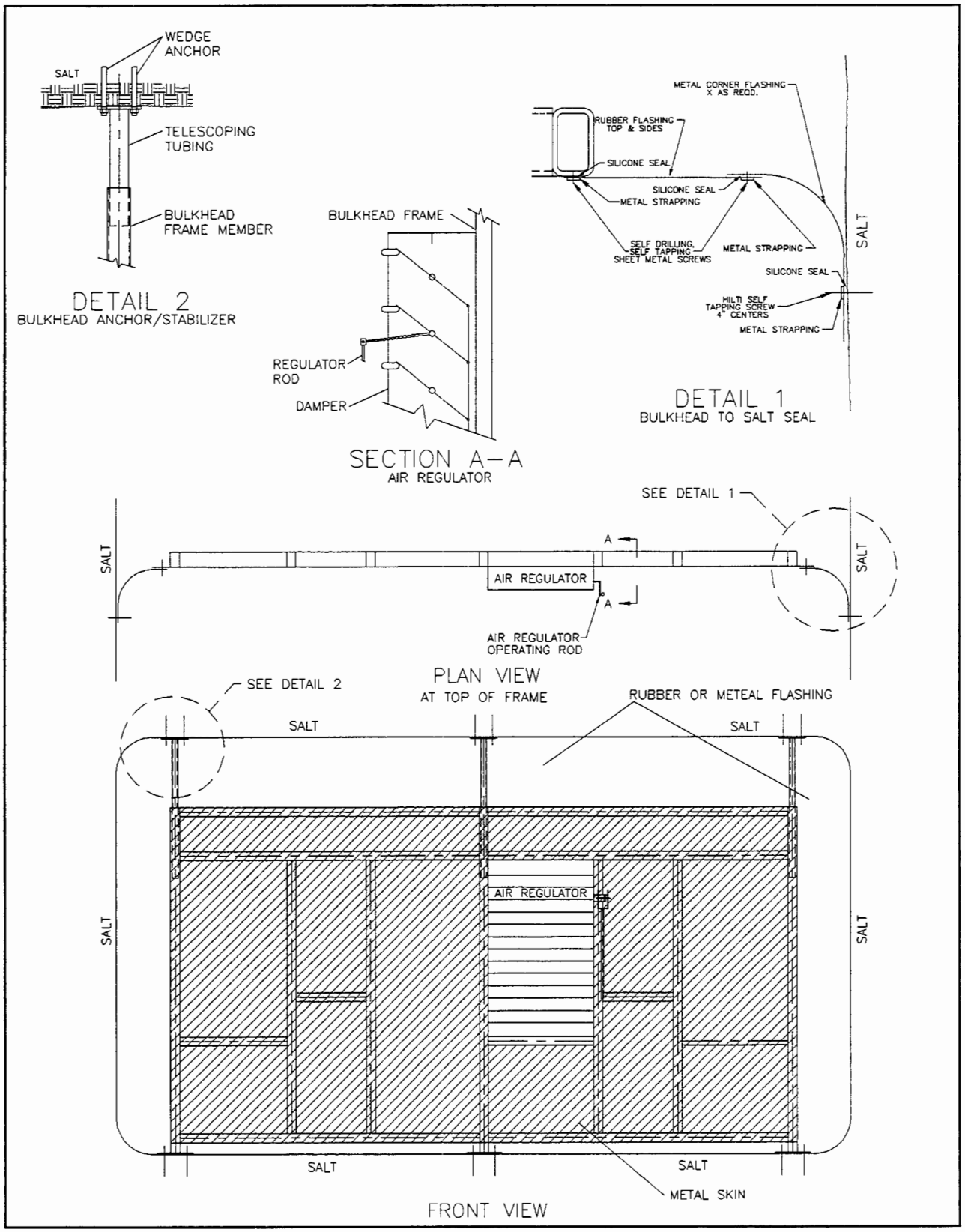

Figure D-34A
Typical Bulkhead Design and Components

RCRAD34A

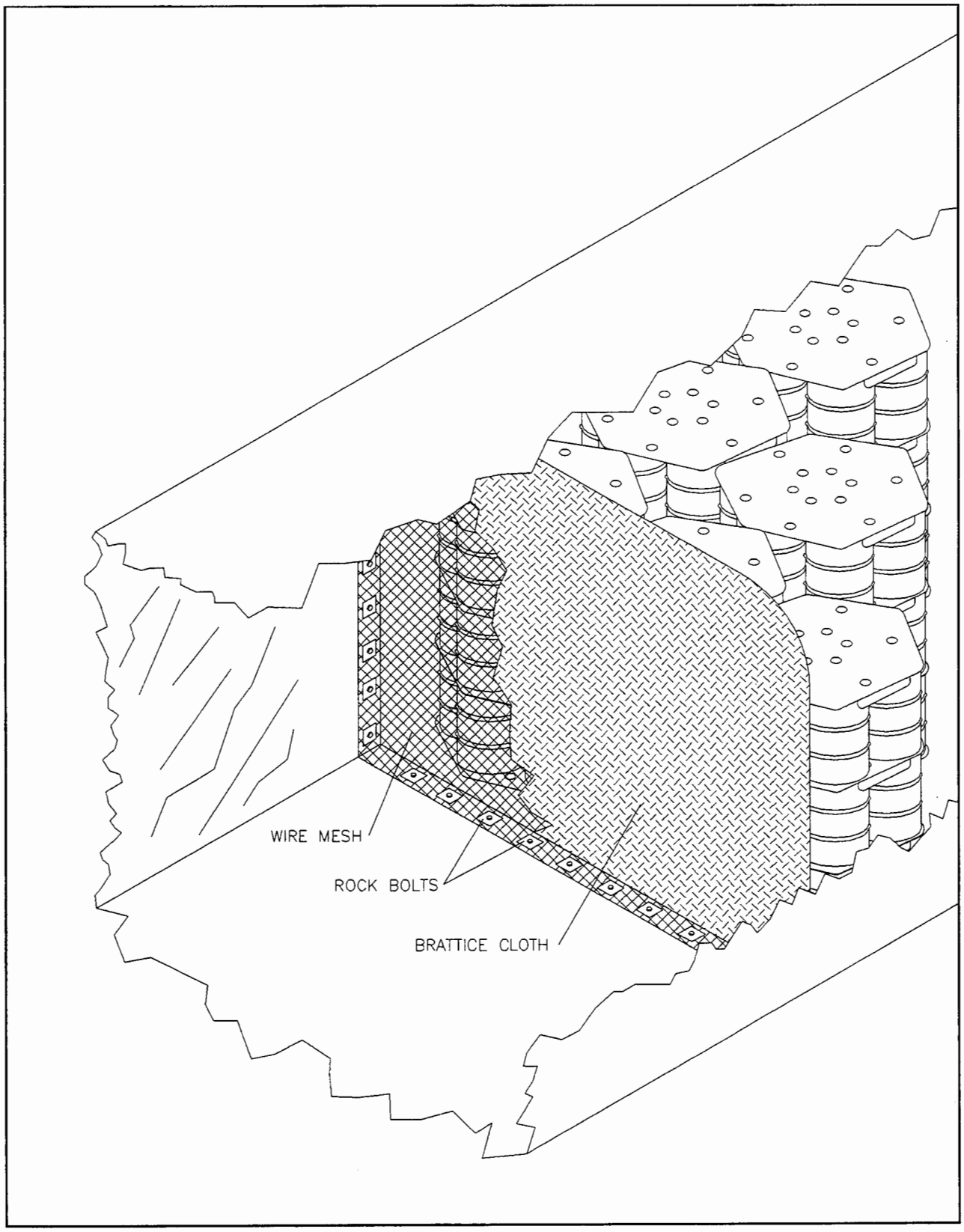

Figure D-34B
Typical Room Barricade

RCRAD34B

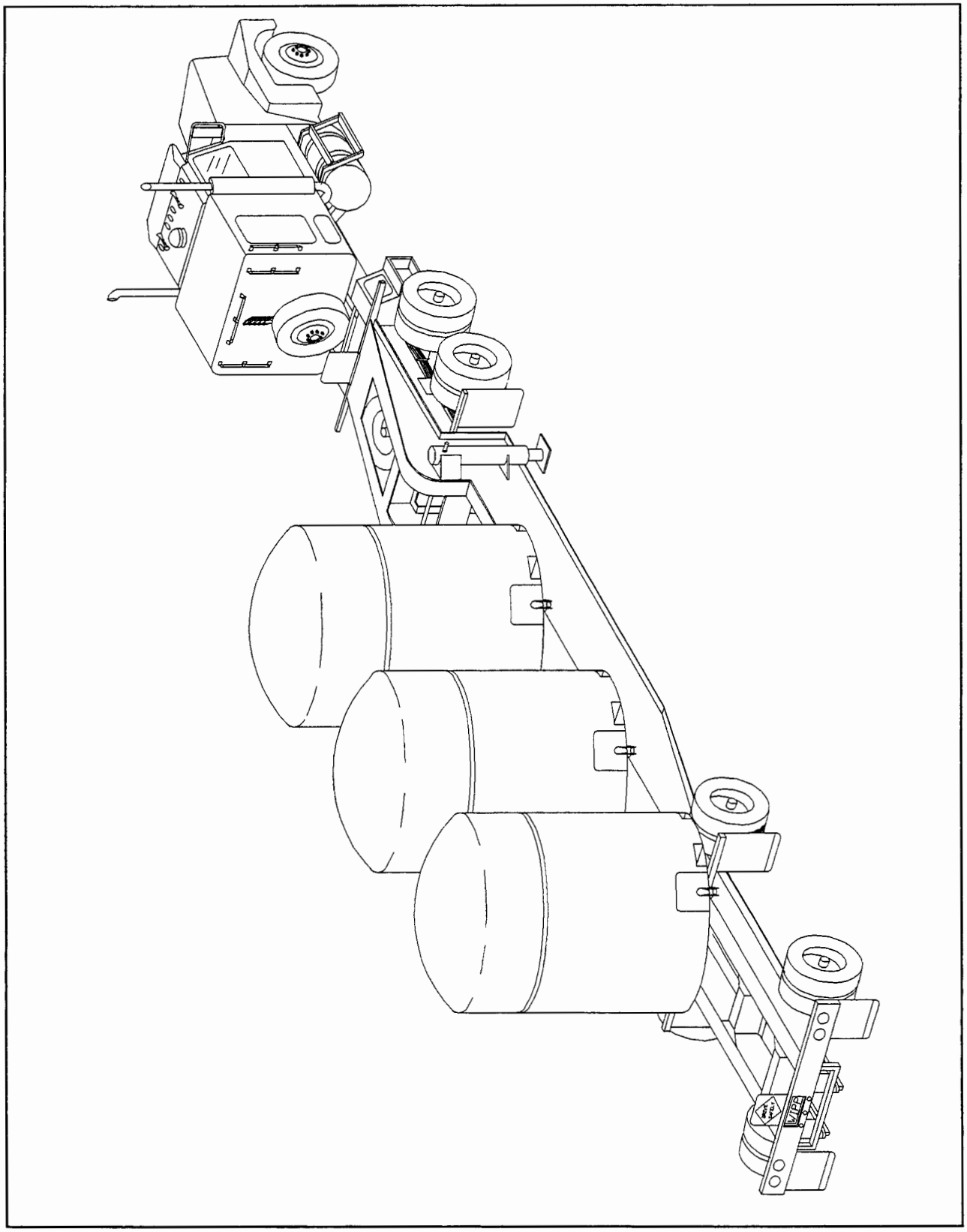

Figure D-35
TRUPACT-II Containers on Trailer

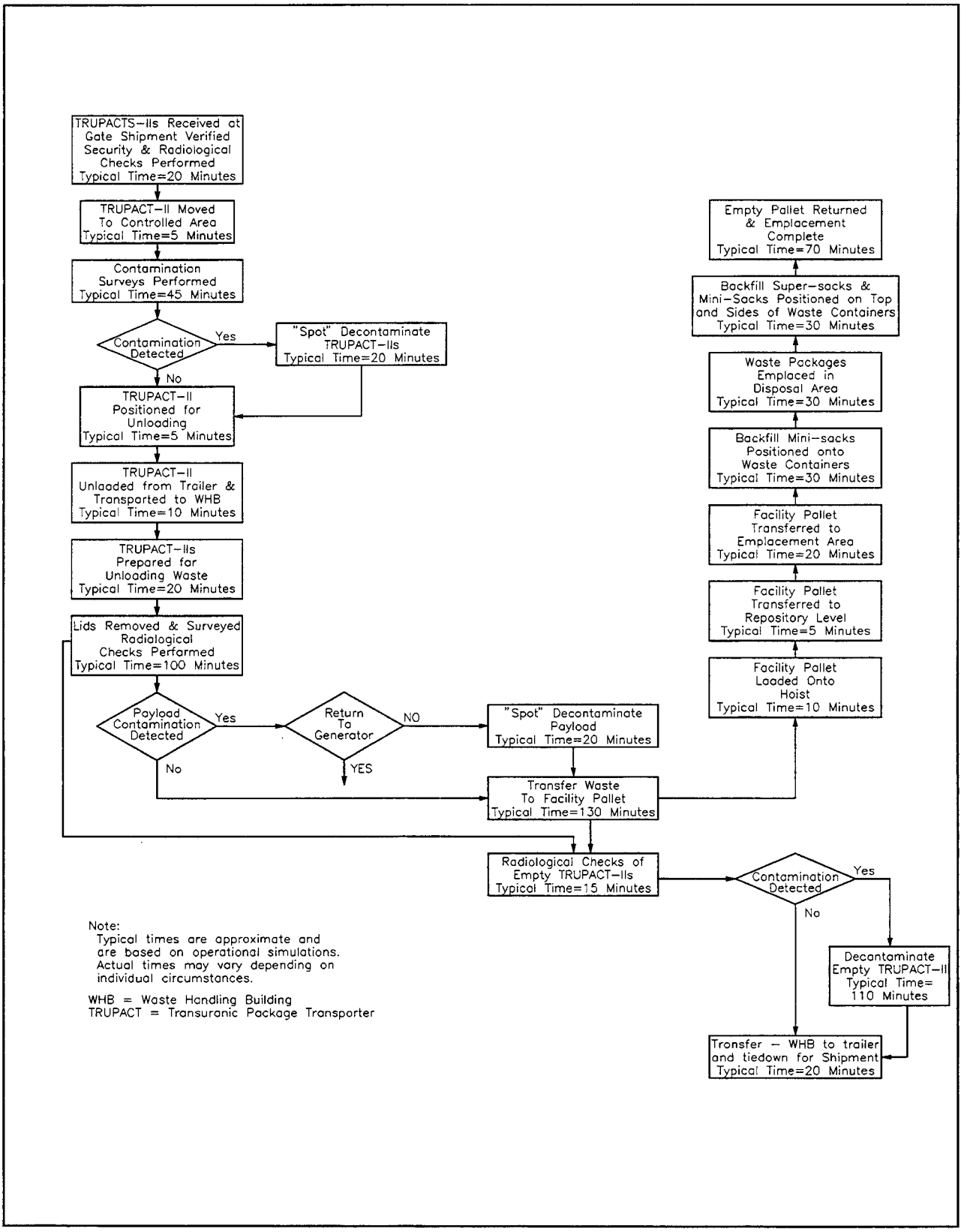

Figure D-36

WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram

RCRAD–36

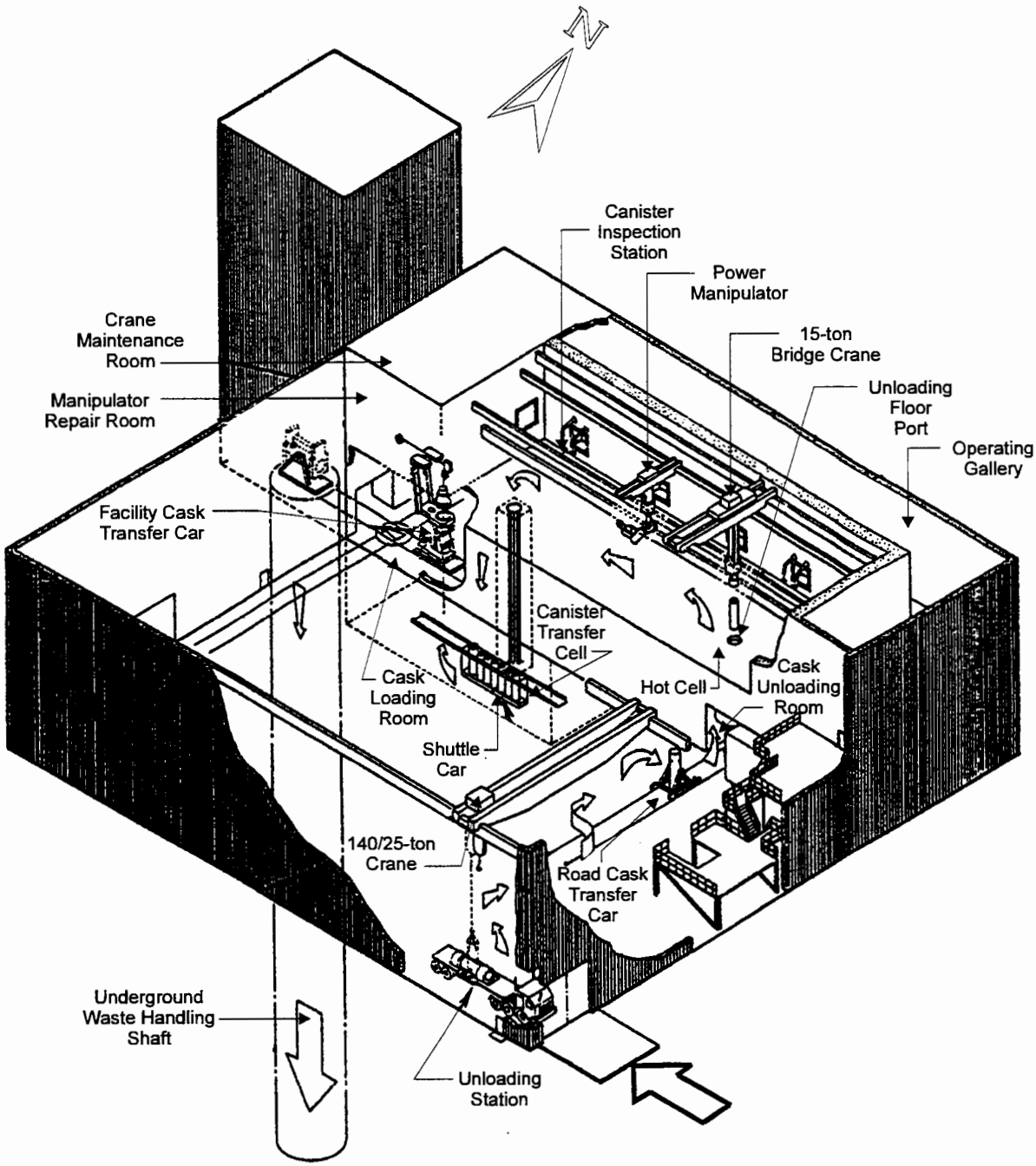

Figure D-37

RH Transuranic Mixed Waste Handling Process

RCRAD37

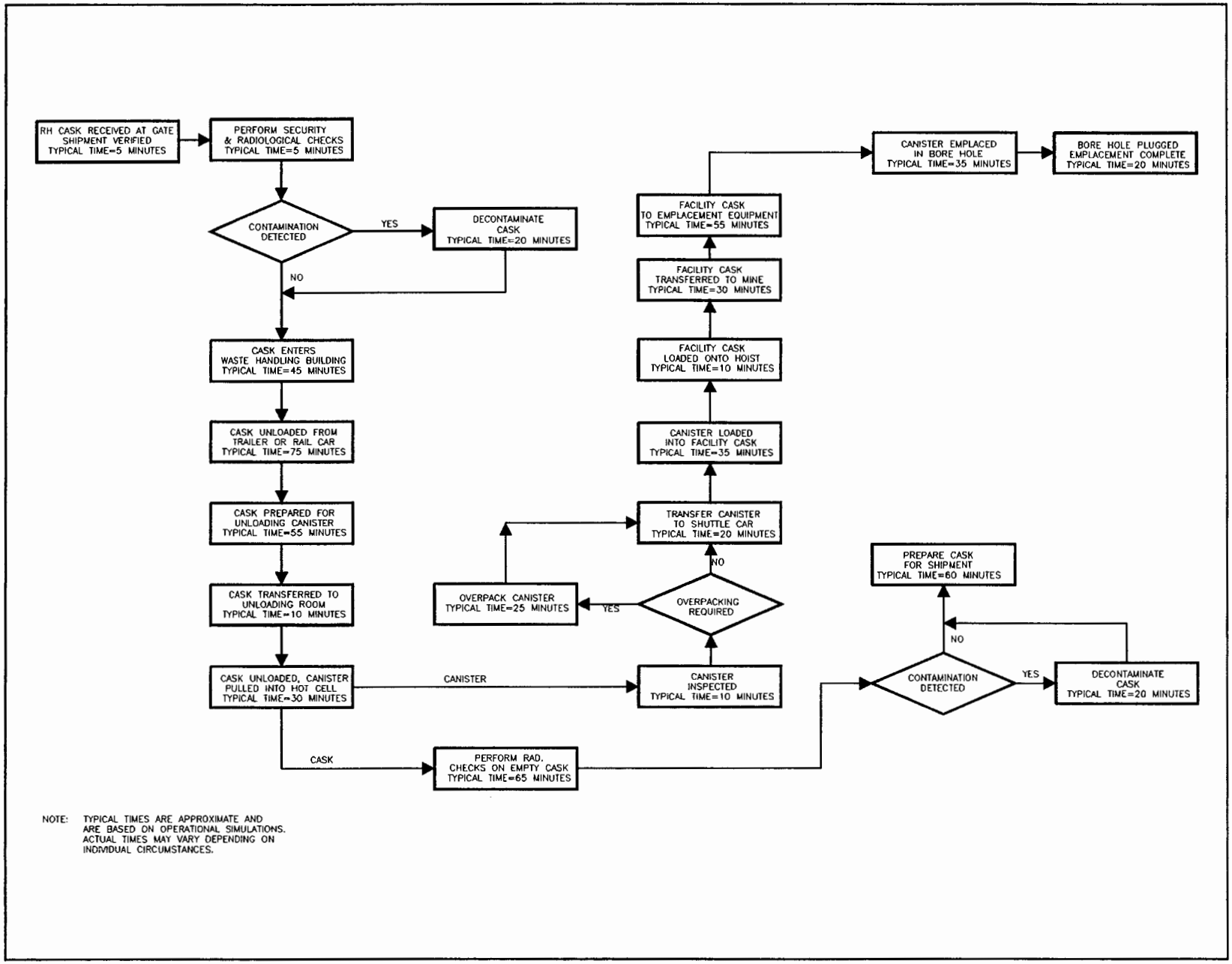

Figure D-38

WIPP Facility Surface and Underground RH Transuranic Mixed Waste Process Flow Diagram

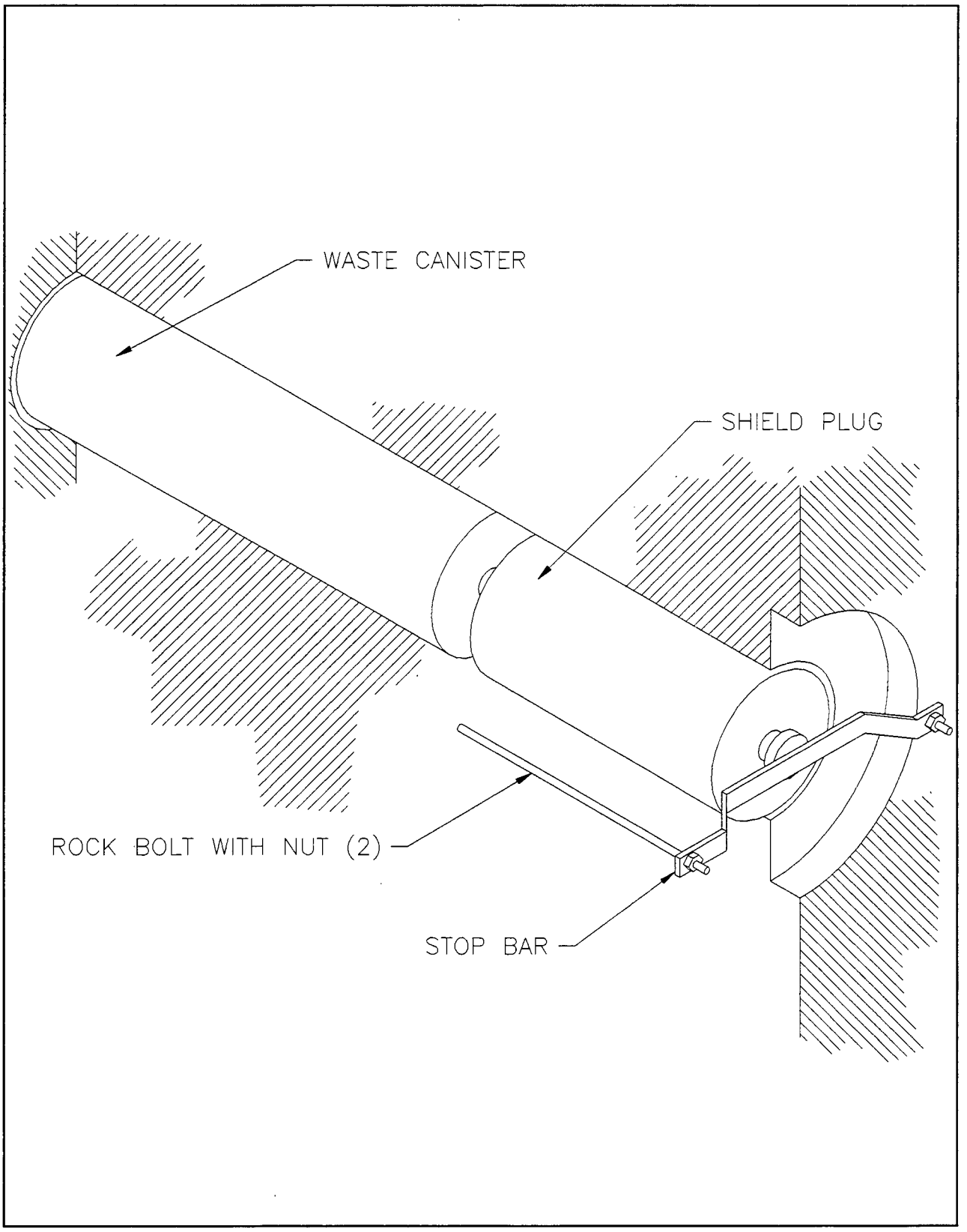

Figure D-39
Waste Canister and Shield Plug Installation

RCRAD18A

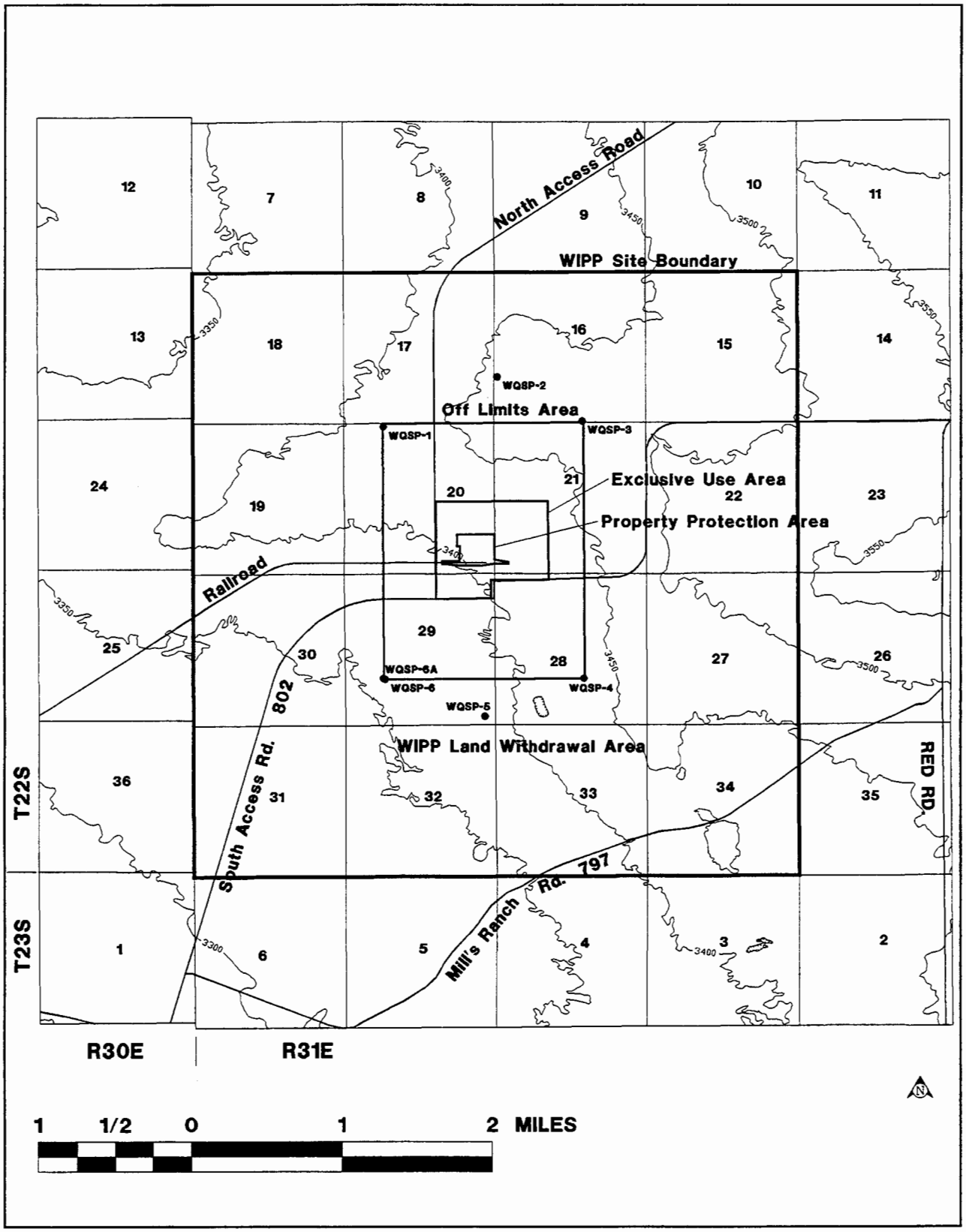

Figure D-39A
Location of the New Water Quality Sampling Wells

RCRAD39A

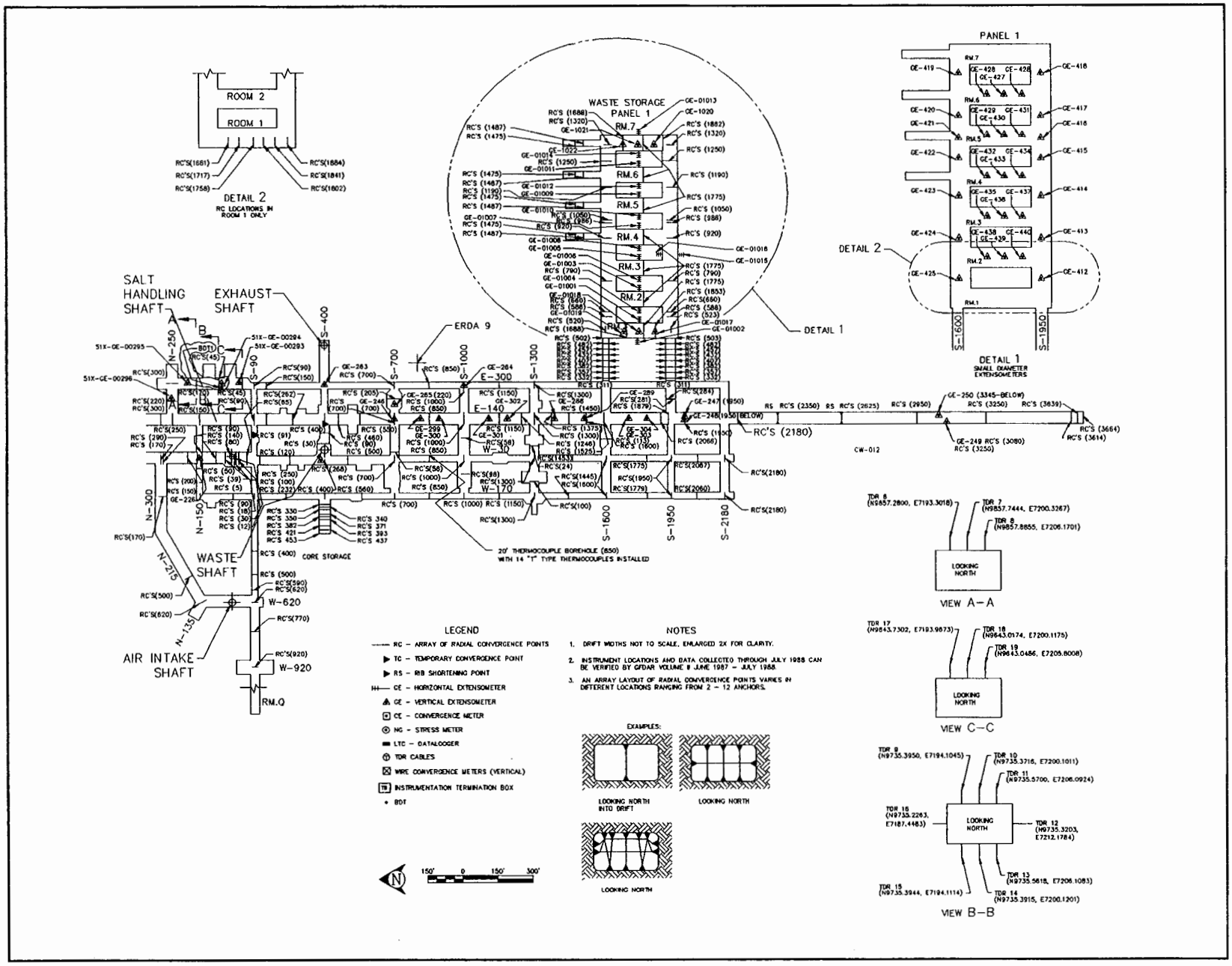

Figure D-40
Layout and Instrumentation - As of 1/96

CHAPTER F

PROCEDURES TO PREVENT HAZARDS

CHAPTER F
PROCEDURES TO PREVENT HAZARDS
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CHAPTER F
PROCEDURES TO PREVENT HAZARDS

Introduction

The purpose of this chapter is to describe the measures taken at the Waste Isolation Pilot Plant (WIPP) during the Disposal Phase to prevent hazards. It describes the security equipment and procedures in place at the WIPP facility that continuously monitor and control entry onto the active portion[1] of the facility, including 24-hour security surveillance, fencing, and signs. This chapter discusses the facility inspections (including container inspections) that are conducted to detect malfunctions, deterioration, operator errors, and discharges that may cause or lead to releases of hazardous waste or hazardous waste constituents to the environment or that could be a threat to human health. Preparedness and prevention procedures, structures, and equipment are also documented.

F-1 Security

The security requirements contained in Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart V, §264.14, and in 20 NMAC 4.1, Subpart IX, §270.14(b)(4), require that security be provided by 24-hour surveillance <u>or</u> that a barrier be provided to control entry to the active portion of the facility at all times. If these requirements cannot be met, a waiver from the security requirements may be requested. The following sections demonstrate that the WIPP facility fully complies with the requirements and that a waiver is not requested.

F-1a Security Procedures and Equipment

The design and operation of the WIPP facility are specifically planned to fully meet the security requirements contained in 20 NMAC 4.1, Subpart V, §264.14(b) and (c). The WIPP facility is not requesting a waiver under 20 NMAC 4.1, Subpart V, §264.14(a), as it has 24-hour security surveillance and the means to control entry to the active portion of the facility. In addition, warning signs are provided. The WIPP facility meets the security requirements as discussed below.

---

[1]The active portion of the facility is the Property Protection Area (PPA) as described in Chapters B and D. Within this area, the only area where transuranic (TRU) mixed wastes are handled outside of the Transuranic Package Transporter (TRUPACT-II) shipping container is inside the Waste Handling Building (WHB), the waste hoist, and the underground. Whenever TRU mixed waste is handled, a Radiological Controlled Area (CA) is established, for the purpose of radiation protection, which limits access to only trained personnel or to untrained personnel (visitors) who are continuously under the escort of trained personnel. CAs are established in accordance with the Department of Energy's (DOE) Radiological Control Manual (DOE, 1994) and are managed to limit the radiation exposure to personnel to less than 100 millirem per year. The CA is initially set at the entrances to the contact-handled (CH) Bay, the remote-handled (RH) Bay, and portions of the underground. The boundary of the CA is posted with signs as specified by the DOE.

F-1a(1) 24-Hour Surveillance System

The WIPP facility's 24-hour surveillance system is comprised of security officers that provide protection 24 hours per day, 365 days per year. Security officers work to written procedures that require visitors, contractors, and vendors to log in before they are allowed to proceed to the Main Gate for access into the PPA and require continuous monitoring of the active portion of the facility. This system fulfills the requirements of 20 NMAC 4.1, Subpart V, §264.14(b)(1).

Figure B-7 in Chapter B, Facility Description, shows the relationship of the WIPP facility boundary, the PPA, and Zone II. Figure B-6 shows the WIPP facility surface structures, their usage and structure numbers, and their relation to the fence. Figure F-1 shows the WIPP facility security gate, the Vehicle Trap, and the Gate House.

The major duties of the security officers are to control personnel, vehicle, and material access/egress 24 hours per day, 365 days per year. During nonoperational hours, the security officers conduct documented security patrols outside of the PPA, at a minimum rate of two per 12-hour shift, as well as inside of the PPA at a rate of one every two hours. In addition to the security officers, WIPP facility employees are called upon to challenge any person in the WIPP facility who is not wearing a badge or who is not under escort when an escort is required. Further physical protection is provided by fences, protective lighting, and locked buildings.

F-1a(2) Barrier and Means to Control Entry

The existence of a barrier and a means to control entry demonstrates compliance with 20 NMAC 4.1, Subpart V, §264.14(b)(2). Each is discussed in detail in the following sections.

F-1a(2)(a) Barrier

The surface portion of the WIPP facility PPA is contained within a 35 acre (14 hectare) fenced area. This area is surrounded by a permanent 7 foot (ft) (2.13 meter [m]) high chain-link fence that is topped by three strands of barbed wire, for a total height of 8 ft (2.44 m). The fence encloses major surface structures. The regularly inspected chain-link fencing at the WIPP facility completely surrounds the active portion of the facility, thereby complying with 20 NMAC 4.1, Subpart V, §264.14(b)(2)(i). Access is normally through the Main Gate on the west side of the PPA. Two other gates are available for emergency use. One of these gates is opened to allow salt trucks access to the salt pile. Use of all gates is under the supervision of security. Figure F-2 shows the fence and signs that surround the PPA.

F-1a(2)(b) Means to Control Entry

Entry into the PPA, whether by personnel or vehicles, is through controlled gates and doors. WIPP-facility access-control procedures are designed to ensure that only properly identified and authorized persons, vehicles, and property are allowed entrance to and exit from the facility. A personnel identification and access control system is maintained within the facility. Employees

identify themselves with an identification badge when entering or leaving the premises. Security officers require visitors to show proper authorization prior to allowing them to enter the facility. In addition, visitors are required to wear a temporary badge and may require an authorized escort. Because the WIPP facility controls entry to the active portion of the facility at all times, the requirements of 20 NMAC 4.1, Subpart V, §264.14(b)(2)(ii), are met.

For the purposes of entry control to areas where wastes are being handled, the WHB, the boundaries of the parking area south of the WHB, and those portions of the underground where wastes are transported or disposed are posted as CAs. The WIPP Radiological Control Manual (Westinghouse, 1994) (RADCON Manual) allows access to a CA by anyone who has successfully completed General Employee Radiological Training (GERT), which is included in the General Employee Training Course described in Chapter H. Access for visitors can also be arranged with proper training.

Areas within the CA, however, may have further access restricted. Smaller areas may be designated as Radiological Buffer Areas, Radiation Areas, and Radioactive Materials Area. These smaller areas are generally within the direct vicinity of waste handling activities or waste storage or disposal areas. They are sized and posted in accordance with strict guidelines in the RADCON Manual. Activities in these areas are performed under a Radiological Work Permit (RWP), and personnel must be listed on the RWP before they are allowed to enter. To be listed on the RWP, personnel must have the appropriate radiological and hazardous waste worker training and must have available radiation dose for the task. In addition, the individuals must sign the RWP acknowledging that they intend to comply with the radiological controls that are in place. Personnel may be escorted into the smaller areas if they are escorted by a person who meets all of the above requirements and is not performing any work in the area.

The WHB, the parking area container storage unit, and the underground (HWMU's) will be posted with a sign that states: "Danger: Authorized Personnel Only" in both English and Spanish.

F-1a(3) <u>Warning Signs</u>

The permanent chain-link fence surrounding the PPA is posted at approximately 50 ft (15.24 m) intervals with DOE "No Trespassing" signs and with "Danger: Authorized Personnel Only" signs in English and Spanish (Figure F-2). The signs are legible from a distance of 25 ft (7.62 m) and can be seen from any approach to the facility. These same signs, plus security and traffic signs, are also located on the controlled gates. The fence and gate signs at the WIPP facility fully comply with 20 NMAC 4.1, Subpart V, §264.14(c). Warning signs with "Controlled Area" and "Hazardous Waste Management Unit" will be posted at entrances to the HWMUs prior to the emplacement of waste.

F-1b Waiver

The WIPP facility fully complies with all three of the requirements of 20 NMAC 4.1, Subpart V, §§264.14(b) and (c), as described in Sections F-1a(1), F-1a(2)(a), and F-1a(2)(b) of this chapter. No waiver is requested.

F-2 Inspection Schedule

Equipment instrumental in preventing, detecting, or responding to environmental or human health hazards, such as monitoring equipment, safety and emergency equipment, security devices, and operating or structural equipment are inspected. The equipment will be inspected for malfunctions, deterioration, potential for operator errors, and discharges which could lead to a release of hazardous waste constituents to the environment or pose a threat to human health.

The WIPP facility maintains a series of written procedures that include all the detailed inspection procedures and forms necessary to comply with 20 NMAC 4.1, Subpart V, §264.15(b), during the Disposal Phase. Table F-1 lists each item or system requiring inspection under these regulations, the inspection frequency, and the organization responsible for the inspection. 20 NMAC 4.1, Subpart V, §§264.15(b), 264.174, and 264.602, list requirements that are applicable to the WIPP facility. Appendix F1 contains examples of inspection checklists.

As discussed in Sections F-2b(2) through F-2b(8) of this chapter, the WIPP facility does not manage TRU mixed waste using tanks, surface impoundments, waste piles, incinerators, land treatment, landfills, or drip pads. Therefore, 20 NMAC 4.1, Subpart V, §§264.193(i), 264.195, 264.226, 264.254, 264.273, 264.303, and 264.574, are not applicable to the WIPP facility. In addition, 20 NMAC 4.1, Subpart V, §§264.1033, 264.1052, 264.1053 and 264.1058, are not applicable to the WIPP facility because the WIPP facility does not perform distillation, fractionation, thin-film evaporation, solvent extraction, or air- or steam-stripping operations and does not have routine operations where equipment comes in contact with TRU mixed waste with organic concentrations of at least 10 percent by weight. Compliance with the specific requirements is discussed below and in the following sections.

Operational procedures detailing the inspections required under 20 NMAC 4.1, Subpart V, §§264.15(a) and (b), are maintained in controlled document locations at the WIPP facility. Frequency of inspections is discussed in detail in Section F-2a(2). Inspections are conducted often enough to identify problems in time to correct them before they pose a threat to human health or the environment and may also be based on regulatory requirements. The operational procedures assign responsibility for conducting the inspection, the frequency of each inspection, the types of problems to be watched for, what to do if items fail inspection, directions on record keeping, and inspector signature, date, and time. The operational procedures are maintained at the WIPP facility. In addition to operational inspections for CH equipment, procedures are in place for preventative maintenance of RH equipment, which cannot be inspected while waste is being handled or stored due to the high radiation fields. Table F-1 summarizes inspections, frequencies, responsible organizations, personnel making the inspection (by job title), and the

types of anticipated problems. Inspection records are maintained at the WIPP site for three years by the responsible organization shown in Table F-1.

Waste handling equipment and area inspections are typically controlled through established logbooks. Operators are trained to consult the logbook to identify the status of any piece of waste handling equipment prior to its use. Once a piece of equipment is identified to be operable, a preoperational inspection is initiated in accordance with the appropriate sheet in Appendix F1. Inspection results as described below are entered in the applicable logbook.

Inspections include identifying malfunctions or deteriorating equipment and structures. Inspection results and data, including deficiencies, discrepancies, or needed repairs are recorded. A negative inspection result does not necessarily lead to a repair. A deficiency, such as low fluid level, may be corrected by the inspector immediately. A discrepancy, such as an increasing trend of a data point, may necessitate additional inspection prior to the next scheduled frequency. The actions taken (corrected, additional inspection, or Action Request (AR) for repair submitted) are recorded on the inspection form, the WIPP automated Maintenance Management tracking program (CHAMPS) work order sheet, or the equipment logbook, whichever is applicable.

Items that are operational with restrictions are tagged with those restrictions. Items that are not operational are tagged and locked to prevent their use. Tagged and locked items are listed on the Tagout/Lockout Index. Once a scheduled repair or replacement is accomplished in accordance with the work authorization procedures, the tag or lock is removed from the item in accordance with the equipment tagout/lockout procedures. Normally, the individual inspecting the equipment/system is not qualified to make repairs and consequently, prepares an AR if repairs are needed. The AR is tracked by the CHAMPS system through the work control process. When parts are received and work instructions are completed, the work order can be scheduled on the Plan of the Day (POD). The POD is held daily to ensure facility configuration can support scheduled work items and to allocate and coordinate the resources necessary to complete the items.

Work orders are released for work by the responsible organization. When repairs are complete the responsible organization tests the equipment to ensure the repairs corrected the problem, then closes out the work order, to return the equipment to an operational status for normal operations to resume. Implementation of these procedures constitutes compliance with 20 NMAC 4.1, Subpart V, §264.15(c).

Requirements of 20 NMAC 4.1, Subpart V, §264.15(d), are met by the inspections for each item or system included in Table F-1. The results of the inspections are maintained for at least three years. The inspection logs include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions. Major pieces of waste handling equipment use proceduralized inspections as shown in Appendix F1. The status of these pieces of equipment is maintained in an equipment logbook that is separate from the checklist. The logbook contains information regarding the condition of

the equipment, including the number of any AR that has been prepared for the equipment. Equipment operators are required, by the inspection checklist, to consult the logbook as the first activity in the inspection procedure. This logbook is maintained in the operating record. Equipment that is controlled by a logbook includes the waste handling fork lifts, all waste handling cranes, the adjustable center of gravity lift fixture, the CH TRU underground transporter, the conveyance loading car, the trailer jockey, the Brudi, and underground openings, roofbolts, and travelways. In addition to the inspections listed in Table F-1, many pieces of equipment are subject to regular preventive maintenance. This includes more indepth inspections of mechanical systems, load testing of lifting systems, calibration of measurement equipment and other actions as recommended by the equipment manufacturer or as required by DOE Orders. These preventive maintenance activities along with the inspections in Table F-1 make mechanical failure of waste handling equipment unlikely. The WIPP Safety Analysis Report contains the results of a systematic analysis of waste handling equipment and the hazards associated with mechanical failures. Those that cannot be practically mitigated are retained for analysis and are the basis for contingency planning. RH inspections in Table F-1 do not apply until receipt of RH waste. The forms in Appendix F1 are primarily for preventive maintenance, to assure the equipment is maintained operational. Logbooks for recording preoperational inspections of RH equipment noted in Table F1 will be established to provide the inspection records. These logs will be established and used as discussed in Section F-2 above.

F-2a General Inspection Requirements

Tables F-1 and F-2 list the major categories of monitoring equipment, safety and emergency systems, security devices, and operating and structural equipment that are important to the prevention or detection of, or the response to, environmental or human health hazards caused by hazardous waste. These systems may include numerous subsystems. These systems are inspected according to the frequency listed in Table F-1, a copy of which is maintained at the WIPP facility. The frequency of inspections is based on the nature of the equipment or the hazard and regulatory requirements. When in use, daily inspections are made of areas subject to spills, such as TRU waste loading and unloading areas in the WHB, looking for deterioration in structures, mechanical items, floor coatings, equipment, malfunctions, etc., in accordance with 20 NMAC 4.1, Subpart V, §264.15(b)(4).

As required in 20 NMAC 4.1, Subpart V, §264.33, the WIPP facility inspection procedures for communication and alarm systems, fire-protection equipment, and spill control and decontamination equipment include provisions for testing and maintenance to ensure that the equipment will be operable in an emergency.

F-2a(1) Types of Problems

The inspections for the systems, equipment, structures, etc., listed in Table F-1, include the types of problems (e.g., malfunctions, cracks in coatings or welds, and deterioration) to be looked for during the inspection of each item or system, if applicable, and are in compliance with

20 NMAC 4.1, Subpart V, §264.15(b)(3). The WIPP facility has performed analyses using waste characterization data provided by the waste generators. Based on these analyses, which are discussed in Section D-9b, no monitoring for releases of hazardous waste or hazardous constituents, is needed or required in the WHB. Consequently, such equipment does not appear on the list of equipment requiring inspection. This conclusion is based in part on the analyses performed for the WIPP facility and discussed in Chapter D, which show that there will be no releases of hazardous waste or hazardous waste constituents to the soil, surface water, or groundwater. Furthermore, as discussed in Chapter D releases of Volatile Organic Compounds (VOCs) from waste within the Waste Handling Building (WHB) are not covered by the regulations.

F-2a(2) Frequency of Inspections

Tables F-1 and F-2 list the inspection frequencies and monitoring schedule for equipment and systems subject to the 20 NMAC 4.1 hazardous waste management requirements. The frequency is based on the rate of possible deterioration of the equipment and the probability of an environmental or human health incident if the deterioration or malfunction, or any operator error, goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, are inspected daily when in use, consistent with the requirements of 20 NMAC 4.1, Subpart V, §264.15(b)(4).

F-2a(3) Monitoring Systems

There are three monitoring systems used at the WIPP to provide assurance that facility systems are operating correctly, that areas can be used safely, and that there have been no releases of hazardous waste constituents. These systems are shown in Table F-2 and include the radiation monitoring system, the geomechanical monitoring system, and the central monitoring system (CMS). The radiation monitoring system includes portable and fixed radiation detection equipment used to detect the presence of radioactivity external to containers. This equipment is used to implement the principle of co-detection. The geomechanical monitoring system is used to assess the condition of mined excavations to assure no unsafe conditions are allowed to develop. The CMS continuously assesses the status of the fixed radiation monitoring equipment, electrical power, fire alarm systems, ventilation system, and other facility systems including waste tank levels. In addition, the CMS collects data from the meteorological monitoring system.

Several other monitoring programs are discussed for information in Chapter D. These systems do not have waste management or emergency response functions. Consequently, they are not discussed in Chapters F or G.

F-2b Specific Process Inspection Requirements

20 NMAC 4.1, Subpart V, §264.15(b)(4), requires inspections of specific portions of a facility, rather than the general facility. These include container storage areas, tank systems, waste

piles, surface impoundments, incinerators, landfills, land treatment facilities, drip pads, and miscellaneous units. Each is addressed below.

F-2b(1) Container Inspection

Containers are used to manage TRU mixed waste at the WIPP facility. These containers are described in Chapter D. Off-site CH TRU waste will arrive in 55-gallon drums arranged as seven (7)-packs, as Ten Drum Overpacks (TDOP), or as standard waste boxes (SWB). RH TRU waste will arrive in RH canisters. The waste containers will be visually inspected to ensure that the waste containers are in good condition and that there are no signs that a release has occurred. This visual inspection shall not include the center drums of 7-packs and waste containers positioned such that visual observation is precluded due to the arrangement of waste assemblies on the facility pallets. RH TRU waste containers stored in the Hot Cell or the Transfer Cell will not be inspected, as this would violate the radiological control program goal to minimize occupational radiological exposures As Low As Reasonably Achievable. However, these areas are monitored using remote closed circuit video cameras. If waste handling operations should stop for any reason with containers located on the TRUPACT-II Unloading Dock (TRUDOCKS) in the TRUPACT-II shipping containers, primary waste container inspections could not be accomplished until the containers of waste are removed from the shipping containers.

Inspections will be conducted in the parking area container management area at a frequency not less than once weekly. These inspections are applicable to loaded, stored TRUPACT-IIs and road casks. The perimeter fence located at the lateral limit of the parking area, coupled with personnel access restrictions into the WHB, will provide the needed security. The perimeter fence and the southern border of the WHB shall mark the lateral limit of the parking area storage area. Radiation control areas can be established temporarily with barricades. More permanent structures can be installed. The western boundary can be established with temporary barricades since this area is within the perimeter fence. Access to CAs will only be permitted to personnel who have completed GERT, a program defined by the DOE, or escorted by personnel who have completed GERT. This program ensures that personnel have adequate knowledge to understand radiological posting they may encounter at the WIPP site. If a fence is moved in the future, a permit modification will be submitted identifying the changes. Since waste to be stored in the parking area will be in TRUPACT-II shipping containers and/or road casks, there will be no additional requirements for engineered secondary containment systems. Inspections of the TRUPACT-IIs and/or road casks stored in the parking area shall be conducted at a frequency no less than once weekly and will focus on the inventory and integrity of the shipping containers and the spacing between TRUPACT-II trailers and road casks. This spacing will be maintained at a minimum of four feet.

Container inspections will be included as part of the surface TRU mixed waste handling area inspections described in Table F-1. These inspections will also include the derived waste storage area delineated in Figure D-6. The derived waste area will consist of containers of 55 or 85-gallon drums or SWBs. The total storage volume of this area is up to 66.3 cubic feet (1.88 cubic meters). Satellite accumulation area containers (SAAs) may be required in areas adjacent to the TRUDOCKs and in the operating gallery adjacent to the Hot Cell. These SAAs will be set up on an as needed basis at or near the point of generation and the derived waste will be discarded into the active derived waste container. These SAAs will be inspected in accordance with 20 NMAC 4.1, Subpart III, §262.34.

F-2b(2) Tank System Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using a tank system as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart J. Tank system regulations are not applicable to the WIPP facility.

F-2b(3) Waste Pile Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using a waste pile as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart L. Waste pile regulations are not applicable to the WIPP facility.

F-2b(4) Surface Impoundment Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using a surface impoundment as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart K. Surface impoundment regulations are not applicable to the WIPP facility.

F-2b(5) Incinerator Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using an incinerator as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart O. Incinerator regulations are not applicable to the WIPP facility.

F-2b(6) Landfill Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using a landfill as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart N. Landfill regulations are not applicable to the WIPP facility.

F-2b(7) Land Treatment Facility Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using land treatment as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart M. Land treatment regulations are not applicable to the WIPP facility.

F-2b(8) Drip Pad Inspection

The WIPP facility does not manage hazardous or TRU mixed waste using drip pads as defined in 20 NMAC 4.1, Subpart I, §260.10, and regulated under 20 NMAC 4.1, Subpart V, Subpart W. Drip pad regulations are not applicable to the WIPP facility.

F-2b(9) Miscellaneous Unit Inspection

20 NMAC 4.1, Subpart V, §264.602, requires that inspections required in 20 NMAC 4.1, Subpart V, §264.15 and §264.33, as well as any additional requirements needed to protect human health and the environment, be met. The requirements of 20 NMAC 4.1, Subpart V, §264.15 and §264.33, are discussed in Section F-2 of this chapter, along with how the WIPP facility complies with those requirements for standard types of inspections. The geomechanical monitoring program is described in Section D-10d(1). Inspection frequencies for geomechanical monitoring equipment are provided in Table F-1. The monitoring schedule for geomechanical instrumentation is given in Table F-2.

F-3 Waiver or Documentation of Preparedness and Prevention Requirements

As described in the following sections, the WIPP facility has a variety of communications systems and emergency response equipment and possesses a continuous water supply to meet emergency situations. In addition, procedures are in place to respond to emergencies involving hazardous waste or hazardous waste constituents. These systems and procedures fully meet the preparedness and prevention requirements of 20 NMAC 4.1, Subpart V, §§264.32, 264.34, and 264.35, and therefore, no waiver under 20 NMAC 4.1, Subpart IX, §270.14(b)(6), is requested.

F-3a Equipment Requirements

The WIPP facility is well equipped with internal and external communications systems, emergency equipment, and water for fire control. As shown in the following sections, the facility fully meets the requirements of 20 NMAC 4.1, Subpart V, §264.32 and §264.34.

F-3a(1) Internal Communications

20 NMAC 4.1, Subpart V, §264.32(a), requires a facility to have an internal communications or alarm system capable of providing immediate emergency instructions (voice or signal) to facility personnel. In addition, 20 NMAC 4.1, Subpart V, §264.34(a), requires that employees have

immediate access to an internal alarm or emergency communication device when handling TRU mixed waste. The following discussions show that the WIPP facility is well equipped for internal communications and fully complies with the regulations.

The intraplant communication systems, designed to provide immediate emergency instructions to facility personnel, include two-way communication by the public address (PA) system and its intercom phones and paging channels, an intraplant telephone system, mine phones, pagers and plectrons, portable two-way radios, and local and facility wide alarm systems. The procedures for notifying facility personnel in an emergency are contained in the Contingency Plan, Chapter G, Section G-4a, of this permit application. See also Section F-3a(2).

The intercom system (with an integral PA system) consists of handset stations and loudspeaker assemblies, with multiple amplifiers. The system has multiple channels in the main buildings. Initial communication between parties within the plant can be established by using the paging channel. Each designated location has a single set of electrically isolated speakers and a handset. In order to cover most areas in the plant, loudspeakers are properly oriented, and volume levels are adjusted. If one station fails, the remaining stations are isolated from the out-of-service unit to prevent a failure in the remaining system.

Private branch automatic exchange two-way communication is provided between any two telephones located above or below ground. Direct dialing to outside telephones and direct dialing to WIPP facility telephones are provided by this system. Failure of a single telephone station does not affect the balance of the telephone system. If the telephone system should fail, the PA system, the plectrons, and the portable two-way radios provide backup surface communications.

The Site Notification System (SNS) consists of pagers in the possession of office wardens and plectrons located in various buildings. The SNS pagers and plectrons are tone-activated radio receivers that are activated by the two-way radio system. To generate a tone on the pagers and plectrons or to send a verbal message, the radio operator enters a security code into the two-way radio system and begins broadcasting. The SNS pagers are portable and battery-operated. The plectrons are portable and can be plugged into a standard electrical circuit or powered from internal batteries that are continuously recharged when connected to the electrical circuit.

A plant radio station in the Guard and Security Building, one located in the Emergency Operations Center in the Safety and Emergency Services Building, and one in the Central Monitoring Room (CMR), allow two-way radio communication with on-site personnel and with mobile/portable WIPP facility radios operating on and off the WIPP site. The two-way radio also allows one-way emergency notification on the portable SNS pagers and plectrons. The two-way radio system located in the CMR is supplied with power from the uninterruptible power supply if the off-site power supply fails.

There are various alarm systems used at the WIPP facility. The PA system has two alarm tones in use, a yelp and a gong. Its signals are produced in the master PA console by a tone

generator and are transmitted sitewide over the paging channel of the system, overriding its normal use. The signals are intermittent and of high intensity. The evacuation tone is a yelp tone and is used for, and limited to, situations requiring immediate, rapid, and complete (or selective area) evacuation. The evacuation tone is initiated manually on the surface. In the underground, the evacuation tone may be initiated manually or automatically by underground fire detection and alarm systems. This tone is also a yelp tone. It is accompanied with strobe lights for high noise areas. These alarm signals take priority over other signals on the paging channel but do not affect the intercom channels. Evacuation alarms using the PA system, local and plantwide, also can be initiated manually from the CMR in the Support Building. The audible alarm signals are supplemented by warning lights in high ambient-noise areas underground, such as active mining areas. These alarms are supplied with power from the uninterruptible power supply if the off-site power supply fails. The PA system may also produce a gong tone followed by a message. Local fire alarms are bell tones.

Whenever TRU mixed wastes are handled, two persons, at a minimum, are involved in the operation. The WHB contains readily accessible telephones and PA stations throughout. The mine phones are the main means of communication underground, although the PA system is also available.

Underground communication and alarm systems will be arranged to meet the requirements of 30 CFR 57. Telephones or other two-way communication equipment with instructions for their use will be provided for communications from underground to the surface. These communications are typically moved to ensure communications are maintained close to the work areas. Alarm systems capable of promptly warning every person underground, will be provided and maintained in operating condition. If persons are assigned to work areas beyond the warning capabilities of the system, provisions will be made to alert them in a proper manner to provide for their safe evacuation. Typically, these provisions include a flashing light capable of being seen easily. As part of the preoperational inspection, prior to initiating waste handling operations underground, waste handling personnel verify that underground communications are ready and are working. If they are not working, repairs are initiated.

Table G-6 in the Contingency Plan, Chapter G of this permit application, describes the capabilities and locations of the various internal communication systems.

F-3a(2) <u>External Communications</u>

20 NMAC 4.1, Subpart V, §264.32(b), requires that a communications device be available for contacting outside agencies for emergency assistance. In addition, 20 NMAC 4.1, Subpart V, §264.34(b), requires that if just one employee is on the premises, the employee must have immediate access to a device capable of summoning outside help. TRU mixed waste handling operations are not conducted at the WIPP facility when only one person is present on the premises. TRU mixed waste handling operations are conducted by two or more persons. The security officers and staff from Facility Operations are also present at the WIPP facility during TRU mixed waste handling operations. When no TRU mixed waste handling operations

are being conducted at the WIPP facility, at a minimum, the security officers and staff from Facility Operations are present. As discussed below, the WIPP facility has the required external communication devices and operates in a manner that fully complies with these regulations.

The external communication systems, designed to provide two-way communication with outside agencies or for summoning emergency assistance from off site, include the commercial telephone system and two-way radios.

Direct dialing through any telephone located above or below ground allows contact with outside agencies. Failure of a single telephone station does not affect the balance of the telephone system. Sixty percent of the direct-dial incoming and outgoing lines are routed via a microwave system located on the edge of the parking lot. The remaining 40 percent of the direct-dial lines are routed to Carlsbad by means of a buried cable. This diverse routing allows for continued direct-dial capability if either of the routing modes fails.

Plant radio stations in the Guard and Security Building and in the Emergency Operations Center in the Safety and Emergency Services Building allow two-way radio communication with the CMR, the Eddy County and Lea County Sheriff's Departments, the Hobbs Fire Department, the New Mexico State Police, the Guadalupe Medical Center, the Lea Regional Medical Center, and the Otis Fire Response Teams. Another base station is in the CMR, however it is not normally used to communicate with offsite agencies. Radios are not inspected, instead, they are operated daily and repaired if they fail.

Table G-6 in the Contingency Plan, Chapter G of this permit application, describes the capabilities and locations of the various external communication systems.

F-3a(3) Emergency Equipment

Contingency Plan (Chapter G of this permit application) describes the capabilities and locations of the fire-suppression equipment and systems. Table G-7 lists the types of fire-suppression systems by structure. Figure G-5 displays the underground locations of emergency equipment. Figure G-6 shows the fire-water distribution system on the surface. Figure G-7 shows the underground fuel area fire protection system. The information contained in these tables and figures demonstrates that the WIPP facility has the portable fire extinguishers, fire-control equipment (including special extinguishing equipment that use foam, inert gas, or dry chemicals), spill-control equipment, and decontamination equipment needed for compliance with the requirements of 20 NMAC 4.1, Subpart V, §264.32(c).

F-3a(4) Water for Fire Control

20 NMAC 4.1, Subpart V, §264.32(d), requires that the WIPP facility be equipped with water at an adequate volume and pressure to supply water-hose streams, foam-producing equipment, automatic sprinklers, or water-spray systems. The following discussion on fire control systems at the WIPP facility demonstrates compliance with this requirement.

The primary function of the WIPP facility water system is to supply water for domestic use and fire protection. Water is furnished by the Double Eagle Water Company, owned by the City of Carlsbad. Wells located 30 miles (mi) (48.3 kilometers [km]) north of the WIPP facility are the source of the water. Water is supplied by gravity flow through a 24 inch (in.) (61 centimeter [cm]) diameter pipeline to a junction point about 13 mi (20.9 km) north of the site at U.S. Highway 62/180. This line is sized to provide 6,000 gallons (gal) (22,712 liters [L]) per minute for use by others, in addition to the peak flow rate required by the WIPP facility. Controls at the junction point give the WIPP facility priority over flows to all other users. A 10 in. (25 cm) diameter pipeline supplies water by gravity flow from the tie-in point to the WIPP facility.

At the WIPP facility, the water enters a pair of 180,000-gal (681,372-L) aboveground storage tanks located adjacent to the Pumphouse (Figure F-2). These tanks are 32 ft (9.75 m) in diameter and are constructed of welded steel. The water level in each tank is monitored in the CMR. Of the 360,000-gal (1,362,744-L) total capacity, about 160,000 gal (605,664 L) (80,000 gal [302,832 L] per tank) are designated for storage of a two-day supply of domestic water. At least 180,000 gal (681,372 L) of the remaining 200,000 gal (757,080 L) of water are dedicated to fire suppression and are sufficient to handle the maximum credible fire. Separate sets of pumps for the domestic water and fire-water systems are provided in the Pumphouse. During a fire, the fire-water pump is automatically started, and available domestic water is used first. Upon depletion of the domestic-water inventory, the domestic-water pumps are automatically shut off, and the dedicated fire-water reserve is available for fire-suppression use only. The primary fire-water pump is a 100-percent-capacity electric pump. A 100-percent-capacity diesel fire-water pump provides backup in case of a power failure or when maintenance is required on the electric pump. Each fire-water pump is rated at 1,500 gal (5,678 L) per minute at 125 pounds (lb) (56.7 kilograms [kg]) per square in.

The following buildings are connected to and protected by the wet-pipe sprinkler system: the Pumphouse, the Guard and Security Building, the Support Building, the WHB, the Exhaust Filter Building, the TRUPACT Maintenance Facility, the Engineering Building, the Safety and Emergency Services Building, the Training Building, and several other warehouse and maintenance buildings. The Pumphouse, the Support Building, the WHB, and several other warehouse and maintenance buildings also have fire hoses connected to this system. There is no firefighting water-supply system underground. Instead, the underground is equipped with fire extinguishers of various types and in various locations (including vehicles) and a fire truck with a 125 lb (56.7 kg) chemical extinguisher. The underground fuel station is equipped with an automatic, 1,000-lb (453.5 kg) chemical extinguishing systems. Only firefighting foam or water are used to fight fires involving TRU mixed waste.

F-3b Aisle Space Requirement

20 NMAC 4.1, Subpart V, §264.35, requires that a facility maintain sufficient aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to areas of the facility during an emergency (other than a permanent disposal stack).

Waste Handling Building

During TRU mixed waste handling operations, sufficient room is maintained for unobstructed movement of personnel, fire-protection equipment, spill control equipment, or decontamination equipment to areas in the WHB.

Waste containers will remain inside the TRUPACT-II shipping containers on the trailers parked outside the WHB or in RH TRU shipping casks until TRU mixed waste handlers are prepared to handle them. As shown in Figure D-1, there is ready access to all areas within the WHB where hazardous wastes are handled. Seven-packs and/or SWBs are unloaded from the TRUPACT-II container in the CH Bay in the WHB (see Figure D-36). The CH Bay can handle the unloading of four TRUPACT-II containers at one time. RH TRU canisters are unloaded one at a time in the RH Bay.

At all times, written procedures ensure that loaded TRUPACT-II containers, shipping casks, facility pallets, 7-packs, SWBs, 85-gallon overpacks, TDOPs, or canisters are managed in the WHB in a manner to prevent obstructing the movement of personnel, fire-protection equipment, spill-control equipment, and decontamination equipment. Section D-10(2)(a) discusses aisle space for containers in container storage units. An aisle space of 44 in. (1.1 m) between loaded facility pallets will be maintained in all CH TRU waste storage areas, and a minimum of 4 ft of isle space will be maintained between loaded TRUPACT-IIs in the outdoor parking area. Aisle space requirements shall not be met for RH canisters. RH isle space requirements are not specified since only one RH cask is processed at a time in the RH bay.

Underground Hazardous Waste Management Units

The mined areas underground are all maintained to provide free access to the repository and to the face of the waste disposal areas in the active panels. As specified in 30 CFR 57, adequate access is provided for movement of personnel, fire equipment, or spill-controlled equipment to any area of operations during an emergency or response action, as provided in the facility Contingency Plan (Chapter G). These items are subject to inspection by federal mine inspectors at least quarterly. Waste emplacement occurs sequentially on a room-by-room basis until each room in a HWMU panel has been filled with waste. Derived waste will be emplaced in the disposal rooms along with the TRU mixed waste. Once panel closure has been effected, the waste is considered disposed of, and access is no longer provided beyond the panel closure barrier to closed HWMUs.

Proper airflow distribution to all areas of the underground is achieved through a multi-step process. Tests and balances of the underground ventilation system are conducted on a periodic basis with the frequency depending on changes that are occurring in the configuration of the underground. These tests and balances physically measure airflow, pressure, and system resistance. Computer modeling is performed to determine the configuration necessary to achieve any desired underground airflow distribution. Administrative procedures are used as the means of assuring control of the configuration of the ventilation control devices such as

bulkheads, doors, fans, and air regulators needed to achieve the desired configuration. Underground Facility Operations makes daily checks of air quality in all parts of the repository where personnel will be working. Air quantity checks are made on an as-needed basis as changing conditions warrant such checks.

F-4 Preventive Procedures, Structures, and Equipment

The design and operation of the WIPP facility fully meet each of the requirements of 20 NMAC 4.1, Subpart IX, §270.14(b)(8), to prevent hazards associated with unloading operations, prevent runoff from hazardous waste handling areas, prevent contamination of water supplies, mitigate the effects of equipment and power failures, prevent undue exposure of personnel to hazardous waste, and prevent releases to the atmosphere. The individual regulatory requirements are discussed below.

F-4a Unloading Operations

The WIPP facility's equipment, structures, and procedures are specially designed for the safe handling of TRU mixed waste. Section D-10a(3) details how both CH and RH TRU mixed waste are handled, including unloading and transport operations. The following is a summary of the activities, structures, and equipment that were developed to prevent hazards in unloading of TRU mixed waste, as required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(i).

The TRUPACT-II shipping container has a gross loaded weight of 19,265 lbs (8,737 kgs). The TRUPACT-II shipping container has forklift pockets at the bottom of the container specifically for lifting the container with a forklift (see Figure D-27). The 13 ton (11.8 metric tons) electric forklift unloads the TRUPACT-II from the trailer and transfers it to an unloading dock in the WHB (see Figure D-28). The unloading dock is designed to accommodate the TRUPACT-II container and functions as a work platform, providing TRU mixed waste handling and health physics personnel with easy access to the container during unloading operations.

An overhead 5-ton (4.5-metric ton) crane and adjustable center-of-gravity lift fixture transfer TRU mixed waste containers from the TRUPACT-II to the facility pallet in the WHB floor. The facility pallet is a fabricated steel structure designed to securely hold waste containers. Each facility pallet has a rated load capacity of 25,000 lb (11,340 kg). The upper surface of the facility pallet has two recesses sized to accept the waste containers, ensuring that the containers are held in place. Up to four SWBs, four 7-packs, two 4-packs consisting of 85-gallon overpacks, or two TDOPs may be placed on a facility pallet. Each stack of waste containers is strapped down to holding bars in the top reinforcement plate of the facility pallet to avoid spillage during movement. Two rectangular tube openings in the bed allow the facility pallet to be securely lifted by forklift. In order to assure a facility pallet is not overloaded, operationally it will hold the contents of two TRUPACT-IIs as discussed in Section D-10a(2)(c).

The WIPP facility has the capability to handle each of the CH TRU containers singly using forklifts and single container attachments. In such cases, the container would be loaded on the waste shaft conveyance and moved underground as a single unit.

RH TRU mixed waste will arrive at the site in road casks (see Figure D-19), will be surveyed for radiation, and will be placed on cask-transfer cars (see Figure D-20). The cask will be moved to canister Transfer Cells in the Hot Cell area of the WHB RH Bay. The RH Bay also provides space for an overhead bridge crane with an auxiliary hoist used for road-cask handling and maintenance operations. The RH cask will be unloaded from the trailer using the overhead bridge crane.

During cask transfer to the Hot Cell, the cask-seal collar and adapter rings provided will allow the interior of the road cask to become an extension of the hot-cell ventilation system when it is mated to the floor port in the Hot Cell to prevent the release of contaminants outside the Hot Cell. Large concrete shield plugs are provided on the floor of the Hot Cell (see FigureD-21). These are removed when the RH waste is transferred to the Transfer Cell. The major waste handling equipment in the Hot Cell includes a remotely operated bridge crane; a remotely operated bridge-mounted power manipulator; two pairs of manipulators; and a portable, remotely operated welder. The crane is designed to stay on its rails and maintain load control in the event of a design-basis earthquake or electrical outage and has a manual override.

All unloading equipment is inspected in accordance with the schedule shown in Table F-1. Cranes and forklifts that are used in the unloading and handling of TRU mixed waste have been designed and constructed so that they will retain their loads in the event of a loss of power. Cranes in the WHB are also designed to withstand a design basis earthquake without moving off of their rails and without dropping their load. Lowering loads is a priority activity after a disruptive event.

The following is a summary of the activities, structures, and equipment that were developed to prevent hazards in transporting TRU mixed waste.

Palletized TRU mixed waste is transferred by a 13-ton (11.8-metric ton) forklift to the conveyance loading car (see Figure D-18), which is designed with an adjustable bed height that is used to transfer the facility pallets to the special pallet-support stands in the waste hoist cage.

The waste hoist system in the waste shaft and all waste shaft furnishings, designated as Design Class IIIA, are designed to resist the dynamic forces of the hoisting system and to withstand a design-basis earthquake. Maximum operating speed of the hoist is 500 ft (152.4 m) per minute. During loading and unloading operations, the waste hoist is steadied by fixed guides. The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system, such as overtravel, overspeed, power loss, or circuitry failure. The control response is to annunciate the condition and shut the hoist down. Operator response is required to recover from the automatic shutdown. Waste hoist operation is continuously monitored by the

CMS. A battery powered FM transmitter/receiver allow communication between the hoist conveyance and the hoist house.

The waste hoist shaft system has two pairs of brake calipers acting on independent brake paths. The hoist motor is normally used for braking action of the hoist. The brakes are used to hold the hoist in position during normal operations and to stop the hoist under emergency conditions. Each pair of brake calipers is capable of holding the hoist in position during normal operating conditions and stopping the hoist under emergency conditions. In the event of power failure, the brakes will set automatically.

The hoist is protected by a fixed automatic fire suppression system. Portable fire extinguishers are also provided at several points on the hoist floor and in equipment areas.

Once underground, the facility pallet is removed from the hoist cage by the underground waste transporter (see Figure D-31), a commercially available articulated diesel vehicle. The trailer is designed specifically for transporting palletized TRU mixed waste and is sized to accommodate the facility pallet. All motorized waste handling equipment is equipped with on-board fire-suppression systems.

The underground waste transporter is equipped with a speed governor, rupture-proof diesel fuel tanks, and reinforced fuel lines to minimize the potential for a fire involving the fuel system. Waste containers will be placed into underground waste management areas using a battery-powered forklift.

For the RH waste transport, a shuttle car operates beneath the Hot Cell in the canister-transfer cell to move the RH canister to the cask-loading room, where the waste is placed in the facility cask (see Figure D-24) for subsequent transfer underground. The waste hoist is used to move the facility cask to the underground HWMU for emplacement. Transfer operations are monitored by closed-circuit television cameras. The facility cask will be used to move the RH waste underground from the waste hoist to the emplacement area.

All TRU mixed waste transport equipment is inspected at a frequency indicated in Table F-1.

RH inspections in Table F-1 do not apply until receipt of RH waste. The forms in Appendix F1 are primarily for preventive maintenance, to assure the equipment is maintained operational. Logbooks for recording preoperational inspections of RH equipment noted in Table F1 will be established to provide the inspection records. These logs will be established and used as discussed in Section F-2 above.

F-4b Runoff

The following description of procedures, structures, or equipment used at the WIPP facility to prevent runoff from TRU mixed waste handling areas to other areas of the facility or environment or to prevent flooding is required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(ii).

The WHB is a physical barrier that will prevent TRU mixed waste spills from reaching the environment before a cleanup could be initiated and completed. A detailed description of the WHB containment capability is contained in Section D-1a(4). The WHB floor plan is shown in Figure D-9. Appendix D3 contains engineering drawings showing additional WHB details (e.g., fire protection and ventilation). TRU mixed waste handling operations are described in Section D-10a(3). TRU mixed waste containers remain in the shipping container until removed at the unloading dock in the CH Bay or in the RH Bay inside the WHB.

The WHB floor is demonstrated shown in Section D-1a(4) to provide sufficient secondary containment for the amounts of CH TRU and RH TRU waste that could be routinely stored in the WHB. Secondary containment is also provided by the shipping containers while waste are within them. These are sealed vessels with no vents or openings and therefore cannot leak.

TRU mixed waste received for emplacement at the WIPP facility must be certified under the waste acceptance criteria (WAC) as nonliquid waste; in some cases, the DOE will allow up to one percent residual liquids (see discussion Section D-1a). The WAC are procedural controls that must be met at the generator or storage site and the data must be verified by the WIPP facility staff prior to acceptance for the Disposal Phase and shipment to the WIPP facility. Chapter C contains information regarding WAC requirements for shipping and discusses receipt and verification of the TRU mixed waste at the WIPP facility. Calculations in Section D-1a(3) demonstrate that one percent residual liquid in TRU mixed waste containers is easily contained by the WHB floor or the sumps in the Hot Cell and the Transfer Cell.

As discussed in Section B-3b, Floodplain Standard, of this permit application, the WIPP facility does not lie within a 100-year floodplain. There are no major surface-water bodies within 5 mi (8 km) of the site, and the nearest river, the Pecos River, is approximately 12 mi (19 km) away. The general ground elevation in the vicinity of the surface facilities (approximately 3,400 ft [1,036 m] above mean sea level) is about 500 ft (152 m) above the riverbed and 400 ft (122 m) above the 100-year floodplain. Protection from flooding or ponding caused by probable maximum precipitation (PMP) events is provided by the diversion of water away from the WIPP facility by a system of peripheral interceptor diversions. Additionally, grade elevations of roads and surface facilities are designed so that storm water will not collect on the site under the most severe conditions.

Repository shafts are elevated at least 6 in. (15.2 cm) to prevent surface water from entering the shafts. The floor levels of all surface facilities are above the levels calculated for local flooding due to PMP events (see Appendix D7). Section D-9a(1)(d), Surface Water Hydrology; Section D-1a(7), Control of Run-On; and Section D-9b(3), Protection of Surface Water, Wetlands,

and Soil Surface, of this permit application also discuss this subject. Drawing 24-C-028-0W1 in Appendix D3 of this permit application displays the water diversions that have been constructed at the WIPP facility. Therefore, flooding of WIPP facility roads and surface structures is not expected from the flooding of surface waters as a result of PMP events or because of site-runoff design.

Flood-control structures are inspected as part of a general facility inspection at least annually. During this inspection, the structures are checked to assure there has been no wind or rain erosion or animal-caused damage that would cause the structures to fail. Further, the areas around the structures are inspected to ensure they are free of vegetation, debris, or other items that would impede the diversion of water. Experience with these structures has shown that annual structural inspections are adequate for the climate and soil conditions at the WIPP facility; however, inspections are also conducted after severe natural events, such as severe storms and a design basis earthquake.

Whenever TRU mixed waste is outside the WHB, it will be contained in shipping containers. TRU mixed waste containers are unloaded from the shipping containers inside the WHB and shipping containers are never opened outside this facility; therefore, TRU mixed waste is not expected to reach the outside environment or other parts of the facility from the TRU mixed waste handling facilities in nonflood circumstances. Flooding of the TRU mixed waste handling facilities is prevented by drainage ditches and berms such that there is no mechanism that might transport TRU mixed waste to the outside environment and between parts of the WIPP facility (see Appendix D7). Neither is there a mechanism to allow TRU mixed waste to find its way to an area of the WIPP site where it would be carried off site by flood or precipitation waters.

F-4c <u>Water Supplies</u>

The following description of procedures, structures, or equipment used at the facility to prevent contamination of water supplies is required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(iii).

The DOE provides groundwater-protection information in accordance with 20 NMAC 4.1, Subpart V, §264.601 in Section E-1, Compliance with Groundwater Protection Requirements, in Chapter E of this permit application. Appendix E1 of this permit application, RCRA Groundwater Protection Information, Waste Isolation Pilot Plant, summarizes the geological, hydrological, and climatological features of the WIPP site which, along with the procedures, structures, and equipment used during the Disposal Phase activities, demonstrate groundwater performance standards. The groundwater protection information demonstrates that groundwater will not come in contact with the TRU mixed waste, and the possibility that any contaminated groundwater can migrate from the disposal horizon to the accessible environment, including water supplies, during the Disposal Phase is unlikely.

At the WIPP facility, water supplied by the Double Eagle Water Company enters a pair of 180,000-gal (681,372-L) aboveground storage tanks located adjacent to the Pumphouse. The 360,000-gal (1,362,744-L) combined capacity of the tanks is used as the potable water source

and for fire control. These tanks are 32 ft (9.8 m) in diameter and are constructed of welded steel. The water level in each tank is inspected daily. Potable water is piped to the site and stored in tanks until distributed by pipe to the fire hydrants and buildings. Managing the potable water supply in this manner prevents the contamination of the supply by TRU mixed waste.

F-4d Equipment and Power Failure

The following description of procedures, structures, or equipment used at the facility to mitigate effects of equipment failure and power outages is required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(iv). The specific systems and facilities related to the protection of human health and the environment during waste handling and management operations are discussed in the in Sections F-4a and D-10a(2)b.

In the event that normal utility power is lost, on-site diesel generators will provide alternating current (AC) power to important WIPP facility electrical loads. Uninterruptible power supply (UPS) units are also on line providing power to important monitoring systems.

If utility power fails, the exhaust filter system goes into the fail position, and the system high-efficiency particulate-air filter dampers are placed into filtration position. When power is restored by the diesel generators, a decision is made whether to remain in filtration mode and energize a filtration fan or to realign the dampers into the minimum exhaust mode. Without any indication of a radiological release, the decision is usually the latter. TRU mixed waste handling and related operations cease upon loss of utility power and are not resumed until normal utility power is returned. All waste handling equipment will "fail safe," meaning that it will retain its load during a power outage.

In case of a loss of utility power, backup power to predetermined loads can be supplied by either of the two on-site diesel generators. Each of these units provide 480 volts (V) of power with a high degree of reliability and are sized to feed the selected loads, as shown in Table F-3. Each of the diesel generators can carry all preselected monitoring loads plus operation of the Air Intake Shaft hoist for personnel evacuation and other selected backup loads. The diesel generators can be brought on line within 30 minutes.

Upon loss of normal power, the diesel generators are manually started from the local control panel or from the CMR. The starter system is a 24-V battery system with a 300-ampere-hour capacity. Although it is standard practice to start the diesel generators from the local control panel, each unit can be remotely started from the CMR when the generator start switch is placed in the "remote" position. The diesel generators and associated breakers can be monitored in the CMR, thus providing the ability to feed selected facility loads from the backup power source, in sequence, without exceeding generator capacity. The on-site fuel storage capacity is sufficient for the operation of one generator at an expected load of 62 percent for three days. Additional fuel supplies are readily available within a few hours by tank truck, allowing on-line refueling and continued operation.

There is a Central UPS, located in the Support Building, that supplies power to selected loads located in the Support Building and WHB. The Central UPS provides back-up power to equipment associated with radiation monitoring, communications, and central monitoring systems. In addition, individual UPSs are provided for the selected equipment associated with these same systems, but are located remotely from the Support Building and the WHB. The CMR is also connected to the Central UPS.

In case of loss of AC power input to the UPSs, the dedicated batteries were designed to supply power to a fully loaded UPS for 30 minutes. It is expected that the AC power input to the UPS will be restored within 30 minutes, either from the off-site electric utility or from the site back-up power generator system.

Human health and the environment are protected during a loss of off-site power by a combination of factors:

- The underground filtration system fails in the "filter" mode so that no releases of contaminated particulates will occur
- The UPS maintains all monitoring systems and alarms in waste handling areas so that fires or pressure loss will be detected and an appropriate response initiated
- Generators are brought on line within 30 minutes, at which time hoisting can be initiated so that personnel do not have to stay underground for extended lengths of time Mine Safety and Health Administration (MSHA) requires personnel evacuation within one hour of ventilation loss)
- Containment of waste constituents is maintained by the WHB and underground ventilation systems
- The waste hoist brakes set automatically so that loads do not fall
- Cranes retain their loads so that spills do not occur from dropped containers
- Communication systems are maintained
- The emergency operations center is powered if it is needed.

The CMS is a computerized system that collects, records, and displays data for all critical facility systems. The system is designed to provide a centralized, integrated location for collecting, monitoring, and storing facility parameters and is informed from signals provided by the seismic, meteorological, radiological effluent, and fire detection and alarm systems. Additionally, the CMS monitors heating, ventilation, air conditioning and electrical system status. Certain control functions of the underground ventilation fans, major facility electrical systems, and the backup

diesel generators can be performed by the CMS from the CMR. The CMS can be set to alarm upon failure of the equipment monitored.

The CMS components of the WHB and the Support Building are powered from the central UPS. The UPS features automatic switching without a loss of power from primary power to alternate power to battery backup power. The components located throughout the facility are powered by various electrical switchboards, with UPS battery backup.

The major components of the system are interconnected by means of a dual, redundant data highway. The data highway is the communications medium for the CMS and consist of dual coaxial cables routed throughout the facility. The system can function on only one of the data highways. Parameters or status are monitored by 24 Local Processing Units strategically located throughout the surface and underground facility.

In addition, a number of automatic checks are performed on the internal processes associated with system components and data highway communications. If any fault is detected, the system has the capability to remove a component from the data highway and alert the CMR Operator (CMRO) of the fault. The status of the data highways is continuously monitored by the CMRO 24 hours per day, seven days per week. If a fault occurs, the CMRO initiates an AR within the Work Control system to correct the problem.

F-4e Personnel Protection

The following description of procedures, structures, or equipment used at the facility to prevent undue exposure of personnel to hazardous waste is required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(v).

Procedures used at the WIPP facility to prevent undue exposure of personnel to hazardous waste and the sections in this permit application where these procedures are discussed in detail are listed below.

- The WAC are criteria designed to prevent the shipment (see Section C-3) or acceptance (see Section C-5) of TRU mixed waste exhibiting the characteristics of ignitability, corrosivity, or reactivity. Section F-5 contains a general discussion of the prevention of the reaction of ignitable, reactive, and incompatible TRU mixed wastes.

- Written procedures to prevent the addition of materials to the TRU mixed waste that could exhibit incompatibility or the characteristics of reactivity and/or ignitability are discussed in Sections F-5 and D-10a(3)(a).

- TRU mixed waste handling operations are conducted so that the need for TRU mixed waste handling personnel to touch the TRU mixed waste containers during unloading and emplacement operations, overpacking, repair, or retrieval (if

necessary) is minimized. Level D personal protective equipment (PPE) (hard hat, safety shoes, safety glasses, and sometimes shop coats) will be worn for normal operations. (See a discussion of TRU mixed waste handling operations in Sections D-10a(3)(b) and D-10a(3)(c) and secondary containment in Section D-1a(4).)

- Tagout/Lockout and work authorization procedures, discussed in Section F-2, prohibit WIPP facility personnel from utilizing TRU mixed waste handling equipment that is temporarily out of service and prevent inappropriate use of TRU mixed waste handling equipment that is not operational for all uses.

- A system for monitoring and inspecting monitoring equipment, safety and emergency systems, security devices, and operating and structural equipment is in place to prevent, detect, or respond to environmental or human health hazards caused by hazardous waste. The inspection/monitoring requirements are described in Section F-2a.

- Adequate aisle space is maintained for emergency response purposes, as discussed in Section F-3b.

- Procedures to protect personnel from hazardous and/or TRU mixed waste during nonroutine events are detailed in the Contingency Plan, Chapter G.

The following discusses the structures and equipment that prevent undue exposures of personnel at the WIPP facility to hazardous constituents:

- The WIPP facility was sited and designed to be protective of human health and ensure safe operations during the Disposal Phase (Section D-9b(1)).

- TRU mixed waste containers are required to meet shipping/structural requirements (Sections D-10a(2)(c) and D-10a(2)(d)).

- The shipping container, forklifts, unloading dock, crane, facility pallets, conveyance loading car, waste hoist cage, hot-cell complex, and underground waste transporter were designed or selected for use in order to minimize the need for TRU mixed waste handling personnel to come into contact with TRU mixed waste. Each of these items is discussed in detail in Section D-10a(2); Section F-4a discusses prevention of hazards to personnel during unloading operations.

- The hood ventilation system, used during the initial opening of the TRUPACT-II shipping container, is used to vent any potential release of radioactive contaminants into the ventilation system of the WHB (Section D-10a(3)(b)). Section D-9b(4) explains that the remaining emissions (i.e., VOCs) are controlled at levels to prevent adverse effects on occupational or environmental receptors.

- The WIPP facility has internal and external communications and alarm systems to notify personnel of emergency situations and provide instructions for response, evacuation, etc. (Section F-3a and Section G-4a).

- The WIPP facility is well equipped with spill-response equipment, transport vehicles, emergency medical equipment and rescue vehicles, fire detection, fire-suppression and firefighting equipment (including water for fire control), PPE, emergency lighting and backup power, and showers and eye-wash fountains. These are discussed in Sections F-3a, F-4c, and F-4d are listed in Section G-5.

- The surface and underground ventilation systems, discussed in Section D-10a(2)(b)(iii), are designed to provide personnel with a suitable environment during routine operations.

F-4f Releases to Atmosphere

The following description of procedures, structures, or equipment used at the facility to prevent releases to the atmosphere is required by 20 NMAC 4.1, Subpart IX, §270.14(b)(8)(vi).

All TRU mixed waste will be contained. TRU mixed waste container vents employ particulate filters that prevent particulate releases to the atmosphere. The nature of the waste itself also mitigates potential releases to the atmosphere. Lead and other heavy metals, which could exhibit the characteristic of toxicity, may be present in some TRU mixed waste forms. The metal in the TRU mixed waste, most of which is lead in monolithic form, is present in bricks and shielding rather than in particulate form. The primary sources of other metals are sheets, rods, plating, equipment parts, or solidified sludges.

A release of hazardous waste or hazardous constituents to the air that may have adverse effects on human health or the environment is unlikely. Although VOCs could be present in the TRU mixed waste emplaced within the unit and could potentially be a source of release to the air, provisions have been made to prevent any adverse effects to human health or environmental receptors.

Section D-9b(4) discusses protection of the atmosphere, including performance standards, air emissions controls, health-risk evaluation, releases of hazardous waste or hazardous constituents from the underground HWMUs, and potential health risks.

F-4g Flammable Gas Concentration Control

Gas concentrations in the mine and around the storage area are controlled by mechanically induced ventilation. There are two primary ventilation fans and three filtration fans. If only one primary ventilation fan is ventilating the mine, it typically will be set to draw 260,000 ft^3 (7,358 m^3) per minute of air through the mine, which is sufficient to adequately ventilate all active areas in the mine. If both primary fans are operating, they will typically be set to draw 425,000 ft^3 (12,028

m^3) per minute of air through the mine. The filtration fans are interlocked so that only one filtration fan can operate at any time. One filtration fan is normally set to draw 60,000 ft^3 (1,698 m^3) per minute of air through the mine. The air is routed through the underground facility with bulkhead doors and dampers to achieve the most efficient use of the air in ventilating for possible gases and maintaining required differential pressures in the underground facility.

Potentially hazardous concentrations of gas in the WIPP underground are managed safely in accordance with established underground mine ventilation practices and federal and state regulations. This includes active working areas, including panel entries during closure operations and closure constructions.

A part of ventilation management at the WIPP is the mine ventilation plan, a living document that is updated at least annually. All underground workings that are not deactivated and barricaded, including dead end drifts, are ventilated in accordance with common, standard mining practice to maintain them in a safe condition.

Mine ventilation plans are not static, and therefore a specific version is not included in the permit application. Plans are updated a least once a year or more often to accommodate changing underground conditions. Dead end drifts are fairly common in underground mines. Ventilation to accessible dead end drifts is provided by auxiliary fans and ducts to the extent necessary. Minimum requirements for air quantity, quality, and air flow velocity depend on the level of activity in a given area and are governed by federal (30 CFR 57, Subpart G) and state regulations. Compliance with those regulations is monitored by facility personnel and through frequent inspections by regulatory authorities.

All activities at the WIPP, including work in artificially ventilated (underground) spaces, are predicated on first establishing safe working conditions. No work is permitted unless health and safety are ensured.

The WIPP Industrial Hygienist, in accordance with DOE Order 5480.10, is responsible for monitoring and/or testing the air in the underground. The tests are on an as needed basis, in areas where chemicals are stored, and in areas where people are working that may contain hazardous concentrations of airborne fumes, mists, or vapors. All surveys are recorded; records contain location, time, job description, or occurrences associated with the contaminants, and the identification of instruments used.

Underground Facility Operations checks the underground air quality on a daily basis in all open drifts utilizing instrumentation which indicates Oxygen, Carbon Monoxide, and Flammable Gas (CH_4) concentration. The results of the monitoring are entered in the Shift Log Daily. If conditions are found that exceed established criteria, additional notification is made to the CMR. Appropriate actions are taken to determine the type of gases and impact on mine activities. The readings taken during specific tests for unusual conditions are recorded in the Daily Shift Log. All the monitoring performed by Underground Facility Operations is in accordance with MSHA (30 CFR 57).

Portable air monitoring equipment is used to assure access to all areas where air quality may be of concern. Two types of measuring systems are used at the WIPP: Draeger Pump Systems and Portable Air Monitoring Instruments. Prior to use, all instruments must have certification of current calibration and check gases must also be certified as accurate within one percent of the label concentration. Instruments are used within the guidelines established by the manufacturers and are accompanied with suitable temperature, barometric and relative humidity measurements (as required). Functional testing of instruments must be done before each use and the results must fall within the ranges specified in air monitoring procedures. Gases that are to be tested include oxygen, methane, carbon monoxide, hydrogen sulfide, sulphur dioxide, nitrogen dioxide, and chlorine. Alarm levels are set for each gas as follows: O_2: 19.5% LOW; 23.0% HIGH; CH_4: 0.25%; CO: 25 ppm; H_2S: 10 ppm; SO_2: 2 ppm; NO_2: 1 ppm; Cl_2: 0.5 ppm. When alarm levels are reached either engineering controls, administrative action to return the atmosphere to a safe condition, or PPE is required. Equipment operation is by trained personnel only, or under the supervision of trained personnel. Air Quality sampling is performed as often as needed to assure safe working conditions. If conditions are worsening, or action has been taken to mitigate high levels of contamination, the frequency of measurement is increased. Underground air quality is checked at the beginning of the day when personnel are underground.

F-5 Prevention of Reaction of Ignitable, Reactive, and Incompatible Waste

20 NMAC 4.1, Subpart IX, §270.14(b)(9), requires a description of precautions taken to prevent accidental ignition or reaction of ignitable, reactive, or incompatible TRU mixed waste as required to demonstrate compliance with 20 NMAC 4.1, Subpart IX, §270.15(c), and 20 NMAC 4.1, Subpart V, §264.17. Because the TRU mixed waste (including the container) received at the facility during the Disposal Phase and any derived TRU mixed waste have been demonstrated to be compatible and do not exhibit the characteristics of ignitability, reactivity, or corrosivity, the WIPP facility is in full compliance with these regulations.

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TABLES

TABLE F-1
INSPECTION SCHEDULE

System/Equipment Name	Responsible Organization	Inspection[a] Frequency and Job Title of Personnel Normally Making Inspection	Deterioration[b]	Leaks/ Spills	Other
Air Intake Shaft Hoist	Mine Operations	Preoperational[c] See Lists 1b and c	Yes	NA	Inspect per Mine Safety and Health Administration (MSHA) requirements
Ambulances and related emergency supplies and equipment	Emergency Management	Weekly See List 11	Yes	NA	Depletion and expiration dates
Adjustable Center of Gravity Lift Fixture	Waste Operations	Preoperational See List 8	Yes	NA	NA
Standby/Emergency Power Backup Diesel Generators	Facility Operations	Monthly See List 3	NA	Yes	Starting and operating both generators
Facility Inspections	Facility Engineering	Annually See List 4	Yes	NA	NA
Central Monitoring Systems (CMS)	Facility Operations	Continuous See List 3	NA	NA	Automatic Self-Checking
Contact-Handled (CH) TRU Underground Transporter	Waste Operations	Preoperational See List 8	Yes	NA	Inspect area around transporter for obstacles
Conveyance Loading Car	Waste Operations	Preoperational See List 8	Yes	NA	Tracks clear of obstacles, guards in the proper place
Exhaust Shaft	Mine Operations	Quarterly See List 1a	Yes	Yes	NA
Eye Wash and Shower Equipment	Industrial Safety	Weekly See List 5	Yes	NA	NA
		Semi-annually See List 2a	Yes	NA	Water replaced
Fire Detection and Alarm System	Industrial Safety	Semiannually See Lists 2b and 11	Yes	NA	Operability of indicator lights. Inspection includes underground fuel station dry chemical suppression system.
Fire Extinguishers[k]	Emergency Management	Monthly See List 11	Yes	Yes	Expiration, seals, fullness, pressure

TABLE F-1 (CONTINUED)
INSPECTION SCHEDULE

System/Equipment Name	Responsible Organization	Inspection[a] Frequency and Job Title of Personnel Normally Making Inspection	Deterioration[b]	Leaks/ Spills	Other
Fire Hoses	Industrial Safety	Annually (minimum) See List 11	Yes	Yes	NA
Fire Hydrants	Emergency Management	Monthly/ quarterly See List 11	Yes	Yes	NA
Fire Pumps	Emergency Management	Weekly/annually See List 11	Yes	Yes	NA
Fire Sprinkler Systems—	Industrial Safety	Monthly/ quarterly See Lists 2b and 11	Yes	Yes	NA
Fire Trucks	Emergency Management	Weekly See List 11	Yes	Yes	NA
Forklifts Used for Waste Handling	Waste Operations	Preoperational See List 8	Yes	NA	On board fire suppression system
Hazardous Material Response Equipment	Emergency Management	Weekly See List 11	Yes	NA	Depletion and expiration dates
Miners First Aid Station	Emergency Management	Quarterly See List 11	NA	NA	Depletion
Mine Pager Phones (between surface and underground)	Facility Operations	Quarterly See List 3	NA	NA	Monthly battery change check
MSHA Air Quality Monitoring	Mine Operations	Daily[c] See List 1	NA	NA	Underground Air Quality Monitoring - MSHA
Perimeter Fence, Gates, Signs	Security	Daily See List 6	Yes	NA	NA
Personal Protective Equipment (not otherwise contained in emergency vehicles or issued to individuals): —Self-Contained Breathing Apparatus	Emergency Management	Weekly See List 11	Yes	NA	NA
	Industrial Safety	Quarterly See List 2a	Yes	NA	NA
Public Address (and Intercom System)	Facility Operations	Monthly See List 3	NA	NA	Systems operated in test mode
Radiation Monitoring Equipment	Radiation Safety	Preoperational See List 7	Yes	NA	Instrument calibrations

TABLE F-1 (CONTINUED)
INSPECTION SCHEDULE

System/Equipment Name	Responsible Organization	Inspection[a] Frequency and Job Title of Personnel Normally Making Inspection	Deterioration[b]	Leaks/ Spills	Other
Radio Equipment	Information Resource Management[i]	Daily[j]	NA	NA	Radios are used until they fail
Rescue Truck	Emergency Management	Weekly See List 11	Yes	Yes	Depletion and expiration dates
Salt Handling Shaft Hoist	Mine Operations	Preoperational See List 1b and c	Yes	NA	Inspect per MSHA requirements
Self-Rescuers	Mine Operations	Quarterly See List 1c	Yes	NA	Inspect per MSHA requirements
Surface TRU Mixed Waste Handling Area[n]	Waste Operations	Preoperational or Weekly[f,l]	Yes	Yes	Floor coating integrity
TRU Mixed Waste Decontamination Equipment	Waste Operations	Annually See List 8	NA	NA	Depletion
Underground Openings—Roof Bolts	Mine Operations	Monthly See List 1a	Yes	NA	NA
Underground Openings—Travelways	Mine Operations	Weekly/ annually See List 1a	Yes	NA	NA
Underground—Geo-mechanical Instrumen-tation System (GIS)	Mine Operations	Monthly See List 9	Yes	NA	NA
Underground TRU Mixed Waste Disposal Area—(mine pager phones, equipment, aisle space, signs, debris, ventilation)	Waste Operations	Preoperational See List 8	Yes	Yes	NA
Uninterruptible Power Supply (Central UPS)	Facility Operations	Daily See List 3	Yes	NA	No malfunction alarms
Vehicle Siren	Emergency Management	Weekly See List 11	Yes	NA	Functional Test
Ventilation Exhaust	Maintenance Operations	Quarterly See List 10	Yes	NA	NA
Waste Handling Cranes	Waste Operations	Preoperational See List 8	Yes	Yes	NA
Waste Hoist	Mine Operations	Preoperational See List 1b and c	Yes	Yes	Inspect per MSHA requirements
Water Tank Level	Facility Operations	Daily See List 3	Yes	NA	Record water levels

TABLE F-1 (CONTINUED)
INSPECTION SCHEDULE

System/Equipment Name	Responsible Organization	Inspection[a] Frequency and Job Title of Personnel Normally Making Inspection	Deterioration[b]	Leaks/ Spills	Other
Brudi	Waste Operations	Preoperational See List 8	Yes	NA	NA
Trailer Jockey	Waste Operations	Preoperational See List 8	Yes	NA	NA
Canister Shuttle	Waste Operations	Preoperational[h, l] See List 8	Yes	NA	NA
Facility Cask	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA
Facility Cask Transfer Car	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA
Facility Cask Turntable	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA
Facility Grapple	Waste Operations	Preoperational[h, l] See List 8	Yes	NA	NA
15-Ton Bridge Crane	Waste Operations	Preoperational[h, l] See List 8	Yes	NA	NA
Grapple Hoist	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA
Hook and Rope on 50/25-Ton Bridge Crane	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA
Manipulator	Waste Operations	Preoperational[h, l] See List 8	Yes	NA	NA
RH Emplacement Machine -Subassemblies -Emplacement Machine	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA
RH Hot Cell	Waste Operations	Preoperational or Weekly [h, l, m]	Yes	Yes	Floor coating integrity
Road Cask Transfer Car	Waste Operations	Preoperational[l] See List 8	Yes	NA	NA

TABLE F-1 (CONTINUED)
INSPECTION SCHEDULE

List 1: Mine Operations

a. Mining Technician *
   Senior Mining Technician *
   Continuous Mining Specialist *
   Senior Mining Specialist *
   Mine OPS Supervisor *
b. Waste Hoist Operator
   Waste Hoist Shaft Tender
c. Senior Dispatcher* - Self Rescuers
   Shaft Technician *

List 2: Industrial Safety

a. Safety Technician *
   Senior Safety Technician *
   Safety Specialist *
   Safety Engineer *
   Industrial Hygienist *
b. Fire Protection Engineering *

List 3: Facility Operations

Facilities Technician *
Senior Facilities Technician *
Facility Operations Specialist *
Central Monitoring Room Operator *
Central Monitoring Room Specialist *
Operations Engineer
Senior Operations Engineer *
Supervisor General U/G Services *
Facility Shift Manager
Operations Technical Coordinator *

List 4: Facility Engineering

Senior Engineer *

List 5: General

Building Landlord *

List 6: Security

Security Protective *
Security Protective Supervisor *

List 7: Radiation Safety

Radiological Control Technician

List 8: Waste Operations

Manager, Waste Operations
TRU-Waste Handler

List 9: Geotechnical Engineering

Engineer Technician *
Associate Engineer *
Engineer *
Senior Engineer *

List 10: Maintenance Operations

Maintenance Technician *
Maintenance Specialist *
Senior Maintenance Specialist *
Contractor *

List 11: Emergency Management

Emergency Services Technician

[a] Inspection may be accomplished as part of or in addition to regularly scheduled preventive maintenance inspections for each item or system. Certain structural systems of the WHB, Waist Hoist and Station A are also subject to inspection following severe natural events including earthquakes, tornados, and severe storms. Structural systems include columns, beams, girders, anchor bolts and concrete walls.

[b] Deterioration includes: cracks, erosion, salt build-up, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

[c] "Preoperational" signifies that inspections are required prior to the first use during a calendar day. For calendar days in which the equipment is not in use, no inspections are required. For an area this includes: area is clean and free of obstructions (for emergency equipment); adequate aisle space; emergency and communications equipment is readily available, properly located and sign-posted, visible, and operational. For equipment, this includes: checking fluid levels, pressures, valve and switch positions, battery charge levels, pressures, general cleanliness, and that all functional components and emergency equipment is present and operational.

[d] "Postoperational" signifies that inspections are required after the last use during a calendar day. For calendar days in which the equipment is not in use, no inspections are required.

[e] These weekly inspections apply to container storage areas when containers of waste are present for a week or more.

[f] Otherwise, these are inspected as indicated above.

[g] In addition, the water tank levels are maintained by the CMR and level readouts are available at any time.

[h] The inspections/maintenance activities associated with these pieces of equipment will be performed when the hot cell is empty of RH waste. If contamination is present, a radiation work permit may be needed.

[i] This organization is responsible for obtaining licenses for radios and frequency assignments. They do periodic checks of frequencies and handle repairs which are performed by a vendor.

[j] Radios are not routinely "inspected." They are operated daily and many are used in day-to-day operations. They are used until they fail, at which time they are replaced and repaired. Radios are used routinely by Emergency Management, Security,

TABLE F-1 (CONTINUED)
INSPECTION SCHEDULE

Environmental Monitoring, and Facility Operations.

k Fire extinguisher inspection is paperless. Information is recorded into a database using barcodes. The database is then printed out. A current copy of the database and barcodes is provided in Appendix F1.

l Inspections of all RH equipment and areas only apply after RH TRU waste receipt begins.

m For the RH Hot Cell limited weekly camera inspections will be done when RH waste is in the Hot Cell.

n Surface TRU mixed waste handling areas include the RH Bay, Cask Unloading Room, Facility Cask Loading Room, CH Container Storage Units, Derived Waste Area and unloading areas.

o No log forms are used for daily readings. However, readings that are out of tolerance are reported to the CMR and logged by CMR operator.

* Positions are not considered RCRA positions (i.e., personnel do not manage TRU mixed waste).

TABLE F-2
MONITORING SCHEDULE

System/Equipment Name	Responsible Organization	Monitoring Frequency	Purpose
Radiological Monitoring Areas[a]	Radiation Safety	Continuous during operations	Maintain exposure potential to workers as low as reasonably achievable (ALARA). Implement the principle of co-detection.
Geomechanical[b]	Repository Engineering	Monthly	To evaluate the geotechnical performance of the underground facility and to detect ground conditions that could affect operational safety
Central Monitoring System	Facility Operations	System Dependent	Monitor and provide status for the following facility parameters: Radiation Monitoring[c] Electrical Power Status[d] Fire Alarm System[e] Ventilation System Status[f] Meteorological Data System[g] Facility Systems (compressors[g], pumps[h], water tank levels[i], waste hoists[j])

[a] Equipment is listed as Radiation Monitoring Equipment in Table F-1.
[b] Equipment is listed as Underground-Geomechanical Instrumentation System (GIS) in Table F-1.
[c] Radiation Monitoring Equipment in Table F-1.
[d] Equipment listed as Standby/Emergency Power Backup Diesel Generator in Table F-1.
[e] Equipment listed as Fire Detection and Alarm System in Table F-1.
[f] Equipment listed as Ventilation Exhaust in Table F-1.
[g] Not RCRA equipment.
[h] Equipment listed as Fire Pumps in Table F-1.
[i] Equipment listed as Water Tank Level in Table F-1.
[j] Equipment listed as Waste Hoist in Table F-1.

TABLE F-3
DIESEL GENERATOR LOADS

Loads	kW	Remarks
Uninterruptible Power System* Central Monitoring System* WHB Continuous Air Monitors*	72	Central Monitoring System Includes: • Radiation monitoring • Electrical power status • Fire alarm system • Ventilation system status • Meteorological data system • Facility systems (compressors, pumps, water tank levels, waste hoist stations)
Central Monitoring Room HVAC System Utilities	20	
Fire Protection Systems in the Waste Handling Building Support Building	30	Battery power provided in fire protection system until the diesel generator is started and loaded.
Fire Pump	160	
Communications System	16	
Guard and Security Building	35	
Air Intake Shaft Hoist (if needed for underground evacuation)*	330	
WHB Lighting	45	
WHB Cranes	80	After the diesel generator is started, cranes are energized as required to land their loads.
WHB Vacuum Pumps	50	
Main Air compressors (1-200 hp)*	160	
Underground Exhaust Fans (1-235 hp)*	188	
WHB Fans*	100	
Underground Sandia Other Experimental Loads	400	
Safety and Emergency Services Building (EOC)*	10	
* Priority Back-up loads. Other loads picked up depending on actual kW loading of diesel or by load shedding.		

Source: DOE, 1995.

FIGURES

Figure F-1
Security Gate, Vehicle Trap and Gatehouse

Figure F-2
Warning Signs on Secured Area Fence. Pair of 180,000-Gallon Water Storage Tanks in Background

CHAPTER G

RCRA CONTINGENCY PLAN

CHAPTER G
RCRA CONTINGENCY PLAN
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CHAPTER G
RCRA CONTINGENCY PLAN

Introduction

The Waste Isolation Pilot Plant (WIPP) Project was authorized by the National Security and Military Applications of the Nuclear Energy Authorization Act of 1980 (Public Law 96-164). Its legislative mandate is to provide a research and development facility to demonstrate the safe disposal of radioactive waste resulting from United States defense activities and programs. The U.S. Department of Energy (DOE) is developing the WIPP facility to demonstrate the efficacy of an underground geologic repository for the safe disposal of transuranic (TRU) waste and TRU mixed waste currently stored at or generated by DOE defense installations.

The WIPP facility is owned and operated by the DOE and co-operated by its designated Management and Operating Contractor (MOC).

This Contingency Plan is prepared in accordance with the Resource Conservation and Recovery Act (RCRA) requirements codified in Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart V, §264.50 to §264.56, "Contingency Plan and Emergency Procedures," and submitted in compliance with 20 NMAC 4.1, Subpart IX, §270.14(b)(7). The purpose of this document is to define responsibilities, to describe coordination of activities, and to minimize hazards to human health and the environment from fires, explosions, or any sudden or nonsudden release of hazardous waste, or hazardous waste constituents to air, soil, or surface water (20 NMAC 4.1, Subpart V, §264.51 [a]). This plan consists of descriptions of processes and emergency responses specific to hazardous substances, contact-handled (CH) TRU mixed waste, remote-handled (RH) TRU mixed waste, and other hazardous waste handled at the WIPP facility.

G-1 General Information

The WIPP facility is located 26 miles (mi) (42 kilometers [km]) east of Carlsbad, in Eddy County in southeastern New Mexico, and includes an area of 10,240 acres (ac) (4,144 hectares [ha]). The facility is located in an area of low-population density, with fewer than 30 permanent residents living within a 10 mi (16 km) radius of the facility. The area surrounding the facility is used primarily for grazing, potash mining, and mineral exploration. Resource development that would affect WIPP facility operations or the long-term integrity of the facility is not allowed within the 10,240 ac (4,144 ha) that have been set aside for the WIPP Project.

The WIPP facility is designed to receive containers of TRU waste, which will be transported to the WIPP facility from the ten major and other minor DOE TRU mixed waste generator and/or storage sites. The waste will be emplaced in the bedded salt of the Salado Formation, 2,150 feet (ft) (655 meters [m]) below ground surface.

As a geologic facility for the management of TRU mixed waste, the WIPP repository is regulated as a "miscellaneous unit," as defined under 20 NMAC 4.1, Subpart V, §264.601 to §264.603. The areas at the WIPP facility subject to RCRA permitting include the surface container storage areas in the Waste Handling Building (WHB) and the parking area south of the WHB, and the areas below ground in which waste will be emplaced.

The WIPP facility includes other surface structures, shafts, and underground areas (Figures G-1, G-2, and G-3). Surface structures other than the WHB, that support TRU mixed waste management include:

Exhaust Filter Building - houses the filter banks to which the underground ventilation can be diverted in the unlikely event of a release of radionuclides.

Guard and Security Building - houses the facility security personnel and communications equipment necessary for them to perform their duties. Section G-4a specifies the duties of the security officers relative to contingency actions.

Safety and Emergency Services Building - houses the surface emergency response vehicles (fire truck, rescue truck, ambulance), Health Services (first aid), Emergency Operations Center, and the Dosimetry Laboratory. Table G-6 describes emergency equipment and associated locations.

Support Building - houses the Central Monitoring Room (see section G-4a).

Transuranic Package Transporter-II (TRUPACT-II) Maintenance Facility - located west of the CH bay, houses equipment required for conducting preventive maintenance and other activities required by the Nuclear Regulatory Commission (NRC) to maintain the Certificate of Compliance. No TRU waste management activities will occur in this facility.

Surface facilities used for storage of support equipment are identified in Table G-6.

Building 452, Safety and Emergency Services Facility, houses the emergency response vehicles, emergency equipment, the mine rescue room, mine rescue team equipment, and the Emergency Operations Center (EOC). The Hazardous Material Response Trailer is staged in the west parking area adjacent to Building 452.

A RCRA Operating permit is sought for TRU mixed waste management activities in the WHB, the parking area, and the disposal areas within the miscellaneous unit. The provisions of this Contingency Plan apply to hazardous waste management units (HWMU) in the underground waste disposal rooms, the WHB, the parking area, the Waste Shaft, and supporting TRU mixed waste handling areas. The remainder of the facility will not manage TRU mixed waste. However, hazardous substances in the remainder of the facility are included as possible triggers of the Contingency Plan. Inclusion is based on their National Fire Protection Association (NFPA)

ratings in addition to their storage quantities. The majority of hazardous substances on-site are not expected to trigger the contingency plan because they are present in the same form and concentration as the product packaged for distribution and use by the general public or are used in a laboratory under the direct supervision of a technically qualified individual. Superfund Amendments and Reauthorization Act (SARA) Title III excludes these from emergency planning reporting. The list of hazardous substances in large enough quantities to constitute a Level II incident (Section G-3) is provided in Table G-1. In addition to TRU Waste, these are the only hazardous substances currently on site which, if spilled, may be of sufficient impact to cause this Contingency Plan to be implemented. Magnesium Oxide (MgO) will be stored on-site in large quantities once CH-Waste emplacement begins. It will be used as backfill in the waste emplacement rooms as a pH buffer. The pH buffer will limit the solubility of radionuclides after the underground rooms are filled and closed. MgO is not a hazardous substance, a release of MgO will not create hazardous waste and poses no threat to human health or the environment, and is therefore not addressed in the Contingency Plan.

Wastes generated as a result of maintenance or response actions will be categorized into one of three groups and disposed of accordingly. These are: 1) nonhazardous wastes to be disposed of in an approved landfill, 2) hazardous nonradioactive wastes to be disposed of at an off-site RCRA permitted facility, and 3) TRU mixed waste to be disposed of in the underground HWMUs. Disposal of TRU mixed waste in the WIPP facility is subject to regulation under 20 NMAC 4.1, Subpart V. As required by 20 NMAC 4.1, Subpart V, §264.601, the DOE must demonstrate that the environmental performance standards for a miscellaneous unit, which are applied to the HWMUs in the underground, will be met. In addition, the technical requirements of 20 NMAC 4.1, Subpart V, §264.170 to §264.178 are applied to the operation of the container storage units in the WHB and in the parking area south of the WHB. Liquid wastes that may be generated as a result of the fire fighting water or decontamination solutions will be managed as follows:

Non-Mixed - Hazardous waste liquids contaminated only with hazardous constituents will be placed into containers and managed in accordance with 20 NNMAC 4.1, Subpart III, 262.34 requirements. The waste will be shipped to an approved off-site treatment, storage, or disposal facility.

Mixed - Liquids contaminated with mixed waste (inside the WHB) will be solidified as they are placed into containers with cement, Aquaset, or absorbent material in them and solidified in the WHB. The solidified materials will be disposed of in the underground WIPP repository as derived waste.

This chapter of the permit application describes the HWMUs, the TRU waste management facilities and operations, compliance with the environmental performance standards, and with the applicable technical requirements of 20 NMAC 4.1, Subpart V, §264.170 to §264.1789 and §264.601, respectively. The configuration of the WIPP facility consists of completed structures; including all buildings and systems for the operation of the facility.

Disposal Phase Overview

The Disposal Phase will consist of receiving both CH and RH TRU mixed waste shipping containers, unloading and transporting the waste containers to the underground HWMUs, emplacing the waste in the underground HWMUs, and subsequently achieving closure of the underground HWMUs in compliance with applicable state and federal regulations. The DOE is seeking a permit to perform these disposal and closure activities.

Panel closure and final facility closure activities will be performed in accordance with Chapter I of this permit application.

The TRU mixed waste that will be disposed at the WIPP facility results primarily from activities related to the reprocessing of plutonium-bearing reactor fuel and fabrication of plutonium-bearing weapons, as well as from research and development. This TRU mixed waste consists largely of such items as paper, cloth, and other organic material; laboratory glassware and utensils; tools; scrap metal; shielding; and solidified sludges from the treatment of wastewater. Much of this TRU mixed waste is also contaminated with substances that are defined as hazardous under 20 NMAC 4.1, Subpart II, Subparts C and D, and subject to the land disposal restrictions of 20 NMAC 4.1, Subpart VIII.

Waste Description

Waste destined for WIPP are, or were, produced as a byproduct of weapons production and have been identified in terms of waste streams based on the processes that produced them. Each waste stream identified by generators is assigned to a Waste Summary Category to facilitate RCRA waste characterization, and reflect the final waste forms acceptable for WIPP disposal.

These Waste Summary Categories are:

S3000—Homogeneous Solids

Solid process residues defined as solid materials, excluding soil, that do not meet the applicable regulatory criteria for classification as debris (20 NMAC 4.1, Subpart VIII, §268.2[g] and [h]). Included in solid process residues are inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Waste Summary Category based on the specific waste stream types and final waste form. This category includes wastes that are at least 50 percent by volume solid process residues.

S4000—Soils/Gravel

This waste summary category includes waste streams that are at least 50 percent by volume soil. Soils are further categorized by the amount of debris included in the matrix.

S5000—Debris Wastes

This waste summary category includes waste that is at least 50 percent by volume materials that meet the criteria for classification as debris (20 NMAC 4.1, Subpart VIII, §268.2) as follows:

> Debris means solid material exceeding a 2.36 inch (60 millimeter) particle size that is intended for disposal and that is: 1) a manufactured object, 2) plant or animal matter, or 3) natural geologic material.

Included in the S5000 Waste Summary Category are metal debris, lead containing metal debris, inorganic nonmetal debris, asbestos debris, combustible debris, graphite debris, heterogeneous debris, and composite filters, as well as other minor waste streams.

Examples of waste that might be included in the S5000 Waste Summary Category are asbestos-containing gloves, fire hoses, aprons, flooring tiles, pipe insulation, boiler jackets, and laboratory tabletops. Also included are combustible debris constructed of plastic, rubber, wood, paper, cloth, graphite, and biological materials. Examples of graphite waste that would be included are crucibles, graphite components, and pure graphite.

Wastes may be generated at the WIPP facility as a direct result of managing the TRU and TRU mixed wastes received from the off-site generators. Such generated waste may occur in either the WHB or the Underground. For example, when TRU mixed wastes are received at the WHB, the shipping containers (TRUPACT-II and the RH cask) and the TRU mixed waste containers are checked for surface contamination. Under some circumstances,[1] if contamination is detected, the shipping container and/or the TRU mixed waste containers will be decontaminated. In the underground, waste may be generated as a result of radiation control procedures used during monitoring activities. The waste generated from radiation control procedures will be assumed to be TRU and/or TRU mixed waste. Throughout the remainder of this plan, this waste is referred to as "derived waste." All such derived waste will be placed in the rooms in HWMUs along with the TRU mixed waste for disposal.

Containers

The waste containers that will be used at the WIPP facility qualify as "containers," in accordance with 20 NMAC 4.1, Subpart I, §260.10. That is, they are "portable devices in which a material is stored, transported, treated, disposed of, or otherwise handled."

[1]Typically contamination that is less than six square feet in area and less than 2000 disintegrations per minute (dpm) alpha or 20,000 dpm beta/gamma, may be decontaminated. Containers that exceed these thresholds will be returned to the point of origin for decontamination.

TRU waste containers, containing off-site waste, are not opened at the WIPP facility. Derived waste containers are kept closed at all times unless waste is being added or removed.

Liquid waste will not be emplaced in the WIPP. TRU waste for emplacement in the WIPP shall contain as little residual liquid as is reasonably achievable. All internal containers (e.g., bottles, cans, etc.) must be well-drained, but may contain residual liquids. As a guideline, residual liquids in well-drained containers will be restricted to approximately one percent of the volume of the internal container. In no case shall the total liquid equal or exceed one volume percent of the waste container (e.g., drum or standard waste box [SWB]).

Special requirements for ignitable, reactive, and incompatible waste are addressed in 20 NMAC 4.1, Subpart V, §§264.176 and 177. The WIPP Waste Acceptance Criteria (WAC) precludes ignitable, reactive, or incompatible TRU mixed waste at the WIPP.

Description of Containers

CH TRU mixed waste containers will be either 55-gallon (gal) (208-liter (L)) drums singly or arranged into seven (7)-packs, 85-gal (321-L) drums (used as overpacks) singly or arranged into four (4)-packs, ten-drum overpacks (TDOP), or 66.3 ft^3 (1.88 m^3) SWBs. RH mixed waste containers will be 31.4 ft^3 (890-L) canisters.

Description of Surface Hazardous Waste Management Units

The WHB is the surface facility where waste handling activities will take place. The WHB has a total area of approximately 84,000 square feet (ft^2) (7,803 square meters [m^2]) of which 33,175 ft^2 (3,083 m^2) are designated for the waste handling and container storage of CH TRU mixed waste, and 21,318 ft^2 (1,981 m^2) are designated for the waste handling and container storage of RH TRU mixed waste. These areas are being permitted as a container storage unit. The concrete floors are sealed with an impermeable coating that has excellent resistance to the chemicals in TRU mixed waste and, consequently, provide secondary containment for TRU mixed waste. In addition, a parking area south of the WHB will be used for storage of waste in sealed shipping containers awaiting unloading. This area is also being permitted as a container storage unit. The sealed shipping containers provide secondary containment in this HWMU.

CH Bay and RH Bay Operations

The maximum processing rate for CH waste is 14 TRUPACT-IIs per day. Two shifts per day are planned; four days per week. The fifth day is for equipment maintenance with weekends available for more extensive maintenance, when necessary.

Once unloaded from the TRUPACT-IIs, CH waste containers (7-packs or SWBs) are placed in one of two positions on the facility pallet. The 7-packs or SWBs are stacked, as they arrive in the TRUPACT-II, on the facility pallets (one- or two-high, depending on weight considerations). The use of facility pallets will elevate the waste approximately 6 inches (in.) (15 centimeters [cm])

from the floor surface. Pallets of waste will then be relocated to the northeast area of the CH bay for normal storage. This storage area will be clearly marked to indicate the lateral limits of the storage area. This storage area will have a maximum capacity of seven facility pallets of waste during normal operations. These pallets will typically be staged in this area for a period of one to four days.

In addition, four TRUPACT-IIs, containing up to eight 7-packs or SWBs, may occupy the staging positions at the TRUPACT-II Unloading Docks (TRUDOCK).

The amount of RH TRU mixed waste disposal planned is two canisters per day, or eight per week, on the same shifts as CH waste operations.

During normal operations, a maximum of five RH canisters will be stored in the Hot Cell and a maximum of seven canisters will be stored in the Transfer Cell. The combined storage capacity of the Hot Cell and the Transfer Cell is 77 ft^3 (2.18 m^3). The floor and wall coatings provide an impermeable surface that serves as secondary containment in the Hot Cell and the Transfer Cell. The storage positions that hold the canisters have openings and stand-offs which keep the canisters from standing in liquid.

Aisle space shall be maintained in all CH Bay waste storage areas. The aisle space shall be adequate to allow unobstructed movement of fire response personnel, spill-control equipment, and decontamination equipment that would be used in the event of an off-normal event. An aisle space between facility pallets will be maintained in all CH TRU waste storage areas. Aisle space requirements shall not be met for RH canisters, since only one is expected to be processed at a time. Because of the high radiation fields, inspections and cleanup of spills and releases will not be conducted while waste is located in these storage areas. If a release were to occur, all waste canisters would be removed from the Hot Cell prior to initiating any clean up activities.

Parking Area

The area extending south from the WHB across the rail sidings is defined as the parking area container storage unit. This area provides space for 12 loaded TRUPACT-IIs and three loaded road casks or four rail casks, corresponding to 1,536 ft^3 (43.5 m^3) of CH waste and 125.6 ft^3 (3.56 m^3) of RH waste. Secondary containment and protection of the waste containers from standing rainwater are provided by the transportation containers.

The maximum number of TRUPACT-IIs that will be stored in the parking area is 20 percent of the TRUPACT-II fleet. This is equivalent to 12 TRUPACT-IIs, containing a maximum of 24 SWBs or 168 drums of CH waste. The TRUPACT-II safety criteria require that they be opened and vented at a frequency of at least once every 60 days. In addition, three road casks or four rail casks containing RH waste may be stored in this area. During normal operations the maximum residence time of any one container in the parking area storage area is four days. Therefore, during normal waste handling operations, TRUPACT-IIs will not require venting while located in the parking area storage area. Any off-normal event that drives residence times to 60 days or

greater in this storage area shall be mitigated by returning the shipment to the generator prior to the expiration of the 60 day NRC venting period or by moving the TRUPACT-IIs or casks inside the WHB where the waste will be removed and placed in one of the permitted storage areas.

Off-Normal Events

Off-normal events could interrupt normal operations in the waste management process line. Additional storage capacity is available on the west side of the CH bay for use during off-normal events. If such off-normal events occur, the New Mexico Environment Department (NMED) will be informed of: 1) how much waste is to be stored, 2) where the waste will be placed, 3) how any applicable secondary containment requirements will be met, and 4) how long the waste is expected to be located in the designated storage area. Waste stored in this area will be inspected at a frequency of at least once weekly, with the exception of the Hot Cell and the Transfer Cell, as previously noted. Any off-normal storage of hazardous waste, beyond the capacity of the WHB permit, will occur under an emergency permit issued by NMED under 20 NMAC 4.1, Subpart IX,§270.61. The DOE will not store RH waste at the facility outside the shipping cask beyond the permitted capacity of the Hot Cell and transfer cell.

Shipments of waste from the generator sites will be stopped in any event which results in an interruption to normal waste handling operations that exceeds three days. This will minimize the potential for large quantities of waste requiring storage in the parking area for extended periods of time.

Containment

The WHB has concrete floors, which are sealed with an impermeable coating that resists all but the strongest oxidizing agents. Such oxidizing agents do not meet the WAC and will not be accepted in TRU mixed waste at the WIPP facility. Therefore, TRU mixed wastes pose no compatibility problems with respect to the WHB floor.

During normal operations, the floor of the normal storage areas within the CH Bay shall be visually inspected on a weekly basis to verify that it is in good condition and free of cracks and gaps. Floors in the Hot Cell and the Transfer Cell can only be inspected when no waste is present. Inspections will occur at least annually when these areas undergo routine maintenance. However, limited camera inspections can be conducted when the Hot Cell contains waste. This less frequent inspection schedule is justified because of the high radiation fields that are present when waste is present and because these floors are not subjected to vehicle traffic.

Floor areas of the WHB used during off-normal events will be inspected prior to use and weekly while in use. Containers located in the permitted storage areas shall be elevated from the surface of the floor. Facility pallets provide about 6 in (15 centimeters [cm]). of elevation. Waste

containers that have been removed from TRUPACT-II shipping containers shall be stored at a designated storage area inside the WHB so as to preclude exposure to the elements.

Secondary containment at permitted storage areas inside the WHB shall be provided by the floor. These areas include the CH Bay floor, the Hot Cell, and the Transfer Cell. The parking area and TRUDOCKs do not require engineered secondary containment, since waste is not stored there unless it is protected by the TRUPACT-II shipping containers or the road casks. Floor drains, the fire suppression water collection sump, and portable dikes, if needed, will provide containment for liquids that may be generated by fire fighting. Sump capacities and locations are shown in Drawing 41-F-087-014. Residual fire fighting liquids will be placed in containers and managed as described above.

G-2 Response Personnel

Persons qualified to act as the RCRA Emergency Coordinator, as required by 20 NMAC 4.1, Subpart V, §264.55, are listed in Table G-2.

A RCRA Emergency Coordinator will be on-site at the WIPP facility 24 hours a day, seven days a week, with the responsibility for coordinating emergency response measures. RCRA Emergency Coordinators are listed in Table G-2, where five individuals have been designated primary RCRA Emergency Coordinators. This is because the on-duty Facility Shift Manager (FSM) is designated as the RCRA Emergency Coordinator. The five individuals shown serve as FSM on a rotating shift basis.

Persons qualified to act as the RCRA Emergency Coordinator are thoroughly familiar with this Contingency Plan, the TRU mixed waste and hazardous waste operations and activities at the WIPP facility, the locations of TRU mixed waste and hazardous waste activities, the locations on the site where hazardous materials are stored and used, and the locations of waste staging and accumulation areas. They are familiar with the characteristics of hazardous substances, TRU mixed waste and hazardous waste handled at the WIPP facility, the location of TRU mixed waste and hazardous waste records within the WIPP facility, and the facility layout. In addition, persons qualified to act as the RCRA Emergency Coordinator have the authority to commit the necessary resources to implement this Contingency Plan. Figure G-4 outlines the RCRA Emergency Coordinator's position relative to other organizations that provide support.

In addition to the RCRA Emergency Coordinator, the following individuals or groups have specified responsibilities during any WIPP facility emergency:

- Assistant Chief Office Warden (ACOW)—Persons assigned to take accountability for sections of the site, and then reporting the accountability to the Chief Office Warden.

- Central Monitoring Room Operator (CMRO)—The on-shift operator responsible for Central Monitoring Room (CMR) operations, including coordination of facility communications. The facility log is maintained by the CMRO.

- Chief Office Warden (COW)—A predesignated individual with responsibilities for complete surface accountability at staging areas in the event of an evacuation. The Chief Office Warden receives reports from the ACOWs.

- Emergency Response Team (ERT)—Supplemental group trained to respond to surface emergencies, to fight only incipient and exterior structure fires, to provide emergency first aid, and to respond to releases of hazardous waste or hazardous material. ERT members are part of the WIPP Supplemental Emergency Response Program.

- Emergency Services Technician (EST)—Regular employee whose job is that of full-time emergency responder. The EST acts as incident commander (on-scene coordinator) for all emergency response events. During non-emergency conditions, the EST conducts inspections of facility fire suppression systems, inspects emergency equipment, and trains supplemental emergency responders commensurate with duties to be performed. The EST is responsible for completion of specific sections of the "WIPP Hazardous Material Incident Report." Additional technical personnel complete identified sections of the report.

- First Line Initial Response Team (FLIRT)—Supplemental primary responders in the event of a general underground emergency for medical and hazardous material response. No fire response beyond incipient stage will be performed by the FLIRT. The FLIRT also provides backup support for the ERT in the event of a general surface-facility emergency. FLIRT members are part of the WIPP Supplemental Emergency Response Program.

- Mine Rescue Team (MRT)—Supplemental group responsible for underground reentry and rescue after an emergency evacuation. The MRT responds in accordance with 30 CFR Part 49 requirements. MRT members are part of the WIPP Supplemental Emergency Response Program.

- Office Warden—An individual assigned responsibility for assuring that personnel are evacuated from his/her assigned area or building during evacuations. Office Wardens maintain a list of all personnel in their specific area. This list is compared with the physical presence of personnel who assemble at the staging areas. The Office Wardens report area accountability to the ACOWs.

- EOC Staff-The EOC consists of a minimum staff, which includes Waste Isolation Division (WID) management personnel, three Operations representatives, one Environment, Safety, and Health representative (ES&H), and one Emergency

Management representative. The EOC staff can also include technical and logistic support personnel from WID Engineering, WID Public Affairs, WID ES&H, WID Operations, and DOE. Additional administrative support staff is made available from site personnel, these personnel provide message runners, communications, and computer assistance. The EOC is activated by the FSM. Since EOC staff are performing duties similar to their normal job functions and providing support related to their area of expertise, no specific RCRA training is required.

G-3 Implementation

The provisions of this Contingency Plan will be implemented immediately whenever there is an emergency event (e.g., a fire, an explosion, or a natural occurrence that involves or threatens hazardous or TRU mixed wastes or a release of hazardous substances, hazardous materials, or hazardous wastes) that could threaten human health or the environment, or whenever the potential for such an event exists as determined by the RCRA Emergency Coordinator, as required under 20 NMAC 4.1, Subpart V, §264.51(b). The following information is utilized for categorization of events to determine implementation of the contingency plan:

1. Medical Emergencies (does not implement the Contingency Plan)

2. Nonemergency (does not implement the Contingency Plan)

   a. Fire already out, did not involve any hazardous materials.
   b. Spill or release involved materials excluded according to the SARA Title III, Statute 42 U.S.C. 11021 (e). Such as:

      1) Any substance present in the same form and concentration as product packaged for distribution and use by the general public. (Example: Cleaning solutions)
      2) Any substance to the extent it is used in a laboratory under the direct supervision of a technically qualified individual.
      3) Petroleum, including crude oil or any fraction thereof, which is not otherwise specifically listed or designated as a hazardous substance by Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

3. Incident Level I: According to the NFPA 471, Responding to Hazardous Materials Incidents (See Table G-3). If the product(s) involved in the fire, explosion, spill or leakage meets the following criteria, it will be classified as a Level I incident and does not implement the Contingency Plan.

   a. The product does not require a U.S. Department of Transportation (DOT) placard, is a NFPA listed 0 or 1 for all categories, or is Other Regulated Materials A, B, C, or D.

b. The fire is under control and the reactivity rating of the material is less than a rating 2, indicating a low potential for subsequent explosion as the hazardous material can be considered normally stable.
c. There was no release or the release can be confined with readily available resources.
d. There is no life-threatening situation.
e. There is no potential environmental impact.

4. Incident Level II: According to NFPA 471, Responding to Hazardous Materials Incidents, (See Table G-3). If the product(s) involved in the fire, explosion, spill or leakage meets the following criteria, it will be classified as a Level II incident and the Contingency Plan will be implemented by the RCRA Emergency Coordinator.

   a. The product requires a DOT placard, is an NFPA 2 for any categories, or is Environmental Protection Agency (EPA) regulated waste (Site-specific: Table G-1 and TRU waste) AND
   b. The incident involves multiple packages.
   c. There is potential for the fire to spread since the hazardous material's flammability level (rating 2) is below 200 degrees Fahrenheit, or the reactivity (rating 2) indicates that violent chemical changes are possible and thus may be explosive.
   d. The release may not be controllable without special resources.
   e. The incident requires evacuation of a limited area for life safety.
   f. The potential for environmental impact is limited to soil and air within incident boundaries.
   g. The container is damaged but able to contain the contents to allow handling or transfer of product.

5. Incident Level III: According to NFPA 471, Responding to Hazardous Materials Incidents. (See Table G-3) If the product(s) involved in the fire, explosion, spill or leakage meet the following criteria, it will be classified as a Level III incident and the Contingency Plan will be implemented by the RCRA Emergency Coordinator.

   a. The product is a poison A (gas), an explosive A/B, organic peroxide, flammable solid, material that is dangerous when wet, chlorine, fluorine, anhydrous ammonia, NFPA 3 and 4 for any categories including special hazards, EPA extremely hazardous substances, and cryogenics. (Site specific: RH TRU waste.)
   b. The site-specific container size for this incident level will be a tank truck or an RH waste canister.
   c. There is potential for the fire to spread since the hazardous material's flammability level (rating 3 or 4) is below 100 degrees Fahrenheit, or the reactivity (rating 3 or 4) indicates that the material may explode.
   d. The release may not be controlled even with special resources.
   e. The incident requires mass evacuation of a large area for life safety.

f. Even though the NFPA guidelines for this incident level indicate that the potential for environmental impact is severe, due to the site engineering controls for RH Waste, the impact is contained within the HWMUs.
g. The container is damaged to such an extent that catastrophic rupture is possible.

The above categories include fire situations, weather conditions, natural phenomena, and explosions which will have to be evaluated to make an incident level determination. A Level II (potential threat to human health in localized area, potential for moderate on-site environmental impact) or Level III (potential threat to human health in a larger area, potential for severe environmental impact) incident by definition is considered to be a potential threat to human health or the environment and, therefore, is considered to be an emergency requiring activation of the Contingency Plan.

G-4 Emergency Response Method

Methods that describe how and when the WIPP Contingency Plan will be implemented cover the following 11 implementation areas:

1. Notification (Section G-4a)
2. Identification of hazardous materials (Section G-4b)
3. Assessment of the nature and extent of the emergency (Section G-4c)
4. Control, containment, and correction of the emergency (Section G-4d)
5. Prevention of recurrence or spread of fires, explosions, or releases (Section G-4e)
6. Management and containment of released material and waste (Section G-4f)
7. Incompatible waste (Section G-4g)
8. Post-emergency facility and equipment maintenance and reporting (Section G-4h)
9. Container spills and leakage (Section G-4i)
10. Tank spills and leakage (Section G-4j)
11. Surface impoundment spills and leakage (Section G-4k)

G-4a Notification

Notification requirements in the event of an emergency at a RCRA hazardous waste management facility are defined by 20 NMAC 4.1, Subpart V, §§264.56(a) and (d). Necessary

notifications in case of an emergency at the WIPP facility are described in this section (Figure G-4a). Personnel at the WIPP facility are trained to respond to emergency notifications.

Initial Emergency Response and Alerting the RCRA Emergency Coordinator

The first person to become aware of an incident shall immediately report the situation to the CMRO, and provide the following information, as appropriate:

- Name and telephone number of the caller
- Location of the incident and the caller
- Time and type of incident
- Severity of the incident
- Magnitude of the incident
- Cause of the incident
- Assistance needed to deal with or control the incident
- Areas or personnel affected by the incident

In addition to receiving incident reports, the CMRO, who is located in the Support Building (Building 451) (Figure G-1), continuously monitors (24 hours a day) the status of mechanical, electrical, and/or radiological conditions at selected points on the site, both above and below ground. Alarms to indicate abnormal conditions are located throughout the WIPP facility. The alarm(s) (e.g., fire, radiation) may be the first notification of an emergency situation received by the CMRO. The CMRO monitors alarms, takes telephone calls and radio messages, and initiates outgoing calls to emergency staff and outside agencies.

Once the CMRO is notified of a fire, explosion, or a release anywhere in the facility (either by eyewitness or an alarm), the RCRA Emergency Coordinator is immediately notified. Once notified, the RCRA Emergency Coordinator assumes responsibility for the management of activities related to the assessment, abatement, and/or cleanup of the incident.

A RCRA Emergency Coordinator is on-site at all times and, therefore, can be reached at any time via a two-way radio or over the public address (PA) and plectrons on-site. If the RCRA Emergency Coordinator is unavailable or unable to perform these duties, a qualified alternate RCRA Emergency Coordinator is available.

The EST is also notified in case of fire, explosion, or release. The RCRA Emergency Coordinator, in consultation with the EST as incident commander, determines if supplemental emergency responders are necessary. Notification of the ERT (surface) is made by the EST using the ERT pagers. If the EST is unable to make the notifications, the CMRO performs this function. The CMRO will notify the FLIRT using the Mine Page Phone System. If the MRT is needed the RCRA Emergency Coordinator will instruct the CMRO to make a PA announcement for the MRT to assemble in the Mine Rescue Room, located in building 452.

Off-shift personnel may be notified using the on-call list, which is updated weekly by the Emergency Management section of the ES&H Department. The FSM, CMRO, each individual on the on-call list, and WIPP Security receive copies of the on-call list. The CMRO may direct Security to make the notifications.

The response to an unplanned event will be performed in accordance with procedures based on the applicable federal, state, or local regulations and/or guidelines for that response. These include the U.S. Mine Safety and Health Administration (MSHA); NMAC; CERCLA; Chapter 74, Article 4B, New Mexico Statutes Annotated 1978, New Mexico Emergency Management Act; and agreements between the DOE and/or the WIPP MOC and local authorities (Section G-6) for emergencies throughout the WIPP facility.

After notification by the CMRO, the EST shall immediately investigate to determine pertinent information relevant to the actual or potential threat posed to human health or the environment. The information will include the location of release, type, and quantity of spilled or released material (or potential for release due to fire, explosion, weather conditions, or other naturally occurring phenomena), source, areal extent, and date and time of release. The EST shall provide information for classification of the incident, according to the emergency response guidelines, to the RCRA Emergency Coordinator. The RCRA Emergency Coordinator then classifies the incident after evaluation of all pertinent information. This classification must consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off from water or chemical agents used to control fire and heat-induced explosions).

When the RCRA Emergency Coordinator determines that an Incident Level II or III has occurred, the Contingency Plan is implemented. The RCRA Emergency Coordinator then may choose to activate the EOC for additional support (Figure G-4). If the RCRA Emergency Coordinator determines that due to extenuating circumstances the potential to upgrade to an incident Level II or III exists, the RCRA Emergency Coordinator also may activate the EOC. The EOC will assist the RCRA Emergency Coordinator in mitigation of the incident with use of communications equipment and technical expertise from any WIPP organization (see Section G-4c).

The EOC staff will assess opportunities for coordination and the use of mutual-aid agreements with local outside agencies making additional emergency personnel and equipment available (Section G-6), as well as the use of specialized response teams available through various state and federal agencies. As a DOE facility, the WIPP facility may use the resources available from the Federal Response Plan, signed by 27 federal departments and agencies in April 1987, and developed under the authorities of the Earthquake Hazards Reduction Act of 1977 (42 U.S.C. 7701 et seq.) and amended by the Stafford Disaster Relief Act of 1988. Most resources are available within 24 hours. The WIPP facility maintains its own emergency response capabilities on-site. In addition to the supplemental emergency responders, radiological control technicians, environmental sampling technicians, wildlife biologists, and various other technical experts are available for use on an as-needed basis. The EST will continue as the on-scene incident commander communicating with the RCRA Emergency Coordinator.

Communication of Emergency Conditions to Facility Employees

Procedures for notifying facility personnel of emergencies depend upon the type of emergency. Methods of notification are:

- Local Fire Alarms

  The local fire alarms sound a bell tone and may be activated automatically or manually in the event of a fire.

- Surface Evacuation Signal

  The evacuation signal is a yelp[2] tone and is manually activated by the CMRO when needed. The CMRO shall follow the evacuation signal with verbal instructions and ensure the Site Notification System (i.e., the plectron) has been activated.

- Underground Evacuation Warning System

  The evacuation signal is a yelp tone and flashing strobe light. In the event of an evacuation signal, underground personnel will proceed to the nearest egress hoist station (Section G-7b) to be apprised of the nature of the emergency and the evacuation route to take. Underground personnel are trained to report to the underground assembly areas and await further instruction if all power fails or if ventilation stops. In that event, personnel will remain underground until power can be restored. MSHA requires personnel to be brought to the surface within 60 minutes if a ventilation outage occurs. This is done using the Air Intake Shaft Hoist, powered by the backup electric generators.

- Contingency Evacuation Notification

  If the primary warning system consisting of alarms and signals fails to operate when activated (as in a total power outage and failure of the back-up power systems), WIPP Security will be notified by the CMRO to initiate the contingency evacuation plan. In this event Security officers will alert personnel to evacuate the area and will check trailers, if possible, to ensure that personnel have been alerted/evacuated.

WIPP facility personnel are trained and given instruction during General Employee Training to recognize the various alarm signals and the significance of each alarm. WIPP facility employees and site visitors are required to comply with directions from emergency personnel and alarm

[2]The yelp tone increases from 500 to 1,000 hertz and drops to 500 hertz.

system notifications and to follow instructions concerning emergency equipment, shutdown procedures, and emergency evacuation routes and exits.

Notification of Local, State, and Federal Authorities

If it is determined that the facility has had a fire, an explosion, a spill, or a release of hazardous waste or hazardous waste constituents (included in 20 NMAC 4.1, Subpart II) in the miscellaneous unit or TRU mixed waste handling areas, or an emergency resulting in a release of a hazardous substance (included in 40 CFR §302.4 and §302.6 or the New Mexico Emergency Management Act, §74-4B-3 and §74-4B-5) that could threaten human health or the environment outside the facility, the RCRA Emergency Coordinator, after consultation with the DOE, will assure that local authorities are notified by telephone and/or radio, including:

- Carlsbad Police Department (telephone number: [505] 885-2111) (or 911)
- Carlsbad Fire Department (telephone number: [505] 885-2111) (or 911)
- Eddy County Sheriff (telephone number: [505] 887-7551)
- Hobbs Fire Department (telephone number: [505] 397-9308)

After local authorities are notified, the RCRA Emergency Coordinator will ensure notification of the following:

- New Mexico Environment Department (NMED)
  Department of Public Safety
  24-Hour Emergency Reporting Telephone Number: (505) 827-9329
  FAX number: (505) 827-9368

- Department of Public Safety WIPP Coordinator
  Telephone Number: (505) 827-9221
  FAX number: (505) 829-3434

- Hazardous Materials Emergency Response, Chemical Safety Office, Department of Public Safety, State Emergency Response Commission
  Telephone number: (505) 827-9223
  FAX number: (505) 829-3434

- National Response Center
  Telephone number: 1-800-424-8802
  FAX number: (202) 479-7181

- Local Emergency Planning Committee
  Telephone number: (505) 887-9511
  Fax number: (505) 887-1039

The first notification of public safety and regulatory agencies will include the following:

- The name and address of the facility and the name and phone number of the reporter
- The type of incident (fire, explosion, or release)
- The date and time of the incident
- The type and quantity of material(s) involved, to the extent known
- The exact location of the incident
- The source of the incident
- The extent of injuries, if any
- Possible hazards to human health and the environment (air, soil, water, wildlife, etc.) outside the facility
- The name, address, and telephone number of the party in charge of or responsible for the facility or activity associated with the incident
- The name and the phone number of the RCRA Emergency Coordinator
- The identity of any surface and/or groundwater involved or threatened and the extent of actual and potential water pollution
- The steps being taken or proposed to contain and clean up the material involved in the incident

The RCRA Emergency Coordinator will also be available to advise the appropriate local, state, or federal officials on whether or not local areas should be evacuated.

Notification of the General Public

Immediate notification of the general public through the public safety and emergency agencies listed above will be made by, or under the direction of, the RCRA Emergency Coordinator following an evaluation to determine if local adjacent areas need to be evacuated. This evaluation will be made in consultation with the DOE who has management responsibility for the land withdrawal area. DOE policy is to provide accurate and timely information to the public by the most expeditious means possible concerning emergency situations at the WIPP site that may affect off-site personnel, public health and safety, and/or the environment. A DOE Carlsbad Area

Office (DOE/CAO) Management representative is always on-call. This person is available by pager or telephone 24 hours a day.

A Hazards Assessment was conducted, which indicated no need for protective actions or emergency action levels, as defined by the DOE, for the facility. Therefore, no procedures are in place for evacuation of the public. Procedures are in place for notification of the public by radio, television, and newspapers for news items which might include notification of on-site emergency situations. These procedures include a Public Affairs Coordinator in the EOC who writes and transmits press releases to the Greene Street facility, where formal press conferences are conducted.

G-4b Identification of Hazardous Materials

The identification of hazardous wastes, hazardous waste constituents, or hazardous materials involved in a fire, an explosion, or a release to the environment is a necessary part of the assessment of an incident, as described in 20 NMAC 4.1, Subpart V, §264.56(b). RCRA hazardous waste and hazardous substances and materials listed in 40 CFR §302.4 and §302.6 or New Mexico Emergency Management Act, §74-4B-3 and §74-4B-5 and, involved in any release at the WIPP facility will be identified. The identification of likely hazardous materials at any location is enhanced because hazardous materials and hazardous waste are only stored or managed in specified locations throughout the WIPP facility. An attempt will be made to identify products involved by occupancy/location, container shape, markings/color, placards/labels, United Nations/North America/Product Identification Number, on-site technical experts, or field sampling. Further, the ES&H department maintains an updated inventory of hazardous materials/substances that are brought on site, and a master MSDS listing in the Safety and Emergency Services Facility, Building 452.

Sources of information available to identify the hazardous wastes, substances, or materials involved in a fire, an explosion, or a release at the WIPP facility include operator/supervisor knowledge of their work areas, materials used, and work activities underway; the WIPP Waste Information System (WWIS), which identifies the location within the facility of emplaced TRU mixed waste, including emplaced derived waste; and waste manifests and other waste characterization information in the operating record. The WWIS also includes information on wastes that are in the waste handling process. Also available are MSDSs for hazardous material in the various user areas throughout the facility, waste acceptance records, and materials inventories for buildings and operating groups at the WIPP facility. Information or data from the derived waste accumulation areas, the hazardous waste staging area, satellite staging areas, and nonregulated waste accumulation areas are included.

TRU mixed waste received by the WIPP facility during the Disposal Phase will be characterized for hazardous constituents prior to receipt, and acceptable knowledge will be used to characterize derived waste prior to emplacement.

Information required for identifying TRU mixed hazardous constituents in case of an incident is readily available through the WWIS and the waste acceptance records. Waste accepted at WIPP is already known to be compatible with all materials used to respond to an emergency. All non-TRU waste materials received on site, other than those listed in Table G-1, are in such small quantities that no reaction could develop which would trigger an Incident Level II or III response.

The RCRA Emergency Coordinator will have access to the WWIS through Waste Operations, and any personal computer connected to the site network, if any specific information is needed.

The RCRA Emergency Coordinator has access to the inventory lists and MSDSs in the Safety and Emergency Services Facility at all times.

G-4c Assessment of the Nature and Extent of the Emergency

Once the required notifications have been made, the RCRA Emergency Coordinator will ensure that the identity, exact source, amount, and areal extent of any released materials are determined, as required under 20 NMAC 4.1, Subpart V, §264.56(b). The RCRA Emergency Coordinator will determine whether the occurrence constitutes an emergency based on knowledge of the area and access to the waste identification/characterization information described in Section G-4b. An emergency will require response by only trained emergency response personnel. The RCRA Emergency Coordinator will be responsible for responding to immediate and potential hazards, using the services of trained personnel to determine: 1) the identity of hazardous wastes, hazardous waste constituents, and other hazardous materials involved in a release, as described in Section G-4b; 2) whether or not a release involved a reportable quantity of a hazardous substance; 3) the areal extent of a release; 4) the exact source of a release; and 5) the potential hazards to human health or to the environment.

After the materials involved in an emergency are identified, the specific information on the associated hazards, appropriate personal protective equipment (PPE), decontamination, etc., will be obtained from MSDSs and from appropriate chemical reference materials at the same location. These information sources may be accessed by the RCRA Emergency Coordinator or through several WIPP facility organizations, including Industrial Safety; Environmental Compliance and Support, both part of the ES&H department; and Hazardous Waste Operations Sections. Any other organization's expertise can also be utilized.

The emergency assessment requires determination of hazards involving evaluation of several criteria, including:

- Exposure: magnitude of actual or potential exposure to employees, the general public, and the environment; duration of human and environmental exposure; pathways of exposure

- Toxicity: types of adverse health or environmental effects associated with exposures; the relationship between the magnitude of exposure and adverse effects

- Reactivity: hazardous materials or hazardous wastes, which are not TRU mixed wastes, involved in an incident will be assessed for reactivity through accessing the MSDSs for the affected material and the recommended method(s) for managing such waste

- Uncertainties: considerations for undeterminable or future exposures; uncertain or unknown health effects, including future health effects

G-4d Control, Containment, and Correction of the Emergency

The WIPP facility is required to control an emergency and to minimize the potential for the occurrence, recurrence, or spread of releases due to the emergency situation, as described in 20 NMAC 4.1, Subpart V, §264.56 (e). The WIPP Emergency Response procedures utilize the incident mitigation guidelines in NFPA 471, Responding to Hazardous Materials Incidents, with initial response priority being on control, and those actions necessary to ensure confinement and containment (the first line of defense) in the early, critical stages of a spill or leak. The RCRA Emergency Coordinator is responsible for stopping processes and operations when necessary, and removing or isolating containers. TRU waste will remain within the WHB, parked TRUPACT-II containers, road casks, and the underground HWMU.

All Emergencies

The WIPP Emergency Response procedures include, but are not limited to, the following actions appropriate for control:

1. Isolate the area from unauthorized person by fences, barricades, warning signs, or other security and site control precautions. Isolation and evacuation distances vary, depending upon the chemical/product, fire, and weather situations.
2. Identify the chemical/product according to Section G-4b.
3. Drainage controls.
4. Stabilization of physical controls (such as dikes or impoundment[s]).
5. Capping of contaminated soils to reduce migration.
6. Using chemicals and other materials to retard the spread of the release or to mitigate its effects.
7. Excavation, consolidation, removal, or disposal of contaminated soils.
8. Removal of drums, barrels, or tanks where it will reduce exposure risk during situations such as fires.

If the facility stops operations in response to a fire, explosion, or release, the RCRA Emergency Coordinator must ensure continued monitoring for leaks, pressure buildup, gas generation, or

ruptures in valves, pipes, or other equipment, wherever appropriate. If operations continue, personnel normally assigned to these tasks will continue.

Both natural and synthetic methods will be employed to limit the releases of hazardous materials so that effective recovery and treatment can be accomplished with minimum additional risk to human health or the environment. A combination of the above methods to achieve protection of human health and the environment, with emphasis on two basic methods for mitigation of hazardous materials incidents - Physical and Chemical (Tables G-4, G-5) mitigation, will be used.

1. Physical methods of control involve any of several processes to reduce the area of the spill leak, or other release mechanism (such as fire suppression).

   A. Absorption is the process in which materials hold liquids through the process of wetting. Absorption is accompanied by an increase in the volume of the sorbate/sorbent system through the process of swelling. Some of the materials utilized in response to Level I incidents or Level II incidents involving liquids will be absorbent sheets of polyolefin-type fibers, spill control bucket materials (specifically for solvents, neutralization, or for acids/caustics), and absorbent socks for general liquids or oils.

   B. Covering refers to a temporary form of mitigation for radioactive incidents that will be utilized in response to Level II or Level III incidents involving TRU waste. These could include absorbent sheets, plastic, or actual ambulance blankets.

   C. Dikes or Diversions refer to the use of physical barriers to prevent or reduce the quantity of liquid flowing into the environment. Dikes may be soil or other barriers temporarily utilized to hold back the spill or leak. Diversion refers to the methods used to physically change the direction of the flow of the liquid. Absorbent socks or earth may be utilized as dikes or diversions for all levels of incidents.

   D. Overpacking is accomplished by the use of an oversized container. Overpack containers will be compatible with the hazards of the materials involved.

   E. Plug and Patch refers to the use of compatible plugs and patches to reduce or temporarily stop the flow of materials from small holes, rips, tears, or gashes in containers. A Series A hazardous response kit containing nonsparking equipment to control and plug leaks may be utilized for response to all levels of incidents.

   F. Transfer refers to the process of moving a liquid, gas, or some forms of solids, either manually or by pump, from a leaking or damaged container.

Scoops, shovels, jugs, and pails as well as drum transfer pumps for chemical and petroleum transfer are utilized as needed in response to all levels of incidents.

G. Vapor Suppression refers to the reduction or elimination of vapors emanating from a spilled or released material through the most efficient method or application of specially designed agents such as an aqueous foam blanket.

2. Chemical Methods of Mitigation

A. Neutralization is the process of applying acids or bases to a spill to form a neutral salt. The application of solids for neutralizing can often result in confinement of the spilled material. This would include using the neutralizing adsorbents.

B. Solidification is the process whereby a hazardous liquid is added to material such as an absorbent so that a solid material results.

The established procedures are based upon the incident level and a graded approach for nonradioactive, CH, or RH waste emergencies and initiated to:

1. Minimize contamination or contact (through PPE, etc.)
2. Limit migration of contaminants
3. Properly dispose of contaminated materials

<u>Fire</u>

The incident level emergency response identified in Section G-3 includes fire/explosion potential. WIPP fire response will be limited to incipient and exterior structure fires unless directed otherwise by the EST as part of a rescue life saving attempt. For internal structure fires, the Memoranda of Understanding (MOU) may be utilized.

The first option in mine fire response will be to apply mechanical methods to stop fires (e.g., cut electrical power). The last option in mine fire response will be to reconfigure ventilation. The following actions are implemented in the event of a fire:

1. All emergency response personnel at an incident will wear appropriate PPE.

2. Only fire extinguishing materials that are compatible with the materials involved in the fire will be used to extinguish fires. Compatibility with materials involved in a fire are determined by pre-fire plans, Emergency Response Guide Book (DOT, 1993), DOT labeling, and site-specific knowledge of the emergency response personnel. Water and dry chemical materials have been determined to

be compatible with all components of the TRU mixed waste. Pre-fire plans for the WHB are included in Figures G-10 and G-11.

Fires in areas of the WHB should not propagate, due to limited amount of combustibles, and the concrete and steel construction of the structures. Administrative controls, such as landlord inspections and EST inspections, help to insure good housekeeping is maintained. Combustible material and TRU mixed waste will be isolated, if possible. Firewater drain trenches collect the water and channel it into a sump. In areas not adjacent to the trenches, portable absorbent dikes (pigs) will be used to retain as much as possible, until it can be transferred to containers or sampled and analyzed for hazardous constituents. The co-detection principle (Appendix I3) is used.

3. If the fire spreads or increases in intensity, personnel will be directed to evacuate.

4. The RCRA Emergency Coordinator will remain in contact with responding personnel to advise them of the known hazards.

5. In order to ensure that storm drains and/or sewers do not receive potentially hazardous runoff, dikes will be built around storm drains to control discharge as needed. Collected waste will be sampled and analyzed for hazardous constituents, if possible, before being discharged to evaporation ponds. There are two ponds south of the security fence, opposite the WHB, that will collect drainage from the parking area. The rest of the site, inside the security fence, drains to the large pond to the west. Samples will be taken from these ponds, after the emergency has been abated, to determine any cleanup requirements. The WIPP Sampling Plan will be used.

6. The RCRA Emergency Coordinator maintains overall control of the emergency and may accept and evaluate the advice of WIPP facility personnel and emergency response organization members, but retains overall responsibility. Selection of methods and tactics of fire response is the responsibility of the Incident Commander.

7. The RCRA Emergency Coordinator will be in overall control of WIPP facility emergency response efforts until the emergency is terminated.

8. Materials involved in a fire can be identified in the following ways:

   - According to Section G-4b.

   - If the contents of the waste container cannot be determined based on its location and the label is destroyed by fire, the material will be treated as an unknown, evaluated for radiological contamination, and analyzed

according to methods in the EPA's "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" (SW-846), Third Edition, after the fire has been extinguished.

- Airborne radioactivity samples may be obtained during a fire involving radioactive materials, using portable and fixed air samplers. Response personnel will be adequately protected from airborne radioactivity by their PPE required for fire response.

9. Only materials compatible with the waste may be used for fire response.

10. When cleanup has proceeded to the point of finding no radionuclide activity, then the "swipe" can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

    - For waste containers, once radiologically clean and free of any visible evidence of hazardous waste spills on the container, it will be placed in the underground without further action.

    - For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues (for further information see Section G-4d, Emergency Termination Procedures).

11. Fire suppression materials used in response to incidents will be retained on-scene, where an evaluation will be performed to determine appropriate recovery and disposal methods.

<u>Explosion</u>

The following actions will be implemented in the event that an explosion that involves or threatens hazardous or TRU mixed waste or hazardous materials has occurred:

1. The area will be evacuated immediately.

2. The CMRO will immediately notify the appropriate emergency response personnel and the RCRA Emergency Coordinator about the explosion.

3. The Incident Commander will ensure that any injured personnel are treated and transported as necessary.

4. The RCRA Emergency Coordinator will remain in contact with responding personnel to advise them of the known hazards involved and the degree and location of the explosion and associated fires.

5. The RCRA Emergency Coordinator will be in command and may accept and evaluate the advice of WIPP facility personnel and emergency response organization members, but retains the overall responsibility. Selections of methods and tactics of response are the responsibility of the Incident Commander.

6. The RCRA Emergency Coordinator will be in overall control of WIPP facility emergency response efforts until the emergency is terminated.

7. When cleanup has proceeded to the point of finding no radionuclide activity, then samples may be taken for chemical analysis if there is visible evidence to suspect additional hazardous waste residues. Chemical residues on floor surfaces resulting from a hazardous waste explosion will be evaluated, sampled, analyzed (if required), isolated, and returned to appropriate containers, and surfaces will be cleaned using appropriate cleaners.

8. The RCRA Emergency Coordinator may shut down operational units (e.g., process equipment and ventilation equipment) that have been affected directly or indirectly by the explosion. Once the areas have been determined safe for reentry, processes may be reactivated.

Spills

Protection of response personnel at a hazardous material incident is paramount. The primary methods to protect personnel are time, distance, and shielding. If a Level II or III incident exists, the RCRA Emergency Coordinator will implement the following actions:

1. The immediate area will be evacuated.

2. The RCRA Emergency Coordinator will review facility records to determine the identity and chemical nature of released material.

3. Entry team procedures will be utilized, with special attention to the following:

   - Buddy system
   - Appropriate PPE
   - Backup rescue team
   - Supplemental communication signals (hand signals and hand-light signals)
   - Monitoring equipment
   - Exposure time limitations

4. If possible, the source of the release will be secured.

5. A dike to contain runoff may be built.

6. Emergency responders will ensure that storm drains and/or sewers do not receive potentially hazardous runoff or spilled material. They may build dikes around storm drains to control discharge.

7. Released wastes may be collected and contained by stabilizing or neutralizing the spilled material, as appropriate, pouring an absorbent over the spilled material, and sweeping or shoveling the absorbed material into drums or other appropriate containers. The absorbents have been determined to be compatible with all components of the TRU mixed waste.

8. No TRU mixed waste that may be incompatible with the released material will be managed in the affected area until cleanup procedures are complete.

9. The RCRA Emergency Coordinator will direct spill control, decontamination, and termination procedures described below.

Decontamination of Personnel

Decontamination of personnel with radioactive contamination is the responsibility of the Radiological Control (RC) section. If a person is contaminated with radioactivity during a site evacuation to the staging areas, the contaminated area will be covered before the person can be moved (under escort by RC personnel) to the staging area. The RC personnel will ensure the contaminated person remains segregated from other site personnel while under RC supervision.

In the event of an emergency that requires immediate evacuation of the area, the contamination can be covered by any method warranted, given the circumstance (e.g., clean clothing wrapped around the area). If the size of the radioactive contamination on the body is small and localized, it can be covered with clothing (e.g., glove, shoe cover, coveralls). If the size of the radioactive contamination on the body is large, it will be covered by dressing the individual in a full set of Anti-Contamination clothing (coveralls, hood, gloves, shoe covers, etc.).

If time and location permit and the contamination is on the face, it will be decontaminated immediately using a cloth moistened with tepid water (and a mild detergent, if necessary). If the size of the radioactive contamination on the individual's body is small and localized, it will be decontaminated using the same method as for the face, but after the individual has been transferred to an area appropriate for conducting decontamination.

If the individual is transferred to the staging area prior to decontamination, he/she will be decontaminated at:

- The portable decontamination shower (moved to the staging area),
- The decontamination trailer (moved to the staging area), or
- A temporary controlled area posted by RC personnel.

A portable shower is normally stored in the WHB. The decontamination trailer is stored in the northeast corner of the fenced parking area, adjacent to the WHB.

Control of Spills or Leaking or Punctured Containers of CH TRU Mixed Waste

In the event of spills or leaking or punctured containers of CH TRU mixed waste, the WIPP responds in three distinct phases: 1) the event, 2) the re-entry, and 3) the recovery.

1. During the event, the following immediate actions are completed: 1) stop work, 2) warn others (notify CMR), 3) isolate the area, 4) minimize exposure, and 5) close off unfiltered ventilation. These actions can take place simultaneously, as long as they are completed before proceeding to the re-entry phase.

2. During the re-entry phase, a Radiological Work Permit (RWP) is written for personnel to enter with protective clothing to assess the conditions, take surveys and samples, and mitigate problems that could compound the hazards in the area (cover up spilled material with plastic material sheeting and or any approved fixatives such as polyvinyl alcohol (PVA) or paint, place equipment in a safe configuration, etc.). Smears and air sample filters are counted. This information is used by cognizant managers, RC personnel, and As Low As Reasonably Achievable (ALARA) Committee representatives to determine an appropriate course of action to recover the area. A plan to decontaminate and recover affected areas and equipment will be approved with a RWP written to establish the radiological controls required for the recovery.

3. During the recovery phase, the plan will be executed to utilize the necessary resources to conduct decontamination and/or overpacking operations as needed. The completion of this phase will occur prior to returning the affected area and/or equipment to normal activities. The recovery phase will include activities to minimize the spread of contamination to other areas. These activities will involve placing the waste material in another container; vacuuming the waste material; overpacking the spilled, leaking, or punctured waste container; an or decontaminating the affected area(s). If an affected surface cannot be decontaminated to releasable levels, it may be covered with a fixative coating and established as a Fixed Contamination Area to prevent spread of contamination in accordance with Article 222.3 of WP 12-5, WIPP Radiological Control Manual, or it may be removed using heavy machinery and tools, packaged in approved waste containers, and emplaced in the underground. Every reasonable effort to minimize the amount of derived waste, while providing for the health and safety of personnel, will be made.

   Should a breach of a waste container occur at the WIPP that results in external contamination exceeding the small area "spot" decontamination levels, the affected container(s) (e.g., breached and contaminated) will be placed into an

available overpack container (e.g., 85-gal drum, SWB, TDOP, canister overpack). The decontamination of equipment and the overpacking of contaminated/damaged waste containers will be performed in the vicinity of the incident. For example, under normal operations waste will be handled only in the areas of the WHB for which a permit is being sought. Therefore, it is within these same areas that decontamination and/or overpacking operations would occur. By eliminating the transport of contaminated equipment to other areas for decontamination or overpacking, the risk of spreading contamination is reduced.

Equipment used during a spill cleanup or overpacking operation could include: cloths, brushes, scoops, absorbents, squeegees, tape, bags, pails, slings, hand tools, and others as needed for a given incident.

At the underground emplacement room, salt contaminated by a spill of TRU waste would be either covered or cleaned up, depending on location, extent, and spilled material, due to potential radioactive contamination spread via the salt dust. The contaminated salt would be covered, in accordance with Article 222.3 of WP 12-5, WIPP Radiological Control Manual, to isolate it from the workers, and the stacking of waste containers would resume or would be removed and packaged as site-derived waste using damp rags, hand tools and HEPA filtered vacuums.

The decontamination methods will initially involve wiping down structures, equipment, and other containers in the area with absorbent cloths moistened with tepid water. Surveys of these structures will take place and the need to continue decontamination activities will be established. If further decontamination is required, nonhazardous decontaminating agents, such as Liquinox©, Simple Green©, Windex©, citric acid, Bartlett Strip Coat©, and high pressure CO_2 will be used to prevent generating mixed waste.

RWPs and other administrative controls provide protective measures to help ensure that new hazardous constituents will not be added during decontamination activities.

Certain structures and/or equipment may be disassembled to facilitate decontamination or may be placed directly into a derived waste container. Items used in the spill cleanup and decontamination operations (e.g., swipes, tools, PPE, etc.) may also be placed into a derived waste container.

When decontamination is deemed by the recovery team to be complete, RC personnel will conduct one final, intensive radcon survey of the area and components in the area to release it for uncontrolled use. The free release criteria for items, equipment, and areas is < 20 dpm/100 cm^2 for alpha radioactivity and < 200 dpm/100 cm^2 for beta-gamma radioactivity. After cleanup is complete, facility personnel will complete an inspection and include the details of the spill and cleanup in the log.

Control of Spill or Leaking or Punctured Containers of RH TRU Mixed Waste

In the event a contaminated RH TRU waste canister is received, WIPP responds in three distinct phases: 1) the event, 2) the re-entry, and 3) the recovery. The RH canister is checked for surface contamination once it is withdrawn from the road cask to the Hot Cell and before it is placed in the transfer car to await emplacement in the underground.

1. Unlike CH waste, the RH waste canisters, by virtue of being in the Hot Cell, are isolated from personnel. If contamination is detected on the surface of an RH canister, it is placed in an overpack canister, plugged, and seal welded. The overpack canister is then placed in the transfer car to await emplacement in the underground. The CMR is notified and the waste handling and radiological control groups prepare a RWP for entry into the Hot Cell for contamination surveys and cleanup.

2. Once a RWP is written and the Hot Cell is devoid of RH canisters, personnel enter with protective clothing to assess the conditions, take surveys and smears, and record results. Results are utilized by cognizant managers, RC personnel and ALARA Committee representatives to determine the appropriate course of action to recover the area. A plan to decontaminate and recover affected areas and equipment will be approved with a RWP written to establish the radiological controls required for the recovery.

3. During the recovery phase, the plan will be executed to utilize the necessary resource to conduct decontamination and/or fixing operations as needed. The completion of this phase will occur prior to returning the affected area and/or equipment to normal activities. All accessible areas are decontaminated to releasable levels, or may be covered with a fixative coating and established as a Fixed Contamination Area to prevent the spread of contamination in accordance with Article 222.3 of WP 12-5, WIPP Radiological Control Manual.

   Equipment used during recovery could include: cloths, brushes, absorbent, squeegees, tape, bags, pails, slings, hand tools, and others as needed for a given incident.

The decontamination methods will initially involve wiping down structures and equipment in the area with absorbent cloths moistened with tepid water. Surveys of structures will be utilized to determine the need to continue decontamination activities. If further decontamination is required, nonhazardous decontaminating agents such as, Liquinox©, Simple Green©, Windex©, citric acid, Bartlett Strip Coat©, and high pressure CO_2, will be used to prevent generating mixed waste.

RWPs and other administrative controls provide protective measures to help ensure that new hazardous constituents will not be added during decontamination activities.

Certain structures and/or equipment may be disassembled to facilitate decontamination, contamination fixing, or may be placed directly into a derived waste container. Items used in recovery operations (e.g., swipes, tools, PPE, etc.) may also be placed into a derived waste container.

When recovery is deemed by the recovery team to be complete, RC personnel will conduct one final, intensive radcon survey of the area and components in the area to release it for uncontrolled use. The free release criteria for items, equipment, and areas is <20 dpm/100 cm^2 for alpha radioactivity and <200 dpm/100 cm^2 beta-gamma radioactivity.

After cleanup is complete, facility personnel will complete an inspection and include the details of the spill and cleanup in the inspection log.

Natural Emergencies

After a natural emergency (earthquake, flood, lightning strike, etc.) that involves hazardous waste or hazardous materials, the FSM will ensure the following actions are taken:

1. Inspect containers and containment for signs of leakage or damage. Inspect areas where containers are stored looking for leaking containers and for deterioration of containers and the containment system.

2. Inspect affected equipment or areas associated with hazardous waste management activities for proper operating mode in accordance with site procedures and manually check to ensure automatic and alarmed features on the units are working.

3. Inspect affected equipment or areas within the HWMUs in accordance with site procedures for damage.

4. Inspect electrical boards and overhead electrical lines for damage.

5. Check container areas for signs of leakage or damage to drums and containers.

6. Check affected buildings and fencing directly related to hazardous waste management activities for damage.

7. Conduct a general survey of the site looking for signs of land movement, etc.

8. Take any necessary corrective measures, however temporary, to rectify potential or real problems.

9. Record inspection results.

Roof Fall

There is no reason to believe that a roof fall will occur without prior knowledge, due to the design and operation of the WIPP total ground-control program. No roof-falls have occurred to date, a 14 year period, without significant prior knowledge.

The WIPP underground is routinely evaluated for stability and safety of the underground openings. These evaluations can be as simple as the MSHA required visual checks by personnel working in the area or as extensive as the expert review of the roof support system for Room 1 Panel 1 conducted in 1991. An in-depth evaluation of all of the accessible underground is performed on an annual basis as part of the formal ground control operating plans. Weekly visual and sounding inspections are performed by the Mining Operations personnel. More frequent inspections and evaluations are performed in areas where roof or ribs are in need of evaluations, based on visual observations by Geotechnical Engineering and Mining Operations personnel, analysis of rock deformation data, excavation effects program data acquired from observation holes, and support system performance.

This process applies not only to the waste disposal rooms but to the entire WIPP underground. Prior to waste emplacement, stability of each room will be evaluated. This evaluation will concentrate on the age and current performance of the installed support systems (if any) and the rate of roof beam expansion based on data from installed instrumentation. The roof support system's performance and surety, to provide the support necessary for the required time will be addressed. Criteria used will include design parameters such as the amount of load, the deformation of the installed system, and the number and type of component failures observed, if any. Geotechnical criteria will include parameters such as the type and quantity of fracturing, roof beam expansion rates, and future ground performance based on a predictive model.

Should the evaluation results indicate that remedial actions are necessary prior to placement of waste, experiences at the WIPP indicate that rebolting or installing supplemental support can extend the safe life of a room for several years.

After waste emplacement commences, geomechanical monitoring will continue with monitors that are tied into a computer network program. The readings obtained will provide information needed for the roof beam stability assessment. Visual observations of the ground and the support systems will also continue in all accessible areas. Based on the experiences from the Site and Preliminary Design Validation test rooms, it has been proven that any developing instability will be detected through monitoring. Multiple measures to deal with the observed conditions can be implemented months before an event to mitigate any risk associated with a roof fall in the storage room or any affected area within the mine. At a minimum, the affected area will be isolated and withdrawn from ventilation flow. Isolation operations will utilize current available methods, materials, and equipment.

Ground control conditions which could result in a fall can be divided into two scenarios: The first consists of spalling (falling) of individual small and localized rock falling on waste containers.

By definition, they can be considered insignificant as no damage to the drums can occur. The second consists of an entire section of roof falling on multiple stacks of waste containers. Each of these scenarios is discussed below.

Spalling-of-Ground

The possibility of a punctured container due to a spall-of-ground is very remote. The maximum distance between the room roof and a container of waste is 10 ft. Waste containers are designed to withstand impact loads of at least 1,000 pounds (lbs) dropped from a height of 6 ft. flat or 450 lbs dropped on a circumfrontial edge from a height of 4 ft. Both of which correspond to an allowable impact stress of 25,450 pounds per square inch (psi). Rocks from spalling are small and would not be of sufficient weight when striking a drum from a 10 ft vertical height to cause an impact stress of more than 25,450 psi. Taking into account the falling distance, average weight, and the typical shape of the salt rock, the conclusion is that puncturing a drum by spalling is non-credible.

Fall-of-Ground

Fall-of-ground occurs when a large section of roof beam falls onto the waste containers. As previously discussed, the possibility of this occurring in an active room is remote, due to continuous monitoring and engineered roof support systems. Roof falls in a room completely filled with waste are considered to be of no consequence as shown in analysis in the WIPP SAR, DOE/WIPP-95-2065, Rev. 0, Section 5.2.3.11. In addition, a filled room is isolated from ventilation by shutting ventilation bulkhead regulators at the room exit and removed from personnel access by erecting a barricade at the entrance to the room (the bulkhead at the exit of the room prevents access at the room's exit).

Both of the above events are considered non-credible because of the type and amount of monitoring and ground control efforts at WIPP. However, per the request of the NMED, the following actions have been developed and will be taken by the RCRA Emergency Coordinator should a rock fall occur in an active waste emplacement area of the repository:

Spalling-of-Ground

1. Determine whether the roof conditions allow for safe entry and if the waste container or containers in question are accessible.

   The process used to determine if a roof condition of a room will allow for safe entry is the same as the ground control inspection process used for inspection of the ground conditions and roof bolt integrity. The inspection will begin at a safe and sound roof starting point and consist of visual inspections of roof bolts, roof, and rib areas for missing or damaged bolts; deformed roof bolt plates; or roof and rib cracks, fractures, or separations. If during the visual inspection suspicious roof bolts, roof, or ribs are found, then operators will proceed with sounding the area

in question with a scaling bar for loose roof bolts, bad roof, or ribs (loose roof bolts will not ring when sounded). Bad roof or ribs will have a drummy, hollow, or un-solid sound when struck with the scaling bar. When this operation is performed, a safe avenue for retreat is always maintained. Also maintained is a position such that an unexpected event will not place personnel in a position where the scaling bar or material being scaled could fall on personnel. If the inspection reveals ground that cannot be safely scaled manually or with the available mining equipment, the affected area, up to and including the entire room, will be barricaded and removed from ventilation flow.

The criteria used to determine whether a waste container is accessible is based on the location of the container, the amount of waste in the room, and the expense of reaching the waste container safely versus the expense of abandonment of the room. For example, if the room is 95% filled and spalling-of-ground punctured a waste container at or near the exit of the room, the decision to isolate the room and move waste emplacement activities to the next room would be prudent.

2. Restrict access in ventilation flowpath downstream of the incident.

3. Restrict ventilation to the affected room to ensure that there is no spread of contamination (using the principle of co-detection) that may have been released. Survey for contamination and establish the boundaries.

4. Inspect containers and containment for signs of leakage or damage.

5. Cover the spill area with material such as plastic or fabric sheets or PVA, in a way that would safely isolate the area.

6. Determine if the covered spill area safely allows for continued waste disposal operations or whether further cleanup is required. If further cleanup is required, provide with cleanup methods described below. Note: Cleaning may not be required since this is the permitted disposal area.

7. Inspect any affected equipment (vehicles, handling equipment, and communication and alarm equipment) for proper function.

8. Repackage spilled waste and breached waste containers into 55 or 85-gallon drums, SWBs, or TDOPs, depending on volume. Temporarily locate overpack waste containers in an adjacent room. Remove only those intact waste containers necessary to clear the area for decontamination.

9. At the underground emplacement room, salt contaminated by a spill of TRU waste will be covered with materials such as salt, plastic or fabric sheets or PVA to

isolate it from the workers or removed and packaged as site derived waste using damp rags, hand tools, and HEPA filtered vacuums.

10. Manage the radioactive debris as derived waste.

11. Characterize containers of waste based on the waste containers that were damaged.

12. Replace the removed and derived waste containers into the waste stack as appropriate and update the WWIS.

13. Document activities and record results.

Fall-of-Ground

1. Restrict access in ventilation flowpath downstream of the incident.

2. Withdraw the room from ventilation flow by closing bulkhead regulators.

3. Survey for radiological contamination and establish the boundary for a Radiological Buffer Area.

4. Install barricade devices to remove access.

5. At the underground emplacement room, salt contaminated by a spill of TRU waste will be covered with materials such as salt, plastic or fabric sheets, or PVA to isolate it from the worker or removed and packaged as site derived waste using damp rags, hand tools, and HEPA filtered vacuums.

The criteria used to determine whether to close the entire panel or just the affected room of waste containers would include the location of the roof fall and the stability of the unaffected roof area in the panel. Techniques to determine the stability would be the same as previously described in this section.

Structural Integrity Emergencies

The unique nature of the WIPP geologic repository makes the possibility of structural integrity failure in the underground implausible. In the unlikely event of a WIPP facility emergency involving underground structural integrity, the situation will be handled as a natural emergency. Monitoring and inspection procedures ensure the safety and integrity of the WIPP facility underground.

Emergency Termination Procedures

For the transition from emergency phase to cleanup phase, the following items must be complete:

- Emergency scene must be stable
- Release of hazardous substance must be stopped
- Reaction of hazardous substance must be controlled
- The released hazardous substance must be contained within a localized and manageable area
- The area of contamination must be adequately secure from unauthorized entry

At every incident involving hazardous materials, there is a possibility that response personnel and their equipment will become contaminated. Emergency response personnel have procedures to minimize contamination or contact, and to properly dispose of contaminated materials.

For nonemergencies and Incident Level I emergencies, the following methods of decontamination are available for personnel, environment, and/or equipment according to emergency response procedures:

- Absorption
- Adsorption
- Chemical degradation
- Dilution
- Disposal
- Isolation
- Neutralization
- Solidification

The Incident Commander (EST) will stay on-scene until the hazard has been mitigated. Any necessary verification of air, soil, or water samples will be directed by the RCRA Emergency Coordinator. Immediately after an emergency, the RCRA Emergency Coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility in accordance with standard operating procedures.

For Level II and III incidents after the emergency itself is controlled and contained, the RCRA Emergency Coordinator will be responsible for the development and implementation of an incident-specific decontamination plan.

PPE will be decontaminated according to procedure before it is returned to its storage location.

As part of the facility's defense-in-depth approach, equipment will be assumed to be contaminated after each hazardous material response and a thorough check for radioactive contamination will be conducted. If contamination is found, a technically sound decontamination process will be followed. Many types of equipment are difficult to decontaminate and may have to be discarded as hazardous or derived waste. Whenever possible, pieces of equipment will be disposable or made of nonporous material.

The "Start Clean-Stay Clean" operating philosophy of the WIPP Project minimizes probabilities for releases and subsequent decontamination. If radioactive contamination is detected on equipment, on structures, or in the air, it will be assumed that hazardous constituents may also be present. Co-detection methods (see Appendix I3, "Co-Detection of Hazardous and Radioactive Waste Releases") will be used along with other techniques as a detection method to determine when decontamination is required. Radiological cleanup standards will be used to determine the effectiveness of decontamination efforts. To provide verification of the effectiveness of the removal of hazardous waste constituents, once a contaminated surface is demonstrated to be radiologically clean, the "swipe" can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

For waste containers, the analyses becomes documentation of the condition of the container at the time of emplacement. The presence of hazardous waste constituents on a container after decontamination will be at trace levels and will likely not be visible and will not pose a threat to human health or the environment. These containers will be placed in the underground without further action, once the radiological contamination is removed, unless there is visible evidence of hazardous waste spills or hazardous waste on the container and this contamination is considered likely to be released prior to emplacement in the underground.

For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues. If the area is large, a sampling plan will be developed using the guidance in the "Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling" (Westinghouse 1994b). If the area is small, swipes will be used. If the results of the analysis show that residual contamination remains, a decision will be made whether further cleaning will be beneficial or whether final clean up must be deferred until closure. For example, if hazardous constituents react with the floor coating and are essentially nonremovable without removing the coating, then clean up will be deferred until closure, when the coatings will be stripped. In any case, appropriate notations will be entered into the operating record to assure proper consideration of formerly contaminated areas at the time of closure. Furthermore, measures such as covering, barricading, and/or placarding will be used as needed to mark areas that remain contaminated.

For all Contingency Plan emergency responses, the RCRA Emergency Coordinator will ensure, in keeping with standard operating procedures, that, in the affected area(s) of the facility:

- No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed

- All emergency equipment listed in the contingency plan is cleaned and fit for its intended use, or replaced before operations are resumed

G-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases

During an emergency, the RCRA Emergency Coordinator will ensure that reasonable measures are taken so that fires, explosions, and releases do not occur, recur, or spread to TRU mixed waste or other hazardous materials at the facility, as required under 20 NMAC 4.1, Subpart V, §§264.56(e) and (f). These measures include:

- Stopping processes and operations.

- Collecting and containing released wastes and materials.

- Removing or isolating containers of waste or hazardous substances posing a threat.

- Ensuring that wastes managed during an emergency are handled, stored, or treated with due consideration for compatibility with other wastes and materials on site and with containers utilized (Section G-4h).

- Restricting personnel not needed for response activities from the scene of the incident.

- Evacuating the area.

- Curtailing nonessential activities in the area.

- Conducting preliminary inspections of adjacent facilities and equipment to assess damage.

- Overpacking and/or removing damaged containers/drums from affected areas. Damaged equipment and facilities will be repaired as appropriate.

- Constructing, monitoring, and reinforcing temporary dikes as needed.

- Maintaining fire equipment on standby at the incident site in cases where ignitable liquids have been or may be released and ensuring that all ignition sources are kept out of the area. Ignitable liquids will be segregated, contained, confined, diluted, or otherwise controlled to preclude inadvertent explosion or detonation.

No operation that has been shut down in response to the incident will be restarted until authorized by the RCRA Emergency Coordinator. Sections G-4g, Incompatible Waste, and G-4h, Post-Emergency Facility and Equipment Maintenance and Reporting, address specific issues related to decreasing the possibility of a recurrence or spread of a release, a fire, or an explosion.

After resolution of the incident, a Root Cause Analysis will be conducted to review all Level II and Level III incidents for determination of cause, and the corrective action plan to prevent recurrence.

G-4f Management and Containment of Released Material and Waste

Once initial release or spill containment has been completed, the RCRA Emergency Coordinator will ensure that recovered hazardous materials and waste are properly stored and/or disposed, as required by 20 NMAC 4.1, Subpart V, §264.56(g). For spills of liquid, the perimeter of the spill will be diked with an absorbent material that is compatible with the material(s) released. Free-standing liquid will be transferred to a marked compatible container. The remaining liquid will be absorbed with an absorbent material and swept or scooped into a marked compatible container. Spill residue will be removed. Spills of dry material will be swept or shoveled into a labeled compatible recovery container. Material recovered from the spill will be transferred to clean containers or tanks or to containers or tanks that have held a compatible material. All containers will meet DOT specifications for shipping the wastes, and materials will be recovered.

Nonradioactive hazardous waste resulting from the cleanup of a fire, an explosion, or a release involving a nonradioactive hazardous waste or hazardous substance at the WIPP facility will be contained and managed as a hazardous waste until such time as the waste is disposed of, or determined to be nonhazardous, as defined in 20 NMAC 4.1, Subpart II, Subparts C and D. In most cases, hazardous materials inventories for the various buildings and areas at the facility will allow a determination of the hazardous materials present in any cleanup of a release or of the residues from an emergency condition. (The quantities of such spills are so small, it is not likely to trigger an Incident Level II or III.) When necessary, however, samples of the waste will be collected and analyzed to determine the presence of any hazardous characteristics and/or hazardous waste constituents; this information is needed to evaluate disposal options. EPA-approved sampling and analytical methods will be utilized. Hazardous wastes will be transferred to the Hazardous Waste Staging Area. The staging area is used to store hazardous waste awaiting transfer to an off-site treatment or disposal facility in accordance with applicable regulations (e.g., 20 NMAC 4.1 and DOT regulations). The Hazardous Waste Staging Area for nonradioactive hazardous waste is Buildings 474A and 474B, as shown in Figure G-1. Nonradioactive hazardous wastes will be shipped off-site for disposal at a RCRA permitted disposal facility.

Under normal operations, administrative controls will be implemented to ensure that hazardous materials and incompatible materials will not be introduced to the radioactive materials area during TRU mixed waste handling operations. Examples of administrative controls include

restricting the waste received in the TRU mixed waste management area(s) to TRU mixed waste properly manifested from the generator sites and ensuring that materials used in these area(s) are restricted to only those that have previously been determined to be compatible with the TRU mixed waste. The RCRA Emergency Coordinator will have access to building design information and information on specific equipment used within an area upon which to base a determination of the compatibility of materials with the area. If necessary, the RCRA Emergency Coordinator will use EPA-600/2-80-076, "A Method for Determining the Compatibility of Hazardous Waste," (EPA, 1980) for making compatibility determinations. Waste resulting from the cleanup of a fire, explosion, or release in the miscellaneous unit and the TRU mixed waste handling area will be derived from the received TRU mixed waste and will be treated and managed as TRU mixed waste.

In the event of a prolonged cessation of TRU mixed waste handling operations, TRU mixed waste can be placed in areas of the WHB that are available for such contingencies. These areas and the TRU mixed waste containers in them would be located so that adequate aisle space would be maintained for unobstructed movement of personnel and equipment in an emergency. Each shipping cask contains one canister of waste. Chapter D describes the HWMUs in detail, including the facility description, support structures and equipment, security, waste handling areas, ventilation, and fire protection.

The contaminated area will be decontaminated. If a release is to a permeable surface, such as soil, asphalt, concrete, or other surface, the surface material will be removed and placed in containers meeting applicable DOT requirements. Contaminated soil, asphalt, concrete, or other surface material, as well as materials used in the cleanup (e.g., rags and absorbent material) will be contained and disposed of in the same manner as dictated for the contaminant. Clean soil, new asphalt, or new concrete will be emplaced at the spill location.

If a spill occurs on an impermeable surface, the surface will be decontaminated with water and/or a detergent. In the event that the spilled material is water reactive, a compatible nonhazardous cleaning solution will be used. Contaminated wash water or cleaning solution will be transferred to an appropriate container, marked, and managed as described above for nonradioactive or radioactive liquid wastes.

In the event of a hazardous material or hazardous waste release, the RCRA Emergency Coordinator will ensure that no wastes will be received or disposed of in the affected areas until cleanup operations have been completed. This is to ensure that incompatible waste will not be present in the vicinity of the release.

Because of the restrictions which the WIPP facility places on generators, and because of control of WIPP operations, TRU mixed wastes and derived wastes will not contain any incompatible wastes. However, the areas established for the temporary holding of nonradioactive waste routinely generated at the WIPP facility is divided into bays to accommodate the management of wastes that may be incompatible. If waste is generated as the result of a spill or release of hazardous materials or nonradioactive hazardous waste, the waste generated as a result of

abatement and cleanup will be evaluated to determine its compatibility with other wastes being managed in the temporary holding areas. The evaluation will be by identifying the material or waste that was spilled or released and determining its characteristics (e.g., ignitable, reactive, corrosive, or toxic). The waste generated by the abatement and cleanup activities will be stored in that part of the temporary holding area that has been established to manage wastes with which it is compatible.

For small nonemergency liquid spills (e.g., a detergent solution leaking out of the pump handle during decontamination, a spill of hydraulic fluid while servicing a vehicle), spill control procedures will be used to contain and absorb free-standing liquid. The contaminated absorbent will be swept or shoveled into a compatible container and managed as described above. No notifications will be required, but site procedures require documentation of the incident.

G-4g Incompatible Waste

Implementation of the TRU WAC for the WIPP ensures that incompatible TRU mixed waste will not be shipped to the WIPP facility. Nonradioactive waste at the WIPP facility will be carefully segregated during handling and holding and will be transported within and off the facility. The RCRA Emergency Coordinator will not allow hazardous or TRU mixed waste operations to resume in a building or area in which incompatible materials have been released prior to ensuring that necessary post-emergency cleanup operations to remove potentially incompatible materials have been completed. In making the determination of compatibility, the RCRA Emergency Coordinator will have available the resources and information described in Section G-4b, Identification of Hazardous Materials. In addition, ES&H department personnel will be available for consultation. Finally, the RCRA Emergency Coordinator may use EPA-600/2-80-076, (EPA, 1980).

G-4h Post-Emergency Facility and Equipment Maintenance and Reporting

The RCRA Emergency Coordinator will ensure that emergency equipment that is located or used in the affected area(s) of the facility and listed in the Contingency Plan is cleaned and ready for its intended use before operations are resumed, as specified in 20 NMAC 4.1, Subpart V, §264.56(h)(2). Any equipment that cannot be decontaminated will be discarded as waste (e.g., hazardous, mixed, solid), as appropriate. The WIPP facility is committed to replacing any needed equipment or supplies that cannot be reused following an emergency. After the equipment has been cleaned, repaired, or replaced, a post-emergency facility and equipment inspection will be performed, and the results will be documented.

Cleaning and decontaminating equipment will be accomplished by physically removing gross or solid residue; rinsing with water or another suitable liquid, if required; and/or washing with detergent and water. Decontamination and cleaning will be conducted in a confined area, such as a wash pad or building equipped with a floor drain and sump isolated from the environment. Care will be taken to prevent wind dispersion of particles and spray. Liquid or particulate resulting from cleaning and decontamination of equipment will be placed in clean, compatible

containers. Waste produced in an emergency cleanup in the TRU mixed waste handling areas is derived waste and will be emplaced in the underground derived waste emplacement area. Waste resulting from decontamination operations elsewhere in the WIPP facility will be analyzed for hazardous waste constituents and/or hazardous waste characteristics to ensure proper management.

When the WIPP facility has completed post-emergency cleanup of waste and hazardous residues from areas where waste management operations are ready to resume and the RCRA Emergency Coordinator has ensured that emergency equipment used in managing the emergency has been cleaned or replaced and is fit for service, the notifications will be made by the DOE to the following: the EPA Region VI Administrator; the Secretary of the NMED; and any relevant local authorities. This post-emergency notification complies with 20 NMAC 4.1, Subpart V, §264.56(i), and is the responsibility of the RCRA Emergency Coordinator.

G-4i Container Spills and Leakage

The waste received at the WIPP facility must meet stringent WAC (e.g., no free liquids and less than one percent residual liquids), which will minimize the chances of waste container degradation and the possibility of liquid spills. The WIPP facility does manage drum quantities of lubricants, solvents, antifreeze, and recyclable spent solvents elsewhere at the facility. Should a spill or release occur from a container, the WIPP facility will immediately take the following actions, in compliance with 20 NMAC 4.1, Subpart V, §264.52(a) and §264.171:

- Assemble the required response equipment, such as protective clothing and gear, heavy equipment, empty drums, overpack drums, and hand tools
- Transfer the released material to a container that is in good condition or overpack the leaking container into another container that is in good condition
- Once the release has been contained, determine the areal extent of migration of the release and proceed with appropriate cleanup action, such as chemical neutralization, vacuuming, or excavation

G-4j Tank Spills and Leakage

The TRU mixed waste handling areas at the WIPP facility do not include tank storage or treatment of hazardous waste, as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Subpart J. At the WIPP facility, tanks are used to store water and petroleum fuels only. The petroleum tanks store diesel and unleaded gasoline.

G-4k Surface Impoundment Spills and Leakage

The WIPP facility does not manage hazardous or TRU mixed waste using a surface impoundment, as defined in 20 NMAC 4.1, Subpart I, §260.10, and as regulated under 20 NMAC 4.1, Subpart V, Subpart K. Surface impoundment regulations are not applicable to the WIPP facility.

G-5 Emergency Equipment

A variety of equipment is available at the facility for emergency response, containment, and cleanup operations in both the HWMUs and the facility in general. This includes equipment for spill control, fire control, personnel protection, monitoring, first aid and medical attention, communications, and alarms. This equipment is immediately available to emergency response personnel. A listing of major emergency equipment available at the WIPP facility, as required by 20 NMAC 4.1, Subpart V, §264.52(e), is shown in Table G-6. Table G-7 identifies the locations where fire suppression systems are provided. Locations of the underground emergency equipment are shown in Figure G-5. The firewater-distribution system map is shown in Figure G-6. The underground fuel area fire-protection system is shown in Figure G-7.

G-6 Coordination Agreements

The DOE/CAO has established MOUs with off-site emergency response agencies for firefighting, medical assistance, hazardous materials response, and law enforcement. In the event that on-site response resources are unable to provide all the needed response actions during either a medical, fire, hazardous materials, or security emergency, the RCRA Emergency Coordinator will notify appropriate off-site response agencies and request assistance. Once on site, off-site emergency response agency personnel will be under the direction of the RCRA Emergency Coordinator.

The MOUs with off-site cooperating agencies are available from the DOE. A listing and description of the MOUs with state and local agencies and mining operations in the vicinity of the WIPP facility, as required by 20 NMAC 4.1, Subpart V, §264.37 and §264.52(c), are:

- An agreement among the DOE, the WIPP MOC, Mississippi Potash Inc., Western Agriculture Minerals, IMC Fertilizer, Eddy Potash Inc., and New Mexico Potash (June 6, 1994) provides for the mutual aid and assistance, in the form of MRTs, in the event of a mine disaster or other circumstance at either of the two facilities. This provision ensures that the WIPP MOC will have two MRTs available at all times when miners are underground, as required by DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards.

- A joint powers agreement among the DOE; the City of Carlsbad, New Mexico; Eddy County, New Mexico; and the New Mexico Energy, Minerals, and Natural Resources Department for Alternate EOC (April 6, 1994) provides for the

coordination of emergency plans, including the DOE emergency radiological response plans; provides for participation in periodic exercises, drills, and training; provides for establishing and maintaining an alternate EOC at the Living Desert State Park; and assigns responsibilities to the participants.

- A memorandum of agreement between the City of Carlsbad, New Mexico, and the WIPP MOC for ambulance service assistance (August 13, 1981) provides that, upon notification by the WIPP MOC, the Carlsbad Fire Department will be dispatched from Carlsbad toward the WIPP site by a designated route and will accept the transfer of patient(s) being transported by the WIPP facility ambulance at the point both ambulances meet. If the patient(s) is not transferrable, the Carlsbad Ambulance Service will provide equipment and personnel to the WIPP facility ambulance, as necessary.

- A MOU between the DOE and the Guadalupe Medical Center Emergency Radiological Treatment Center for the Waste Isolation Pilot Plant (February 1, 1994) provides for the treatment of radiologically contaminated personnel who have incurred injuries beyond the treatment capabilities at the WIPP facility. The DOE will provide transport of the patient(s) to the Guadalupe Medical Center Emergency Radiological Treatment Center for decontamination and medical treatment.

- A MOU between the DOE and the Lea Regional Hospital Emergency Radiological Treatment Center for the WIPP (August 17, 1993) provides for the treatment of radiologically contaminated personnel who have incurred injuries beyond the treatment capabilities at the WIPP facility. The DOE will provide transport of the patient(s) to the Lea Regional Hospital Emergency Radiological Treatment Center for decontamination and medical treatment.

- A MOU between the DOE and the U.S. Department of Interior (DOI), represented by the Bureau of Land Management (BLM), Roswell District (July 19, 1994), provides for a fire-management program that will ensure a timely, well-coordinated, and cost-effective response to suppress wild fire within the withdrawal area using the WIPP incident commander for fire-management activities. The DOI will provide firefighting support if requested. In addition, the MOU provides for responsibilities concerning cultural resources, grazing, wildlife, mining, gas and oil production, realty/lands/rights-of-way, and reclamation.

- A mutual-aid firefighting agreement between the Eddy County Commission and the DOE (February 1, 1994) provides for the assistance of the Otis and Joel Fire Departments (a volunteer fire district created under the Eddy County Commission and the New Mexico State Fire Marshall's Office), including equipment and personnel, at any location within the WIPP Fire Protection Area upon request by an authorized representative of the WIPP Project. These responsibilities are reciprocal.

- A mutual-aid agreement between the City of Hobbs and the DOE (December 3, 1993) provides for mutual ambulance, medical, fire, rescue, and hazardous material response services; provides for joint annual exercises; provides for use of WIPP facility radio frequencies by the City of Hobbs during emergencies; and provides for mutual security and law enforcement services, within the appropriate jurisdiction limits of each party.

- A mutual-aid agreement between the City of Carlsbad and the DOE (November 24, 1993) provides for mutual ambulance, medical, fire, rescue, and hazardous material response services; provides for joint annual exercises; provides for use of WIPP facility radio frequencies by the City of Carlsbad during emergencies; and provides for mutual security and law enforcement services, within the appropriate jurisdiction limits of each party.

- A MOU between the DOE and the New Mexico Department of Public Safety (DPS) concerning Mutual Assistance and Emergency Management (March 19, 1992) applies to any actual or potential emergency or incident that: 1) involves a significant threat to employees of the DOE\DOE contractor or general public; 2) involves property under the control or jurisdiction of either the DOE or the State; 3) involves a threat to the environment which is reportable to an off-site agency; 4) requires the combined resources of the DOE and the state; 5) requires a resource that the DOE has which the State does not have, or a resource the State has which DOE does not have; or 6) involves any other incident for which a joint determination has been made by the DOE and the State that the provisions of this MOU will apply. The MOU provides that the DPS shall permit qualified and security cleared DOE Emergency Management members into the State EOC for the purpose of: a) coordinating communications functions; b) evaluating and maintaining communications capabilities; c) participating in exercises; d) link the State's High Frequency radio communications network with the DOE; and e) assisting the State during radioactive materials accidents that require joint operations or the use of the DOE Radiological Assistance Program team. The DOE shall permit qualified and security cleared members the State Emergency Management community into the DOE's EOCs for the purposes of coordinating communications and activities. Additional duties for each participant are specified for assistance in incidents or emergencies.

G-7 Evacuation Plan

If it becomes necessary to evacuate the WIPP facility, the assigned on-site and off-site staging areas have been established. The off-site staging areas are outside the security fence. The WIPP facility has implementation procedures for both surface and underground evacuations. Drills are performed on these procedures at the WIPP facility at least once annually. The following sections describe the evacuation plan for the WIPP facility, as required under 20 NMAC 4.1, Subpart V, §264.52(f).

G-7a Surface Evacuation On-site and Off-site Staging Areas

Figure G-8 shows the surface staging areas. Personnel report to their Office Wardens at designated staging areas where accountability is conducted. If site evacuation is necessary, the RCRA Emergency Coordinator will decide which staging areas are to be used and will advise Office Wardens of the selections. The RCRA Emergency Coordinator will communicate the locations to Office Wardens via office warden pager, radio, plectron, WIPP Security, or telephone, as appropriate. Office Wardens will direct personnel to the selected staging area outside the security fence. Personnel who are working in a contaminated area when site evacuation is announced, will assemble at specific staging areas to minimize contact with other personnel during the evacuation (Figure G-8).

Office Wardens conduct accountability of personnel assigned to their specific areas. For complete surface accountability, the Office Wardens report to their ACOW, who reports to the COW. When the COW has reports from all ACOWs, surface accountability is reported to the CMRO, who then notifies the RCRA Emergency Coordinator of the accountability.

The COW and all ACOWs have radios for communication between them and the CMRO. The Office Wardens, ACOWs, and COW also carry pagers with which they are notified of evacuations. At the staging areas Office Wardens report directly to their ACOW.

There are three off-site staging areas identified on Figure G-8. The RCRA Emergency Coordinator determines which staging area will be used. Security officers remain at the primary staging area gate 24 hours a day, and the vehicle trap is opened for personnel during emergency evacuations. The north gate has a single person gate and large gate which can be opened, similar to the main gates for the primary staging area. The east gate is a turnstile gate. Upon notification by the RCRA Emergency Coordinator, Security will respond, open gates, and facilitate egress for evacuation.

The on-site staging areas are identified in Figure G-8. These are used for building or area evacuations as determined by the RCRA Emergency Coordinator.

G-7b Underground Assembly Areas and Egress Hoist Stations

In the event of an underground or surface event, the RCRA Emergency Coordinator can call for underground personnel to report to assembly areas (Figure G-9). Underground personnel are also trained to immediately report to assembly areas under specific circumstances (i.e. loss of underground power or ventilation). If accountability is required, the underground will be evacuated. The Underground Controller is responsible for underground accountability by comparing the brass numbers with the brass tags signed out in the lamproom. Each assembly area contains a Mine Page Phone, miners aid station, and evacuation maps.

In accordance with 30 CFR §57.11, the mine maintains two escapeways. These escapeways are designated as Egress Hoist Stations. When an underground evacuation is called for, all underground personnel report to the Egress Hoist Stations.

Decontamination of underground personnel will be conducted the same way as described for surface decontamination. Contaminated personnel are trained to remain segregated from other personnel until RC personnel can respond to the incident at the underground location.

G-7c Plan for Surface Evacuation

Surface evacuation notification is initiated by the RCRA Emergency Coordinator directing the CMRO to sound the surface evacuation alarm. The Office Wardens assist personnel in evacuation from their areas. Evacuation routes and instructions are posted throughout the site.

If the EST notifies the ERT members by pager to respond to an identified area, these members will not depart the site during an evacuation, but will report to the EST for instructions and accountability. The EST notifies the COW of response members present. These personnel will not evacuate until released by the RCRA Emergency Coordinator.

G-7d Plan for Underground Evacuation

Notification for underground evacuation will be made using the underground evacuation alarm and strobe light signals. This notification equipment has battery-backup power and will continue to operate in the event of a power outage.

Personnel will evacuate to the nearest egress hoist station. Primary underground evacuation routes (identified by green reflectors on the rib) will be used, if possible. Secondary underground evacuation routes (identified by red reflectors on the rib) will be used if necessary (Figure G-5). Brass tags will be collected from personnel at the hoist collar on the surface, and taken to the Underground Controller, who functions as an Office Warden. When all brass tags are accounted for, underground accountability is reported to the RCRA Emergency Coordinator.

Upon reaching the surface, personnel will report to their on-site staging area to receive further instructions.

Members of the FLIRT and the MRT who may be underground, will evacuate the underground when an underground evacuation is called for. A reentry by the MRT will be performed according to 30 CFR 49 and MSHA regulations for reentry into a mine. The two MRTs are trained in compliance with 30 CFR 49 in mine mapping, mine gases, ventilation, exploration, mine fires, rescue, and recovery.

G-7e Further Site Evacuation

In the event of an evacuation involving the need to transport employees, the following transportation will be available:

- Buses/vans—WIPP facility buses/vans will be available for evacuation of personnel. The buses/vans are stationed in the employee parking lot.

- Privately Owned Vehicles—Because many employees drive to work in their own vehicles, these vehicles may be utilized in an emergency. Personnel may be directed as to routes to be taken when leaving the facility.

These vehicles may be used to transport personnel who have been released from the site by the RCRA Emergency Coordinator.

G-8 Required Reports

The RCRA Emergency Coordinator, on behalf of the DOE, must note in the operating record the time, date, and details of any incident that requires implementing this Contingency Plan. This notation will be in the facility log maintained by the CMRO. In compliance with 20 NMAC 4.1, Subpart V, §264.56(j), within 15 days after the incident, the Waste Isolation Division (WID) General Manager will ensure that a written report on the incident will be submitted to the EPA Region VI Administrator and to the Secretary of the NMED. The report must include:

- The name, address, and telephone number of the Owner/Operator

- The name, address, and telephone number of the facility

- The date, time, and type of incident (e.g., fire, explosion or release)

- The name and quantity of material(s) involved

- The extent of injuries, if any

- An assessment of actual or potential hazards to human health or the environment, where this is applicable

- The estimated quantity and disposition of recovered material that resulted from the incident

In addition to the above report, the WID General Manager will ensure that the ES&H Manager, or designee, submits reports to the appropriate agencies as listed in Tables G-8 and G-9.

In accordance with 20 NMAC 4.1, Subpart V, §264.56(i), the DOE will notify the Secretary of the NMED and EPA Region VI Administrator that the WIPP facility is in compliance with requirements for the cleanup of areas affected by the emergency and that emergency equipment used in the emergency response has been cleaned, repaired, or replaced and is fit for its intended use prior to the resumption of waste management operations in affected areas. The means the WIPP facility will use to meet these requirements are described in Sections G-4e, G-4f, G-4g, and G-4h.

The WIPP requires the EST to initiate the "WIPP Hazardous Materials Incident Report" if the Contingency Plan is implemented. A form is attached as Figure G-12. The form is initiated by the EST. The RCRA Emergency Coordinator, CMRO, Environmental Compliance & Support representative, and a Hazardous Waste Operations representative complete their respective sections.

G-9 Location of the Contingency Plan and Plan Revision

The owner/operator of the WIPP facility will ensure that copies of this Contingency Plan are present at controlled-document locations throughout the facility and are, consequently, available to all emergency personnel and organizations described in Section G-2. In addition, the owner/operator will make copies available to the following outside agencies:

- Mississippi Potash Inc., Western Agriculture Minerals, IMC Fertilizer, Eddy Potash Inc., and New Mexico Potash
- New Mexico Energy, Minerals, and Natural Resources Department for Alternate EOC at the Living Desert State Park Office, Carlsbad
- Carlsbad Fire Department, Carlsbad
- Guadalupe Medical Center, Carlsbad
- Lea Regional Hospital, Hobbs
- Otis Fire Department, Otis
- Hobbs Fire Department, Hobbs
- Joel Fire Department, Carlsbad
- BLM, Carlsbad
- Department of Public Safety, Carlsbad
- New Mexico State Police

The owner/operator of the WIPP facility will ensure that this plan is reviewed annually and amended whenever:

- Applicable regulations are revised
- The RCRA Part B permit for the WIPP facility is revised in any way that would affect the Contingency Plan
- This plan fails in an emergency
- The WIPP facility design, construction, operation, maintenance, or other circumstances change in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous constituents or change the response necessary in an emergency
- The list of RCRA Emergency Coordinators change
- The list of WIPP facility emergency equipment changes.

REFERENCES

U.S. Environmental Protection Agency, "A Method for Determining the Compatibility of Hazardous Waste," EPA-600/2-80-076, 1980.

U.S. Department of Transportation, Emergency Response Guidebook, U.S. Government Printing Office, 1993.

Westinghouse Electric Corporation, 1994, "Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling," WP 02-EM1, Westinghouse Electric Corporation, Carlsbad, New Mexico.

U. S. Department of Energy, "WIPP Safety Analysis Report," DOE/WIPP-95-2065, Rev. 0

U. S. Department of Energy, "WP 12-5, WIPP Radiological Control Manual".

TABLES

TABLE G-1
HAZARDOUS SUBSTANCES IN LARGE ENOUGH QUANTITIES TO CONSTITUTE A LEVEL II INCIDENT

Chemical Discription	Building Location	Hazard Category
Ethylene Glycol Solution - 35%	Buildings 411; 412; 451; 452; 486; 463; 474C; FAC 414	Immediate (acute) Delayed (chronic)
Gasoline, Unleaded GASC0001	FAC 480	Fire Immediate (acute) Delayed (chronic)
No. 1 Diesel Fuel Oil GASC0210	S-1300 Maint Shop U/G; FACs 480, 255.1 & 255.2; Transport Tank; Building 456 Trlr 911F	Fire Immediate (acute) Delayed (chronic)

TABLE G-2
RESOURCE CONSERVATION AND RECOVERY ACT EMERGENCY COORDINATORS

Name	Address	Office Phone	Home Phone
G. A. (Gerry) Burns (primary)[1]	2516 Crown Circle	234-8276 or 234-8635	887-7133
R. A. (Richard) Marshall (primary)[1]	Pine Springs Route	234-8276 or 234-8695	885-2220
R. E. (Bob) Wade (primary)[1]	3306 Falling Star	234-8272	885-2448
T. J. (Tim) Wygant (primary)[1]	1514 N. Country Club	234-8276 or 234-8377	885-1655
J. R. (Joe) Franco (primary)[1]	5107 Old Cavern Hwy	234-8276 or 234-8641	887-3285
M. B. (Byron) Cherry[2]	1207 Smedley Road	234-8276 or 234-8635	887-1971
B. J. (James) VanWinkle[2]	2409 Wyoming	234-8276	885-4503
G. L. (Garrod) Ashford[2]	1005 Halegueno	234-8272	885-2585
R. C. (Russ) Stroble[2]	3304 Falling Star	234-8554	885-0220

[1]The on-duty Facility Shift Manager is the primary RCRA Emergency Coordinator pursuant to 20 NMAC 4.1, Subpart V §264.52 and is designated to serve as the RCRA Emergency Coordinator.

[2]The on-duty Facility Operations Engineer is the alternate RCRA Emergency Coordinator and is available as needed.

TABLE G-3
PLANNING GUIDE FOR DETERMINING INCIDENT LEVELS AND RESPONSE

INCIDENT CONDITION	INCIDENT LEVEL		
	I	II *	III *
Product identifications	Placard not required, NFPA 0 or 1 all categories, all Other Regulated Materials A, B, C, and D.	DOT placarded, NFPA 2 for any categories, PCBs without fire, EPA regulated waste. SITE SPECIFIC: Table G-1 and TRU waste AND	Poison A (gas), explosive A/B, organic peroxide, flammable, solid, materials dangerous when wet, chlorine, fluorine, anhydrous ammonia, radioactive materials, NFPA 3 and 4 for any categories including special hazards, PCBs and fire including special hazards, PCBs and fire DOT inhalation hazard, EPA extremely hazardous substances, and cryogenics. SITE SPECIFIC: Remote handled TRU waste
Container size	Container size does not impact this incident level.	Involves multiple packages.	Tank truck or RH waste cannister.
Fire/explosion potential	Under control.	May spread/may be explosive.	May spread/may be explosive.
Leak severity	No release or small release contained or confined with readily available resources.	Release may not be controllable without special resources.	Release may not be controllable even with special resources.
Life safety	No life-threatening situation from materials involved.	Localized area, limited evacuation area.	Localized area, limited evacuation area.
Environmental impact (Potential)	None.	Limited to incident boundaries	Contained within the Hazardous waste Management Units.
Container integrity	Not damaged.	Damaged but able to contain the contents to allow handling or transfer of product.	Damaged to such an extent that catastrophic rupture is possible.

* Contingency Plan is implemented

TABLE G-4
PHYSICAL METHODS OF MITIGATION

METHOD	CHEMICAL		RADIOLOGICAL	
	LIQUID	SOLUTION	LIQUID	SOLUTION
ABSORPTION	YES	NO	YES	NO
COVERING	YES	YES	YES	YES
DIKES, DIVERSIONS	YES	YES	YES	YES
OVERPACK	YES	YES	YES	YES
PLUG/PATCH	YES	YES	YES	YES
TRANSFER	YES	YES	YES	YES
VAPOR SUPPRESSION	YES	YES	NO	NO

TABLE G-5
CHEMICAL METHODS OF MITIGATION

METHOD	CHEMICAL		RADIOLOGICAL	
	LIQUID	SOLUTION	LIQUID	SOLUTION
NEUTRALIZATION	YES	YES[1]	NO	NO
SOLIDIFICATION	YES	NO	YES[2]	NO

(1) When solid neutralizing agents are used, they must be used simultaneously with water.
(2) This method could be utilized for mitigation of firewater involving TRU-waste.

TABLE G-6
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
	Communications	
Building Fire Alarms	Manual and automatic; activation of automatic sprinkler system triggers fire alarm; locally audible, visual display and alarm in Central Monitoring Room (CMR)	Guard and Security Building, Pumphouse, Warehouse/Shops, Exhaust Filter Building, Support Building, CMR/ Computer Room, Waste Handling Building, TRUPACT Maintenance Facility, Salt Handling (SH) Shaft Station, Waste Shaft Station, Underground Fuel Station, SH Hoisthouse, Maintenance Shops, Guard Shack*, Auxiliary Warehouse, Core Storage Building, Engineering Building, Training Facility, Safety Building *local alarms; not connected to the CMR
Underground Fire Alarms	Automatic/Manual; have priority over other paging channel signals but not override intercom channels; alarms sound in the general area of the control panel and are connected to the underground evacuation alarms; they also interface with the CMR.	Fire detection and control panel locations: Waste Shaft, SH Shaft, Panel 1 (outside room 1), E-O/N-1200, Fuel Station #2
Sitewide Evacuation Alarm	Transmitted over paging channel of the public address system, overriding its normal use; manually initiated according to procedures requiring evacuation; automatically initiated by underground fire alarm systems for underground areas; audible alarm produced by tone generator at 10 decibels above ambient noise level (or at least 75 decibels); flashing strobe lights supplement audible alarm in high ambient noise areas; radios and/or pagers are used to notify facility personnel outside alarm range. Monthly test are performed on the PA, site notification alarms, and plectrons.	Sitewide
Vehicle Siren	Manual; oscillating; emergency services/response vehicles, is mechanical and electronic.	WIPP emergency vehicles
Public Address System	Includes intercom phones; handset stations and loudspeaker assemblies, each with own amplifiers; multichannel, one for public address and pages, and others for independent party lines.	Surface and underground
Intraplant Phones	Private automatic branch exchange; direct dial; provide communication link between surface and underground operations	Throughout surface and underground
Mine Page Phones	Battery-operated paging system	CMR, Mine Rescue Room, EOC, underground, and FSM desk.
Pagers	Manual; broadcast high-intensity, intermittent alarm signals for up to 60 seconds	Issued to individuals

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Plectrons	Tone-alert radio receivers placed in areas not accessible by the public address system	Sitewide
Portable Radios	Two-way, portable; transmits and monitors information to/from other transmitters	Issued to individuals
Plant Base Radios	Two-way, stationary, UHF/ VHF-FM; linked to Eddy County and Lea County Sheriff Departments, NM State Police, Carlsbad Emergency Radio (Carlsbad ambulance, fire, HAZMAT and police, Guadalupe Medical Center, and Otis Fire Department), and WIPP Channels 1-4 (Site Security, Site Operations and Site Emergency, maintenance, repeater to Carlsbad)	Various site locations
Mobile Phones	Provide communications link between WIPP Security and key personnel	Issued to individuals plus emergency vehicles,
	Spill Response	
SPILL-X-S Guns and Recharge Powder	Containment; (1)SPILL-X model SC-30-C(Gun) (1)SPILL-X model XC-30-S(Gun) (1)SPILL-X model SC-30-A(Gun); (1) A-Acid, 5 gallon bucket (Recharge Powder) (1)S-Solvent, 5 gallon bucket (Recharge Powder) (1)C-Caustic, 5 gallon bucket (Recharge Powder)	HAZMAT trailer
Absorbent Sheets	Containment or cleanup; (1) 3' x 100' Sheet	HAZMAT trailer
Absorbents	Grab and Go container; spill control bucket; (1) for solvents and neutralizing absorbents; 5 gallon bucket (1) for acids/caustics; 5 gallon bucket	HAZMAT trailer
Absorbent Material	Containment or cleanup; (1) 100 ft. rolled or equivalent socks " Pig" for general liquid (1) 100 ft. rolled or equivalent socks " Pig" for oil	HAZMAT trailer
Air Bag System	Extrication, Stabilization, Cribbing (1) bag system with tank kit and the following bag sizes: (1)12-ton, (1) 21.8-ton, (1)17-ton	Surface rescue truck
Air Chisel	Extrication (1) Capable of cutting 3/16" steel	Surface rescue truck

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Drum Transfer Pumps and Drum Opener	Containment or cleanup; (1) unit for chemical transfer (1) hand operated pump for petroleum transfer (1) drum opener	HAZMAT trailer
Floor Squeegee	Containment or cleanup; (1) straight rubber blade, nonwood handle	HAZMAT trailer
Foam Concentrate	AFFF 6% (4) 5-gallon pail	Fire truck # 1
Gas Cylinder Leak Control Kit	(1)Series A Hazardous Material Response Kit; contains nonsparking equipment to control and plug leaks	HAZMAT trailer
Portable Generator	(1)Backup power; 5,000 watt; 120 or 240 volt	Surface rescue truck
Hand Tools	Containment and cleanup; Underground rescue truck: (1)12# Sledge Hammer (1)3/8" Drive Socket Set (1)1/2" Drive Socket Set (1)3/4" Drive Socket Set (1)25' 1/2" Chain (1)6' Wrecking Bar (1)Bottle Jack (1)4# Hammer (1)18" Crescent Wrench (1)5' Pry Bar (1)2' Pry Bar (1)100' Extension Cord (1)4' Nylon Sling (1)6' Nylon Sling (1)10' Nylon Sling These tools are located in the HAZMAT Trailer. They are non-sparking. (1)14"L adjustable pipe wrench (1)15" multi-opening bung wrench (1)hammer/crate opener (1)8" pipe pliers (1)8" blade Phillips (1)#2 screwdriver (1)6" blade standard screwdriver (1)Claw Hammer	Underground rescue truck, HAZMAT trailer
Come-a-longs	(1) 4-ton; cable-type Ratchet lever tool designed specifically for lifting, lowering and pulling applications including jobs requiring rigging, positioning, and stretching. Used in rescue for extrication.	Surface rescue truck and underground rescue truck
Porta-power	(1) 10-ton hydraulic, hand-powered jaws used for extrication during rescues.	Surface rescue truck

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Jugs	Containment or cleanup; (4) 1-gallon plastic	HAZMAT trailer
Pails	Containment or cleanup; (3) 5-gallon plastic with lid	HAZMAT trailer
Portable Lighting	(1) Emergency lighting system; 120 volts; 500-watt bulbs, suitable for wet location	Underground rescue truck
Patching Kit	Series A Hazardous Response Kit; Class A; contains nonsparking equipment to control and plug leaks.	HAZMAT trailer
Scoops and Shovels	Cleanup; plastic; various sizes; nonsparking; nonwood handles (1) Scoop (3) Shovels	HAZMAT trailer
Medical Resources		
Ambulance #1	Equipped as per Federal Specifications KKK-A-1822 and New Mexico Emergency Medical Services Act General Order 35; equipped with a radio to Guadalupe Medical Center in Carlsbad, VHF radio, UHF medical frequency, cellular phone	Surface (Safety and Emergency Services Facility)
Ambulance #2	Electric cart; equipped with first aid kit, 2 stretchers, and other associated medical supplies	Underground
Rescue Truck	Special purpose vehicle; light and heavy duty rescue equipment; transports 1 litter patient, medical oxygen and supplies for mass casualties, fire suppression support equipment (rescue tool, air bag, K-12 Rescue Saw, 5,000-watt generator, self-contained breathing apparatus (SCBA), and much more equipment	Surface (Safety and Emergency Services Facility)

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Fire Detection and Fire Suppression Equipment		
Building Smoke, Thermal Detectors, and Manual Pull Stations	Ionization and photoelectric or fixed temperature/rate of rise detectors; visual display and alarm in CMR; manual pull stations. The underground has manual fire alarm pull stations located where personnel have access when evacuating. These are connected to the U/G evacuation alarm.	Guard and Security Building, Warehouse/Shops, Support Building, CMR/Computer Room, Waste Handling Building, TRUPACT Maintenance Facility, Waste Shaft Station, Underground Fuel Station, SH Hoisthouse, Engineering Building, Industrial Safety Building, Training Facility
Fire Truck # 1	Equipped per Class "A" fire truck per NFPA; capacity 750 gallons, with pump capacity of 1200 gallons per minute	Surface (Safety and Emergency Services Facility)
Rescue Truck # 2 (U/G)	(1) 125-pound dry chemical extinguisher (1) 150-pound foam extinguisher	Underground
Extinguishers	Individual fire extinguisher stations; various types located throughout the facility, conforming to NFPA-10.	Buildings, underground, and underground vehicles
Automatic Dry Chemical Extinguishing Systems	Automatic; 1,000-pound system (Purple K); actuated by thermal detectors or by manual pull stations	Underground fuel station
Sprinkler Systems	Fire alarms activated by water flow	Pumphouse, Guard and Security Building, Support Building, Waste Handling Building (contact- and remote-handled transuranic waste area only, except Hot Cell), Warehouse/ Shops Building, Auxiliary Warehouse Building, TRUPACT Maintenance Facility, Training Facility, SH Shaft Station, Exhaust Filter Building, Engineering Building, and Safety Building
Water Tanks, Hydrants	Fire suppression water supply; two 180,000-gallon capacity	Tanks are at southwestern edge of WIPP facility; pipelines and hydrants are throughout the surface
Fire Water Pumps	Fire suppression water supply; 125 pounds per square inch, 1,500 gallons per minute centrifugal pump, one with electric motor drive, the other with diesel engine; pressure maintenance pump	Pumphouse

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Hoses	Fire suppression water supply	Pumphouse, Guard and Security Building, Support Building, Waste Handling Building (contact- and remote-handled transuranic waste area only, except Hot Cell), Warehouse/ Shops Building, Auxiliary Warehouse Building, TRUPACT Maintenance Facility, Engineering Building, Exhaust Filter Building
Personal Protection Equipment		
Headlamps	Mounted on hard hat; battery operated	Each person underground
Underground Self-Rescuer Units	Short-term rebreathers; approximately 300	Each person underground
Self-Contained Breathing Apparatus (SCBA)	Oxygen supply; 4-hour units; approximately 14 Mine Rescue Team Draeger units	Mine Rescue Training Room
Chemical and Chemical-Supported Gloves	Body protection; (12 pair) inner-cloth, (12 pair) outer-pvc, (5 pair) outer-viton	HAZMAT trailer
Suit, Acid	Body protection; (4) acid	HAZMAT trailer
Suit, Fully Encapsulated	Body protection; used with SCBAs; full outerboot; (4) Level A; (4) Level B	HAZMAT trailer
Emergency Medical Equipment		
Antishock Trousers	Shock treatment; (2) inflatable, one on each ambulance	Ambulance # 1 and # 2
Laerdal 3000 QRS	Monitor/defibrillator	Ambulance # 1 and # 2

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Oxygen	Patient care; Size D: (2) Ambulance #1 (1) Underground Ambulance (1) Health Services Size E: (1) Rescue Truck (2) Underground Ambulance Size M: (1) Ambulance #1	Ambulance # 1 and # 2, surface rescue truck
Resuscitators (Bag)	Disposable bag resuscitation Ambulance #1: (2) adult size (1) child size Underground Ambulance: (2) adult size	Ambulance # 1, Ambulance # 2
Splints	Immobilize limbs; (1) Adult traction splint, lower extremity, with limb-supporting slings, padded ankle hitch and traction device per ambulance. (2) Rigid splinting devices or equivalents, suitable for immobilization of upper extremities per ambulance. (2) Rigid splinting devices or equivalents, suitable for the immobilization of lower extremities. (1) Set of Airsplints: 6 assorted splints; hand/wrist, half arm, full arm, foot/ankle, half leg, and full leg per miner's aid stations.	Ambulance # 1 and # 2, Miner's Aid Stations
Stretchers	Patient transport; (2) Spine Boards, one short and one long, with nylon straps per ambulance. (also used to perform cardiopulmonary resuscitation) (2) Emergency Stretchers or scoops, or combination per ambulance (1) All-purpose multi-level ambulance stretch (gurney), with 3 safety straps and locking mechanism per ambulance. (1) Stretcher in each miner's aid station.	Various combinations in Ambulance # 1 and # 2, Miner's Aid Station
Suctions	For medical emergencies: Portable (1) Suction unit, capable of delivering at least 300 mm. HG on each ambulance.	Ambulances #1 and #2

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Trauma Kits	(1) adult blood pressure cuff and stethoscope (4) soft-roller bandages (3) triangular bandages (1) pkg. band-aids (2) trauma dressings (25) 4X4 sponges (1) roll adhesive tape (1) bite stick (1) penlight (1) sterile burn sheet (1) oropharyngeal airway (1) glucose substance (2) sterile gauze dressings	(1) kit in each: Ambulances #1 and #2, surface rescue truck
Miner's Aid Station	For First Aid Stations in the Underground (1) Stretcher--as referenced above per station (1) Set of airsplints--as referenced above per station (1) Blanket per station (1) Box of latex gloves (50) per station (5) Pathogen Wipes per station (1) First Aid Kit (24) per station; includes, (3) Band-Aid Combo Paks (2) Swabs, PVP (1) Antibiotic Ointment (1) Sting-Kill Swab (2) Dressing, compresses (2) Roller Bandages (2) Tape (2) Triangle Bandage (1) Eyedressing Pak (1) Burn Dressing (1) Ammonia Inhalants (1) User Log Sheet	Miner's Aid Stations

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
First Aid Supplies	According to General Order #35 (12) bandages, soft roller, self-ahdering type--4" or 6" x 5 yards. (6) triangular bandages, 40" (1) box band-aids (1) 1 pair bandage shears (6) Trauma dressings, 30" x 10" (6) Trauma dressings, 5" x 7" (50) 4" x 4" sponges, individually wrapped and sterile (2) rolls adhesive tape (1) penlight (2) sterile burn sheets (2) oropharyngeal airways -- adult (2) oropharyngeal airways -- child (Ambulance #1 only) (2) oropharyngeal airways -- infant (Ambulance #1 only) (1) Glucose substance (3) Occlusive dressings (1) Roll aluminum foil (6) Rigid cervical collars--2 each small, medium and large sizes (4) Cold packs (4) Heat packs (2) Bite sticks	Ambulance #1
First Aid Supplies	(2) Transfer sheets (2) Blankets	Ambulances #1 and #2
First Aid Supplies	(2) #16g angiosets (2) #18g angiosets (2) #20g angiosets (1) 1000cc LR IV fluid (1) 500cc NS IV fluid	Ambluances #1 and #2, surface rescue truck
General Plant Emergency Equipment		
Emergency Lighting	For employee rescue and evacuation, and fire/spill containment; linked to main power supply, and selectively linked to back up diesel power supply and/or battery-backed power supply	Surface and underground
Backup Power Sources	Two diesel generators, and lead-antimony battery-powered uninterruptible power supply (UPS); use limited to essential loads; manual or remote starting 1,100-kilowatt diesel generators with on-site fuel for 62% load for 3 days for selected loads; 30-minute battery capacity for essential loads	Generators are east of Safety and Emergency Services Building; UPS is located at the essential loads
Hoists	Hoists in Waste Shaft, Air Intake Shaft, and SH Shaft	Waste Shaft, Air Intake Shaft, SH Shaft
Portable Radiation Survey Equipment	α, B-γ survey meters	Operational Health Physics Office, Building 412

TABLE G-6 (CONTINUED)
EMERGENCY EQUIPMENT MAINTAINED AT THE WASTE ISOLATION PILOT PLANT

Equipment	Description and Capabilities	Location
Radiation Monitoring Equipment	(5) Portable air samplers	Operational Health Physics Office located in Building 412
Emergency Shower	For emergency flushing of contaminated individual	Surface
Eye Wash Fountains	For emergency flushing of affected eyes	Various locations on surface and in the underground
Decon Trailer	Self-contained shower, change/survey room trailer for gross decontamination of personnel	West side of Building 412
Decon Shower	Three piece mobile shower unit for gross decontamination of personnel	Building 411
Overpack containers	14-85 Gallon drums 4-SWBs 1-RH Canister overpack for overpacking leaking or damaged containers	Building 411 Building 411 Building 411
HEPA Vacuums	2 HEPA Vacuums to be utilized for removal of contamination.	Waste Handling Building
Aquaset or Cement	100 lbs. of aquaset or cement material for solidification of liquid waste generated as a result of fire fighting water or decontamination solutions.	Waste Handling Building
Polyvinyl Alcohol or Paint	1 - 5 gallon bucket of approved fixative to be used during recovery.	Waste Handling Building
Deionized Soap/Detergent	4-1 Gallon bottles for decontamination of surfaces, equipment, and personnel	Building 411

TABLE G-7
TYPES OF FIRE SUPPRESSION SYSTEMS BY LOCATION

LOCATION	AS	AD	MPS	IFHC	PFE
Waste Handling Building	*		*	*	*
Support Building	*		*	*	*
Exhaust Filter Building	*		*	*	*
Water Pumphouse	*		*	*	*
Underground Support Areas (also has rescue truck)		*	*		*
Station A Effluent Monitoring Shed			*		*
Station B Effluent Monitoring Shed			*		*

(1)Symbols for WIPP fire-protection systems:

AS = Automatic Wet Pipe Sprinkler System
AD = Automatic Dry Chemical Extinguishing System
MPS = Manual Pull Stations
IFHC = Interior Fire Hose Connections
PFE = Portable Fire Extinguishers

(2)The Waste Handling Building and the Support Building contain the following:

- Automatic wet pipe sprinklers
- Interior fire hose connections
- Fire detection in the heating, ventilation, and air conditioning instrumentation (Support Building, only)
- Manual pull stations
- Portable fire extinguishers
- Automatic detectors

The Safety and Emergency Services Building contains the following:

- Automatic wet pipe sprinklers
- Manual pull stations
- Portable fire extinguishers
- Automatic detectors

The Core Storage Building contains the following:

- Automatic wet pipe sprinklers
- Portable fire extinguishers

(3)The Exhaust Filter Building, Underground Facilities, Warehouse/Shops Building, Water Pumphouse, and Salt Handling Hoist house and headframe also have portable fire extinguishers, manual pull stations, and automatic detectors.

TABLE G-8
HAZARDOUS RELEASE REPORTING, FEDERAL

Statute	Chemical Releases Covered	To Whom Report Must Be Made	What Must Be Reported	
			Immediately (Oral)	Subsequently (Written)
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) (40 CFR Part 302)	"Reportable quantities" of CERCLA/SARA "hazardous substances."	National Response Center: (800) 424-8802, State Emergency Response Commission: (505) 827-9223 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (505) 887-9511	1) Chemical identification; 2) what hazardous substance; 3) quantity released; 4) time, location and duration of release; 5) media of release; 6) health risks and medical advice; 7) proper precautions (e.g., evacuation); and 8) name and phone number of reporter and facility.	As soon as practicable, update of oral notice and response action taken. Send report to: New Mexico State Emergency Response Commission, Department of Public Safety, Title III Bureau, P.O. Box 1628, Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 100 North Canal, P.O. Box 1139, Carlsbad, New Mexico 88221-1139. National Response Center will contact the U.S. Environmental Protection Agency (EPA). EPA may request a written report.
Emergency Planning and Community Right-to-Know Act (SARA Title III) (40 CFR Parts 302 and 355)	SARA Title III "extremely hazardous substances."	National Response Center: (800) 424-8802, State Emergency Response Commission: (505) 827-9223 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (505) 887-9511.	1) Chemical identification; 2) what extremely hazardous substance; 3) quantity released; 4) time, location and duration of release; 5) media of release; 6) health risks and medical advice; 7) proper precautions (e.g. evacuation); and 8) name and phone number of reporter and facility.	As soon as practicable, update of oral notice and response action taken. Send report to: New Mexico State Emergency Response Commission, Department of Public Safety, Title III Bureau, P.O. Box 1628, Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 100 North Canal, P.O. Box 1139, Carlsbad, New Mexico 88221-1139. National Response Center will contact the U.S. Environmental Protection Agency (EPA) for an address if a written report is requested by EPA.

TABLE G-8 (CONTINUED)
HAZARDOUS RELEASE REPORTING, FEDERAL

Statute	Chemical Releases Covered	To Whom Report Must Be Made	What Must Be Reported	
			Immediately (Oral)	Subsequently (Written)
Resource Conservation and Recovery Act (RCRA), 40 CFR §§264.56(a) and 265.56(a)	Any imminent or actual emergency situation.	State or local agencies with designated response roles, if their help is needed: Carlsbad Police Department: 885-2111; Carlsbad Fire Department: 885-2111; Eddy County Sheriff: 887-7551.	What assistance is required.	Not Applicable (NA)
RCRA, 40 CFR §§264.56(d), 264.56(i), 265.56(d), and 265.56(i)	RCRA "hazardous waste" release, fire, or explosion, which could threaten human health or environment outside the facility.	National Response Center: (800) 424-8802 and State Emergency Response Commission: (505) 827-9223 (New Mexico State Police, Hazardous Materials Emergency Response).	(1) Name and telephone number of reporter; (2) name and telephone number of facility; (3) time and type of incident; (4) name and quantity of materials involved; (5) extent of injuries, if any; and (6) possible health or environmental hazards outside the facility.	Prior to resumption of operations, notify that: (1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and (2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, 525 Camino de los Marquez, Santa Fe, New Mexico, 87503.

TABLE G-8 (CONTINUED)
HAZARDOUS RELEASE REPORTING, FEDERAL

Statute	Chemical Releases Covered	To Whom Report Must Be Made	What Must Be Reported	
			Immediately (Oral)	Subsequently (Written)
RCRA, 40 CFR §§264.56(i), 264.56(j), 265.56(i), and 265.56(j)	Any incident which triggers implementation of Contingency Plan.	New Mexico Environment Department, Emergency Response Office, 24-hour telephone: (505) 827-9329 or Monday to Friday, 8am to 5pm: (505) 827-2915 or (505) 827-0188.	NA	Within 15 days: 1) name, address and telephone number of owner/operator; 2) name, address and telephone number of facility; 3) date, time and type of incident (e.g. fire, explosion); 4) name and quantity of materials involved; 5) extent of injuries, if any; 6) possible hazards to human health or the environment; 7) estimated quantity of material that resulted from the incident. Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, 525 Camino de los Marquez, Santa Fe, New Mexico, 87503.

TABLE G-9
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Must Be Made	What Must Be Reported	
			Immediately (Oral)	Subsequently (Written)
Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart V and Subpart VI	RCRA "hazardous waste" releases, fire, or explosion, which could threaten human health or environment outside the facility.	National Response Center: (800) 424-8802; State Emergency Response Commission and (505) 827-9223 (New Mexico State Police, Hazardous Materials Emergency Response)	1) Name and telephone number of reporter; 2) name and telephone number of facility; 3) time and type of incident; 4) name and quantity of material involved; 5) extent of injuries, if any; and 6) possible health or environmental hazards outside the facility.	Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, 525 Camino de los Marquez, Santa Fe, New Mexico, 87503.
20 NMAC 4.1, Subpart V and Subpart VI	Any incident which triggers implementation of Contingency Plan.	New Mexico Environment Department, Emergency Response Office, 24-hour telephone: (505) 827-9329 or Monday to Friday, 8am to 5pm: (505) 827-2915 or (505) 827-0188.	1) Name and telephone number of reporter; 2) name and address of facility; 3) name and quantity of materials involved, to extent known; 4) extent of injuries, if any; and 5) possible hazards to human health or the environment, outside the facility.	Within 15 days: 1) name, address and telephone number of owner/operator; 2) name, address and telephone number of facility; 3) date, time and type of incident (e.g., fire, explosion); 4) name and quantity of materials involved; 5) extent of injuries, if any; 6) possible hazards to human health or the environment; and 7) estimated quantity of material that resulted from the incident. Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, 525 Camino de los Marquez, Santa Fe, New Mexico, 87503.

TABLE G-9 (CONTINUED)
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Must Be Made	What Must Be Reported	
			Immediately (Oral)	Subsequently (Written)
New Mexico Emergency Management Act, Section 74-4B-5	Any accident (spill) involving hazardous materials (including hazardous substances, radioactive substances, or a combination thereof) which may endanger human health or the environment.	New Mexico Environment Department: (505) 827-9329, State Emergency Response Commission: (505) 827-9223 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (505) 887-9511	1) Name, address and telephone number of owner or operator; 2) name, address and telephone number of facility; 3) date, time and type of incident; 4) name and quantity of material(s) involved; 5) extent of any injuries; 6) assessment of actual or potential threat to environment or human health; and 7) estimated quantity and disposition of recovered material.	Written submission within one week of time permittee becomes aware of discharge. Same as oral and description of noncompliance and its cause, the period of noncompliance including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence. Send reports to New Mexico Environment Department, Chief, Ground Water Bureau, 525 Camino del los Marquez, Santa Fe, New Mexico, 87503, New Mexico State Emergency Response Commission Department of Public Safety, Title III Bureau, P.O. Box 1628 Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 100 North Canal, P.O. Box 1139, Carlsbad, New Mexico, 88221-1139.

TABLE G-9 (CONTINUED)
HAZARDOUS RELEASE REPORTING, STATE OF NEW MEXICO

Regulations	Chemical Releases Covered	To Whom Report Must Be Made	What Must Be Reported	
			Immediately (Oral)	Subsequently (Written)
New Mexico Water Quality Control Commission, Part 1, Section 203	Any discharge from any facility of oil or any other water contaminant in such quantities as may, with reasonable probability, injure or be detrimental to human health, animal or plant life, or property.	Chief, Ground Water Bureau, New Mexico Environment Department, or his counterpart in any constituent agency delegated responsibility for enforcement of the rules as to any facility subject to such delegation (505) 827-2918.	Within 24 hours: 1) the name, address, and telephone number of the person or persons in charge of the facility; 2) the name, address, and telephone number of the owner/operator of the facility; 3) the date, time, location, and duration of the discharge; 4) the source and cause of the discharge; 5) a description of the discharge, including its chemical composition; and 6) the estimated volume of discharge, and immediate damage from the discharge.	Submit within seven days: verification of the prior oral notification, also provide any appropriate additions or corrections to the information contained in the prior oral notification. Within 15 days: submit a written report describing any corrective actions taken and/or to be taken relative to the discharge. Send reports to Chief, Ground Water Bureau, New Mexico Environment Department, 525 Camino de los Marquez, Santa Fe, New Mexico, 87503.
New Mexico Underground Storage Tank Regulations-2	Any known or suspected release from an Underground Storage Tank (UST) system, any spill or any other emergency situation.	New Mexico Environment Department (Hazardous Waste Bureau): (505) 827-9329.	Within 24 hours: 1) the name, address, and telephone number of the agent in charge of the site at which the UST system is located, as well as the owner/operator of the system; 2) the name and address of the site and the location of the UST system on that site; 3) the date, time, location, and duration of the spill, release, or suspected release; 4) the source and cause of the spill, release, or suspected release; 5) a description of the spill, release, or suspected release, including its chemical composition; 6) the estimated volume of the spill, release, or suspected release; and 7) action taken to mitigate immediate damage from the spill, release, or suspected release.	Mail or deliver within seven days of the incident, a written notice describing the spill, release, or suspected release and any investigation or follow-up action taken or to be taken. Send reports to Underground Storage Tank Program, New Mexico Environment Department, 525 Camino de los Marquez, Santa Fe, New Mexico, 87503.

FIGURES

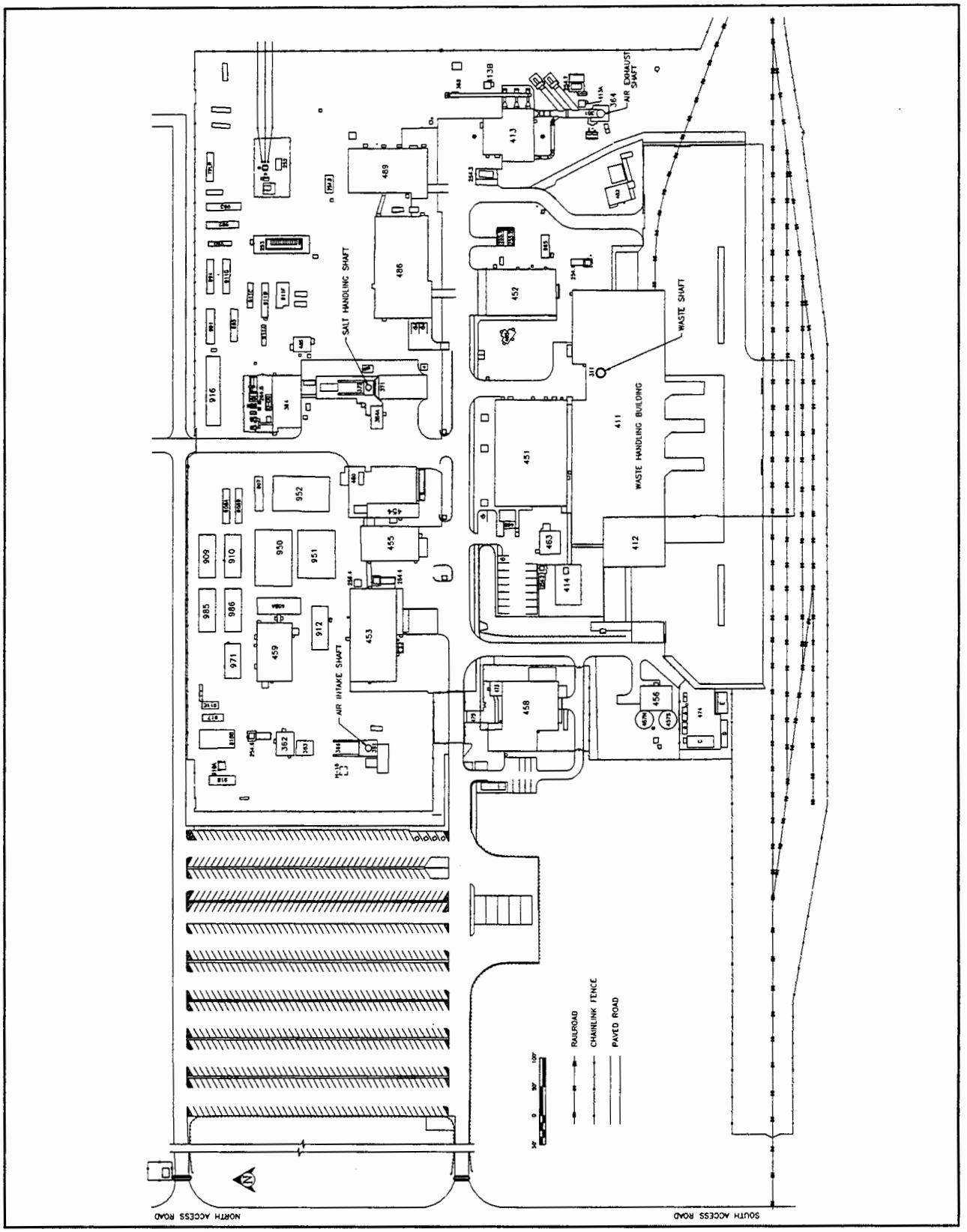


Figure G-1
WIPP Surface Structures

FACILITIES, USAGE AND STRUCTURE NUMBERS

BLDG./ FAC. #	DESCRIPTION
252	SPS UTILITY SUBSTATION
253	13.8 KV SWITCHGEAR 25P-SWG15/1
254.1	AREA SUBSTATION NO.1 25P-SW15.1
254.2	AREA SUBSTATION NO.2 25P-SW15.2
254.3	AREA SUBSTATION NO.3 25P-SW15.3
254.4	AREA SUBSTATION NO.4 25P-SW15.4
254.5	AREA SUBSTATION NO.5 25P-SW15.5
254.6	AREA SUBSTATION NO.6 25P-SW15.6
254.7	AREA SUBSTATION NO.7 25P-SW15.7
254.8	AREA SUBSTATION NO.8 25P-SW15.8
255.1	EMERGENCY GENERATOR #1 25-PE 503
255.2	EMERGENCY GENERATOR #2 25-PE 504
311	WASTE SHAFT
351	EXHAUST SHAFT
361	AIR INTAKE SHAFT
362	AIR INTAKE SHAFT/HOIST HOUSE
363	AIR INTAKE SHAFT/WINCH HOUSE
364	EFFLUENT MONITORING INSTRUMENT SHED A
365	EFFLUENT MONITORING INSTRUMENT SHED B
366	AIR INTAKE SHAFT HEADFRAME
371	SALT HANDLING SHAFT
372	SALT HANDLING SHAFT HEADFRAME
384	SALT HANDLING SHAFT HOISTHOUSE
384A	SALT HOIST OPERATIONS
411	WASTE HANDLING BUILDING
412	TRUPACT MAINTENANCE BUILDING
413	EXHAUST FILTER BUILDING
413A	EFFLUENT MONITORING ROOM A
413B	EFFLUENT MONITORING ROOM B
414	WATER CHILLER FACILITY & BLDG
451	SUPPORT BUILDING
452	SAFETY & EMERGENCY SERVICES FACILITY
453	WAREHOUSE/SHOPS BUILDING
454	VEHICLE SERVICE BUILDING
455	AUXILLIARY WAREHOUSE BUILDING

BLDG./ FAC. #	DESCRIPTION
456	WATER PUMPHOUSE
457N	WATER TANK 25-D-001A
457S	WATER TANK 25-D-001B
458	GUARD AND SECURITY BUILDING
459	CORE STORAGE BUILDING
459A	SANDIA ANNEX
463	COMPRESSOR BUILDING
465	AUXILIARY AIR INTAKE
468	TELEPHONE HUT
473	ARMORY BUILDING
474	HAZARDOUS WASTE STORAGE FACILITY
474A	HAZARDOUS WASTE STORAGE BUILDING
474B	HAZARDOUS WASTE STORAGE BUILDING
474C	OIL & GREASE STORAGE BUILDING
474D	GAS BOTTLE STORAGE BUILDING
474E	HAZARD MATERIAL STORAGE BUILDING
474F	WASTE OIL RETAINER
475	GATEHOUSE
480	VEHICLE FUEL STATION
482	EXHAUST SHAFT HOIST EQUIP. WAREHOUSE
485	SULLAIR COMPRESSOR BUILDING
486	ENGINEERING BUILDING
489	TRAINING BUILDING
816	SANDIA TEST WELL (NOT IDENTIFIED)
907	TRANS. & HAZ. MATERIAL HANDLING TRAILER
908A	ENVIRONMENTAL MONITORING LAB TRAILER
908B	UNIVERSITY CONSORTIUM TRAILER
909	PROJECT CONTROL TRAILER
910	ENVIRONMENTAL MONITORING TRAILER
911A	SITE LOCKSMITH TRAILER
911B	SANDIA M101 TRAILER
911C	SANDIA OFFICES TRAILER
911E	SANDIA TRAILER
911F	SANDIA B49 AND B49 ANNEX

BLDG./ FAC. #	DESCRIPTION
911G	SANDIA LABS TRAILER
912	TRAINING TRAILER
914A	TRAINING TRAILER
915	NEW MEXICO ENVIR. DEPT. TRAILER
916	SANDIA OFFICES TRAILER
917	AIS MONITORING
918	VOC TRAILER
918A	VOC AIR MONITORING STATION
918B	VOC LAB TRAILER
950	WORK CONTROL TRAILER
951	PROCUREMENT / PURCHASING
952	TRAILER (7-PLEX)
965	SAMPLE LABORATORY TRAILER
971	HUMAN RESOURCES TRAILER
982	MAINTENANCE TRAILER
985	QA TRAILER
986	PUBLICATIONS & PROCEDURES TRAILER
991	SANDIA OFFICES TRAILER
992	SANDIA CALIBRATION LAB TRAILER
993	SANDIA OFFICES TRAILER
994	SANDIA LAB TRAILER
995	SANDIA QA RECORDS TRAILER
SWR NO.1	SWITCHRACK NO. 1
SWR NO.2	SWITCHRACK NO. 2
SWR NO.3	SWITCHRACK NO. 3
SWR NO.4	SWITCHRACK NO. 4
SWR NO.6	SWITCHRACK NO. 6
SWR NO.7,7A,7B	SWITCHRACK NO. 7, 7A, 7B
SWR NO.7C	SWITCHRACK NO. 7C
SWR NO.8	SWITCHRACK NO. 8
SWR NO.9	SWITCHRACK NO. 9
SWR NO.10	SWITCHRACK NO. 10
SWR NO.11	SWITCHRACK NO. 11
--	SANDIA GENERATOR NO.1
--	SANDIA GENERATOR NO.2

Figure G-1a
Legend to Figure G-1

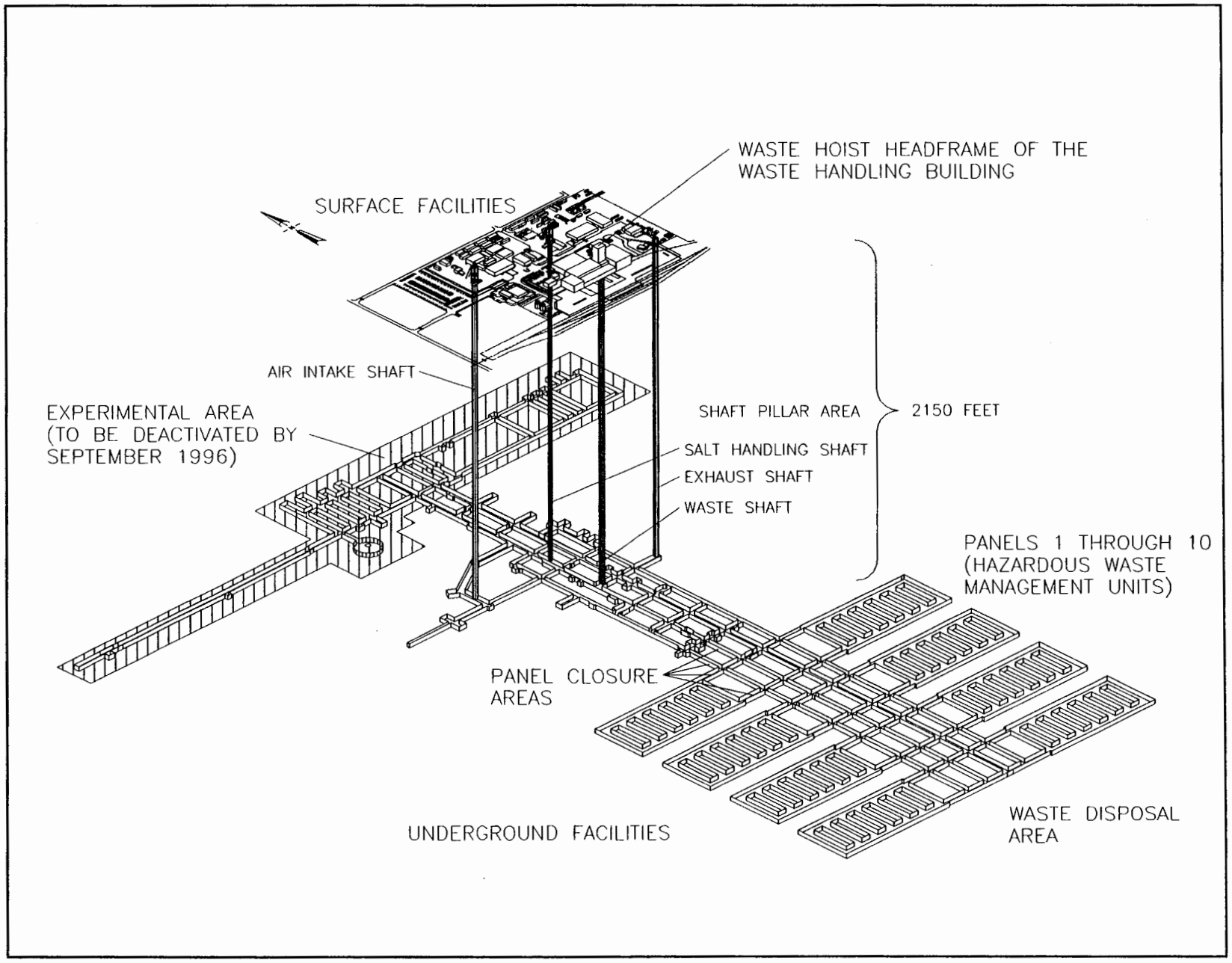


Figure G-2
Spatial View of the WIPP Facility

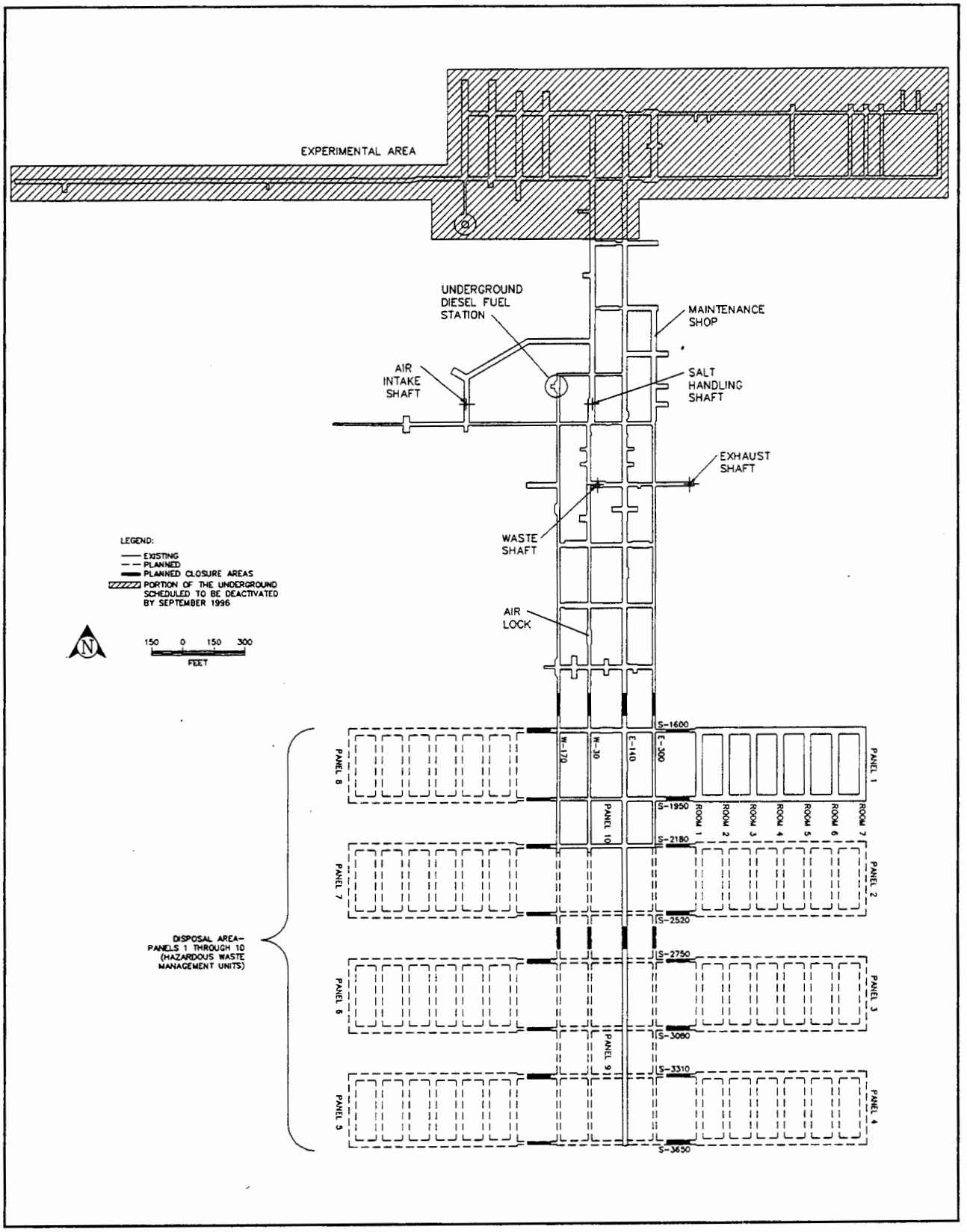
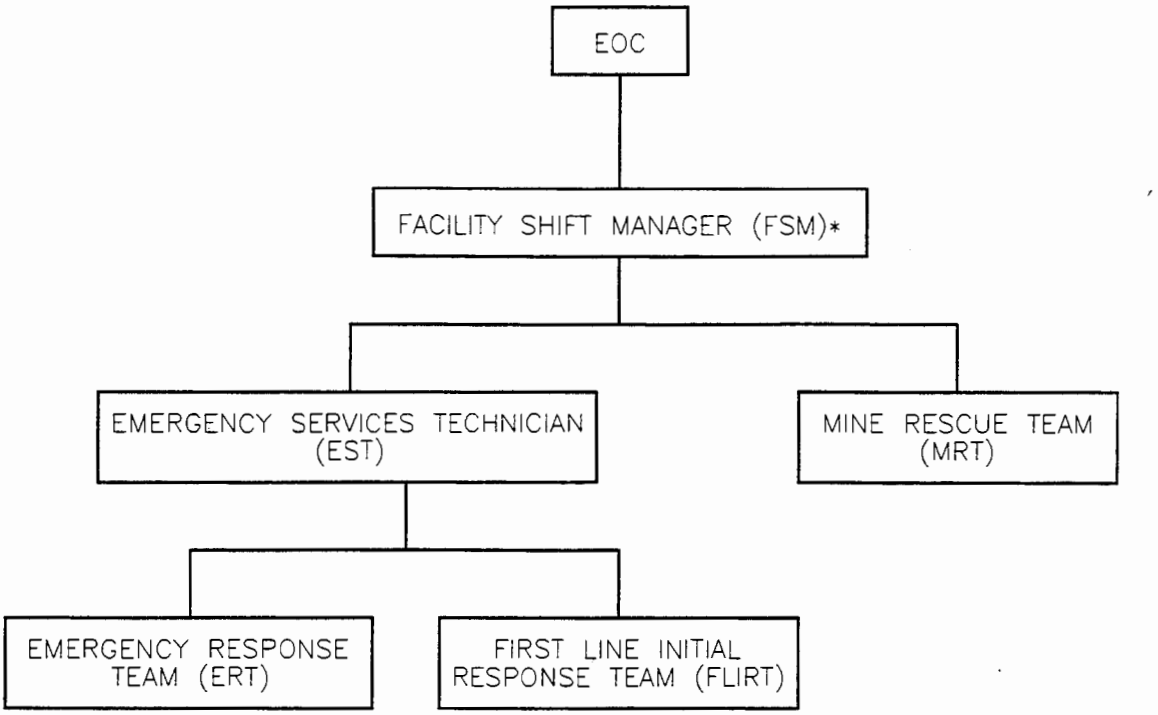


Figure G-3
WIPP Underground Facilities



* = THE FSM IS THE RCRA EMERGENCY COORDINATOR

Figure G-4

Direction and Control Under Emergency Conditions In Which the Contingency Has Been Implemented

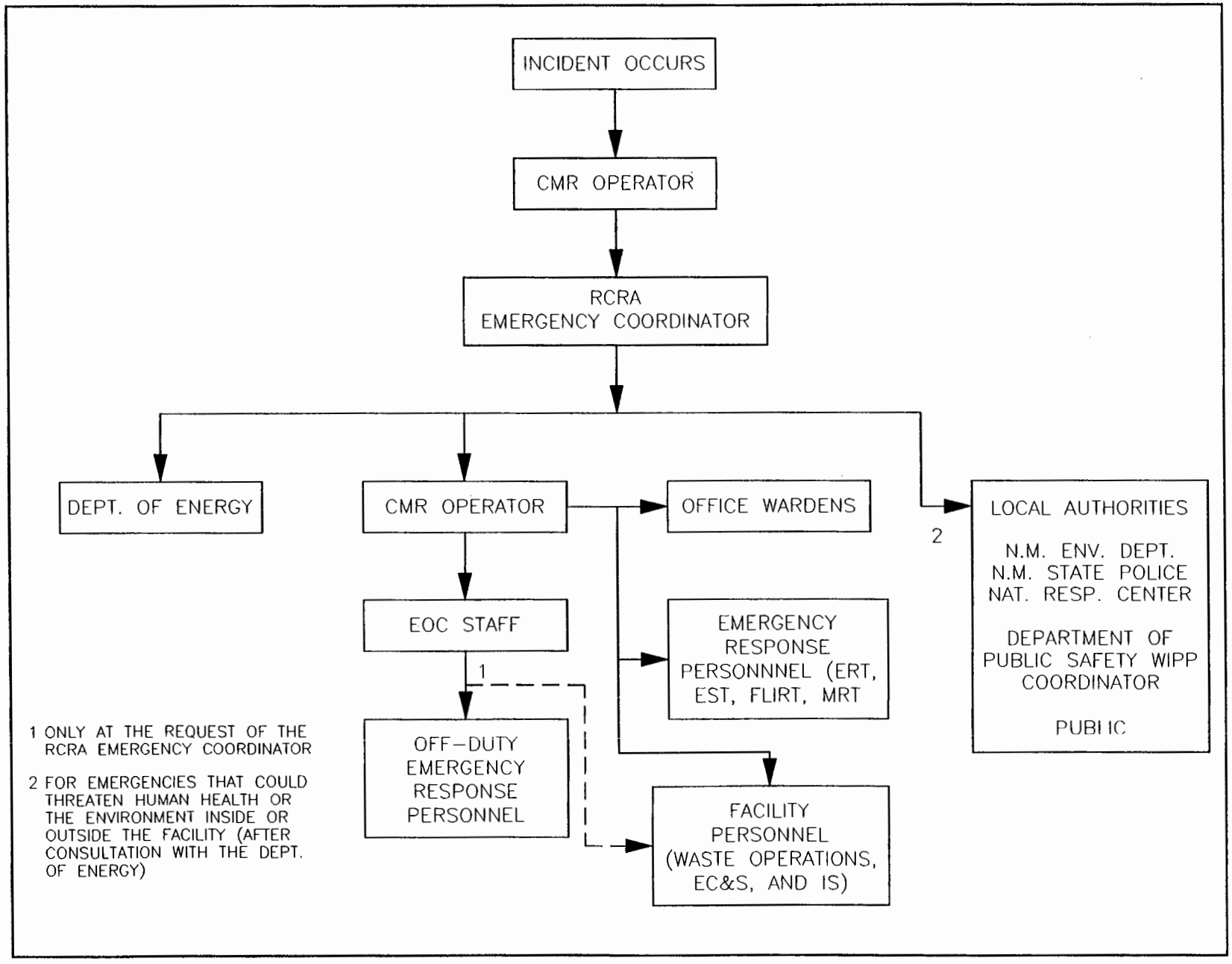


Figure G-4a
WIPP Facility Emergency Notifications

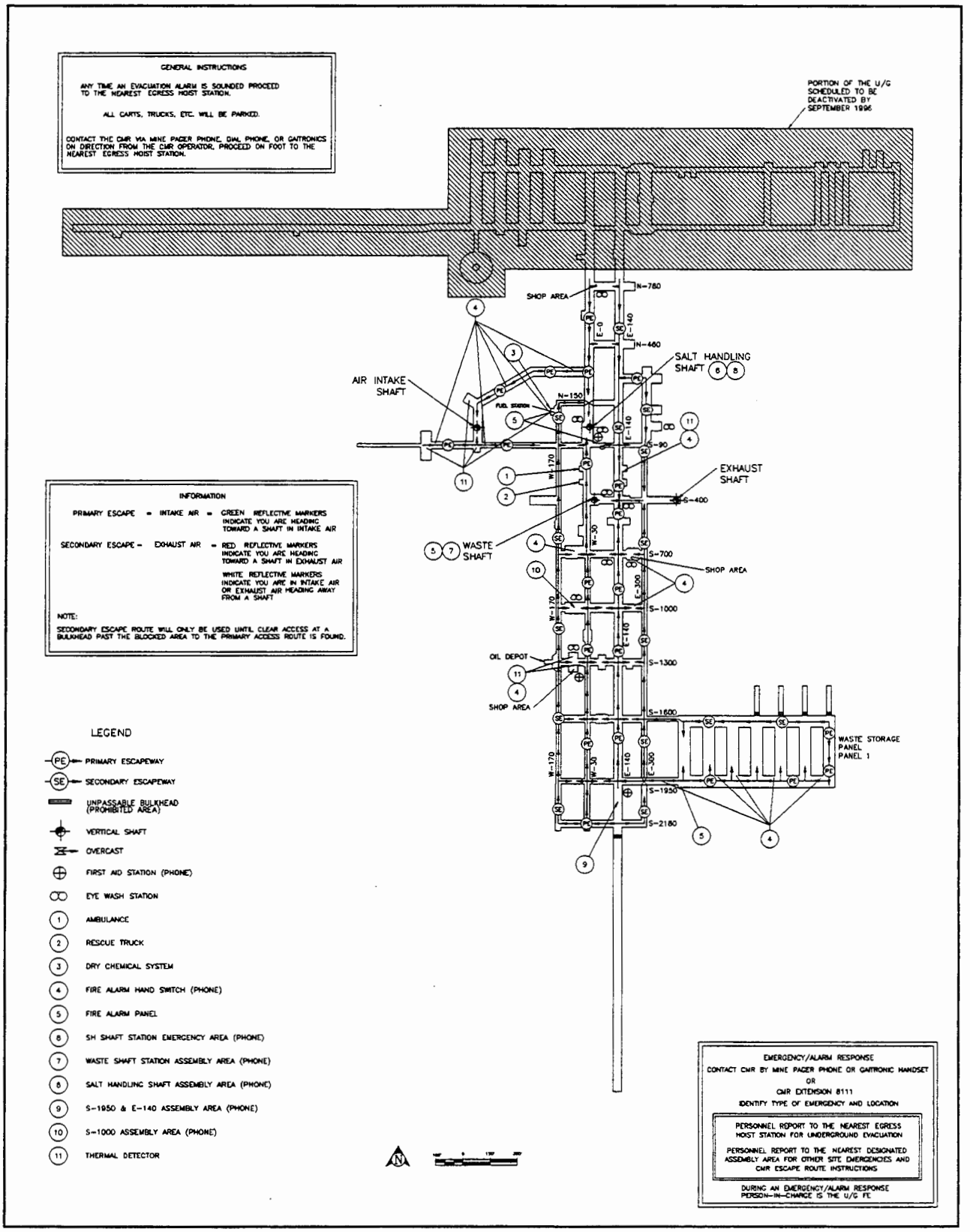


Figure G-5

Underground Emergency Equipment Locations and Underground Evacuation Routes

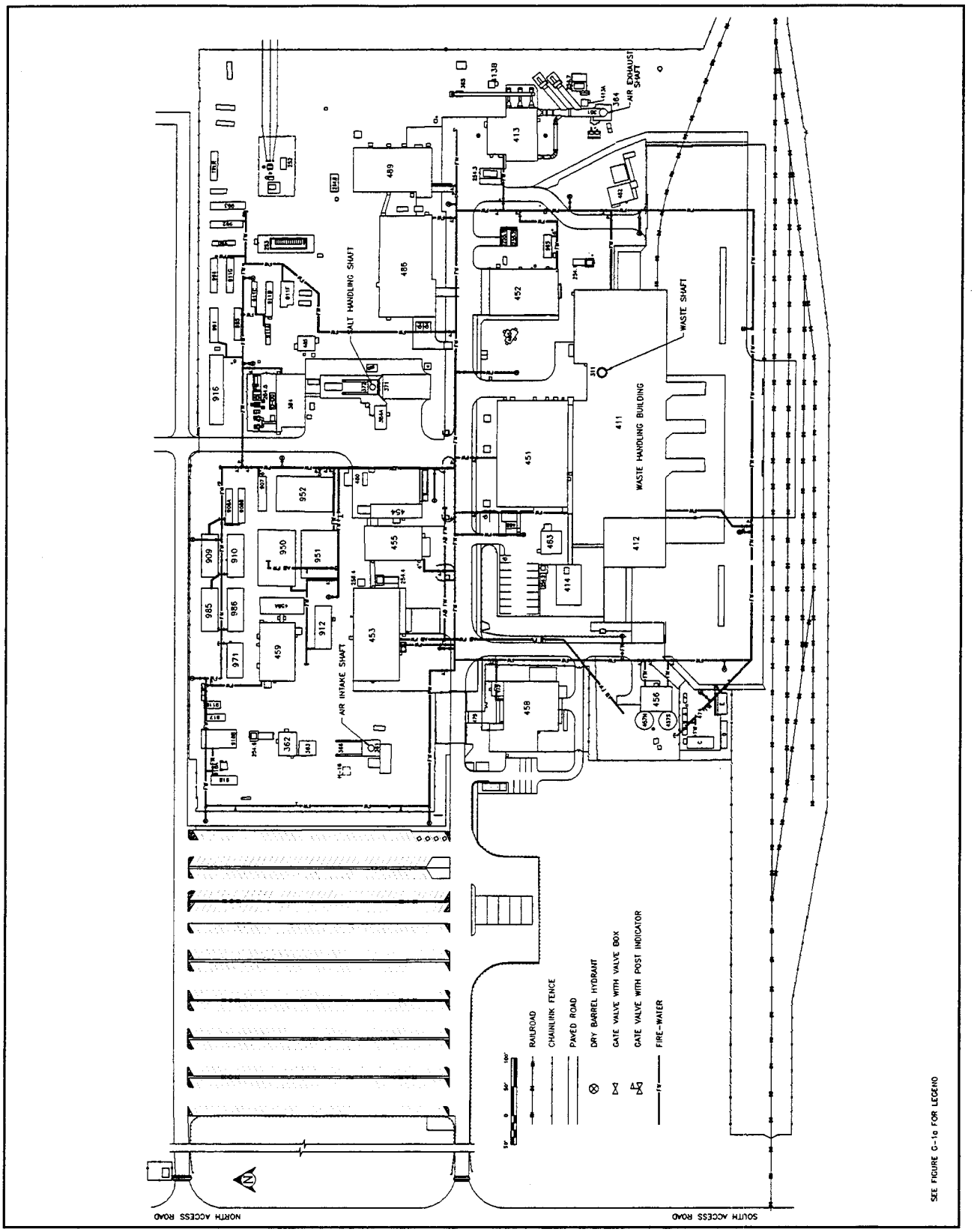


Figure G-6
Fire-Water Distribution System

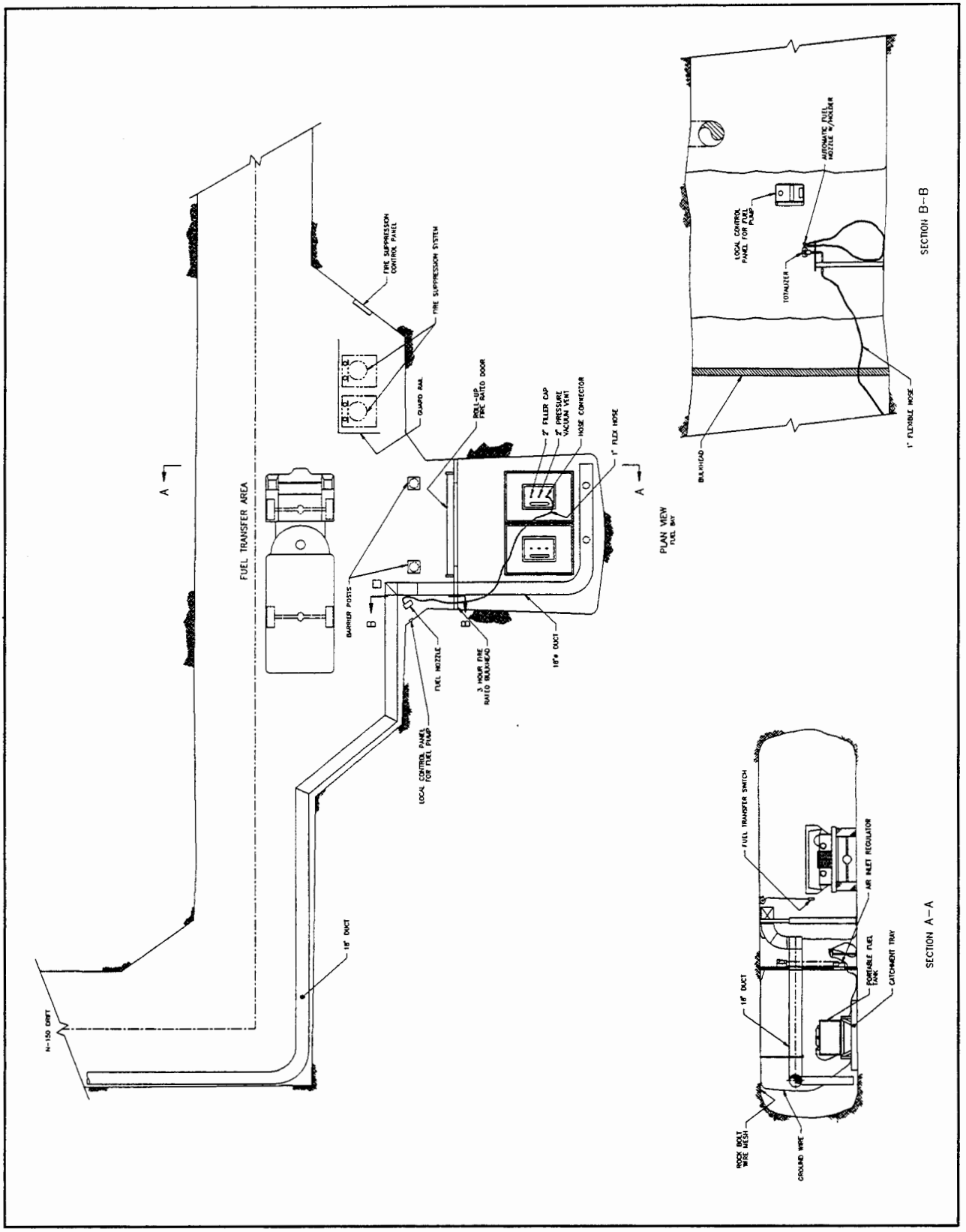


Figure G-7
Underground Diesel Fuel-Station Area Fire-Protection System

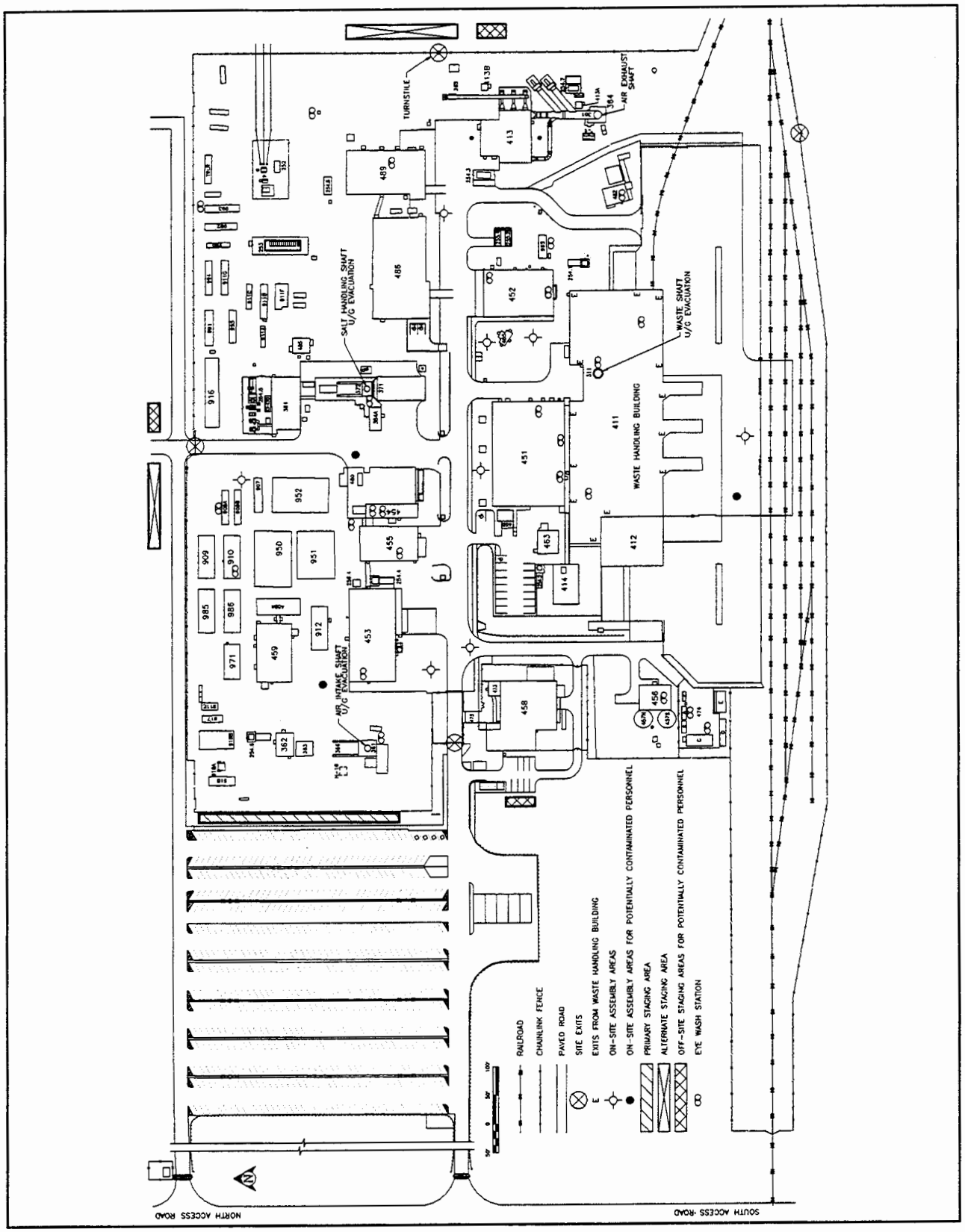


Figure G-8
WIPP On-Site Assembly Areas and WIPP Staging Areas

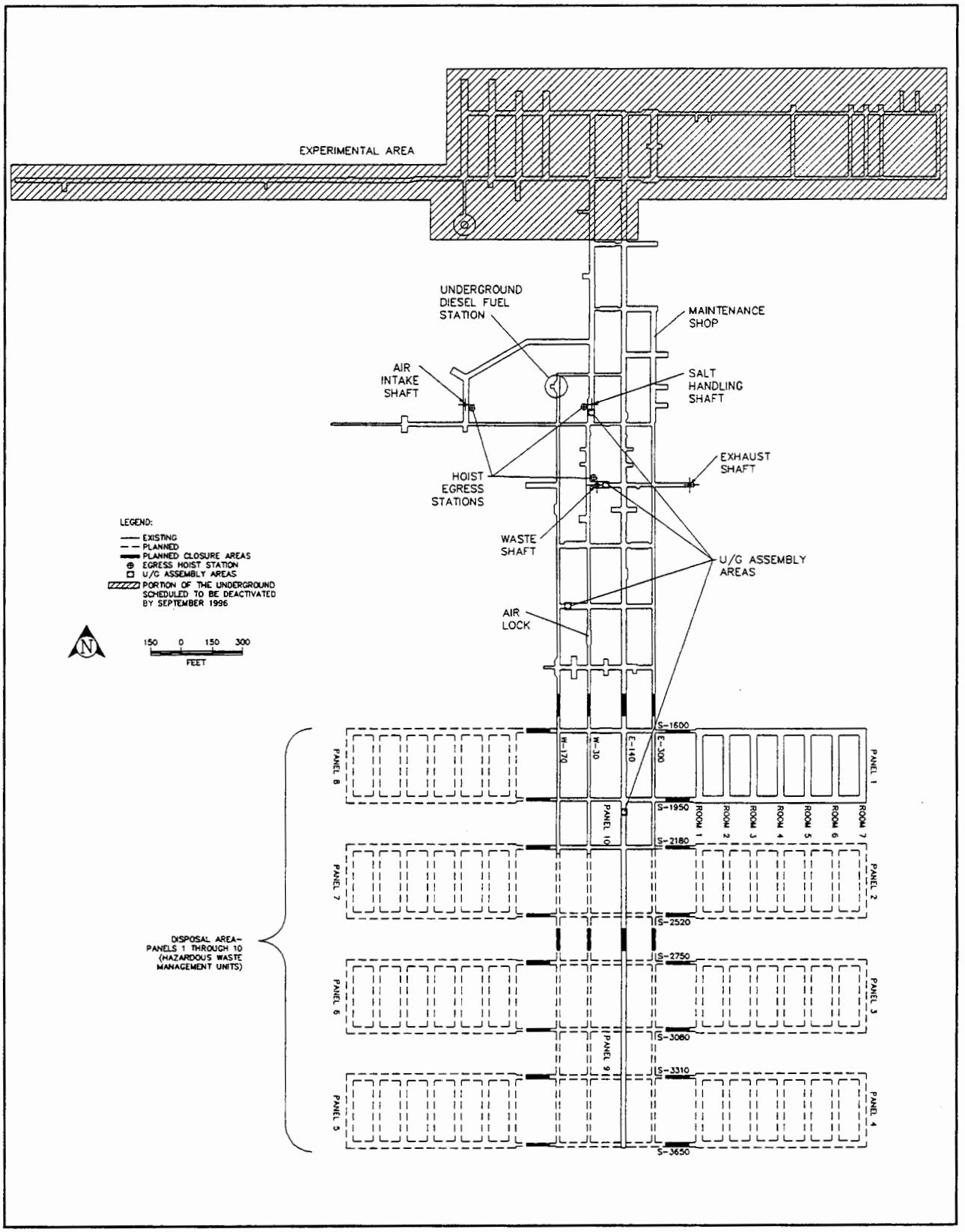
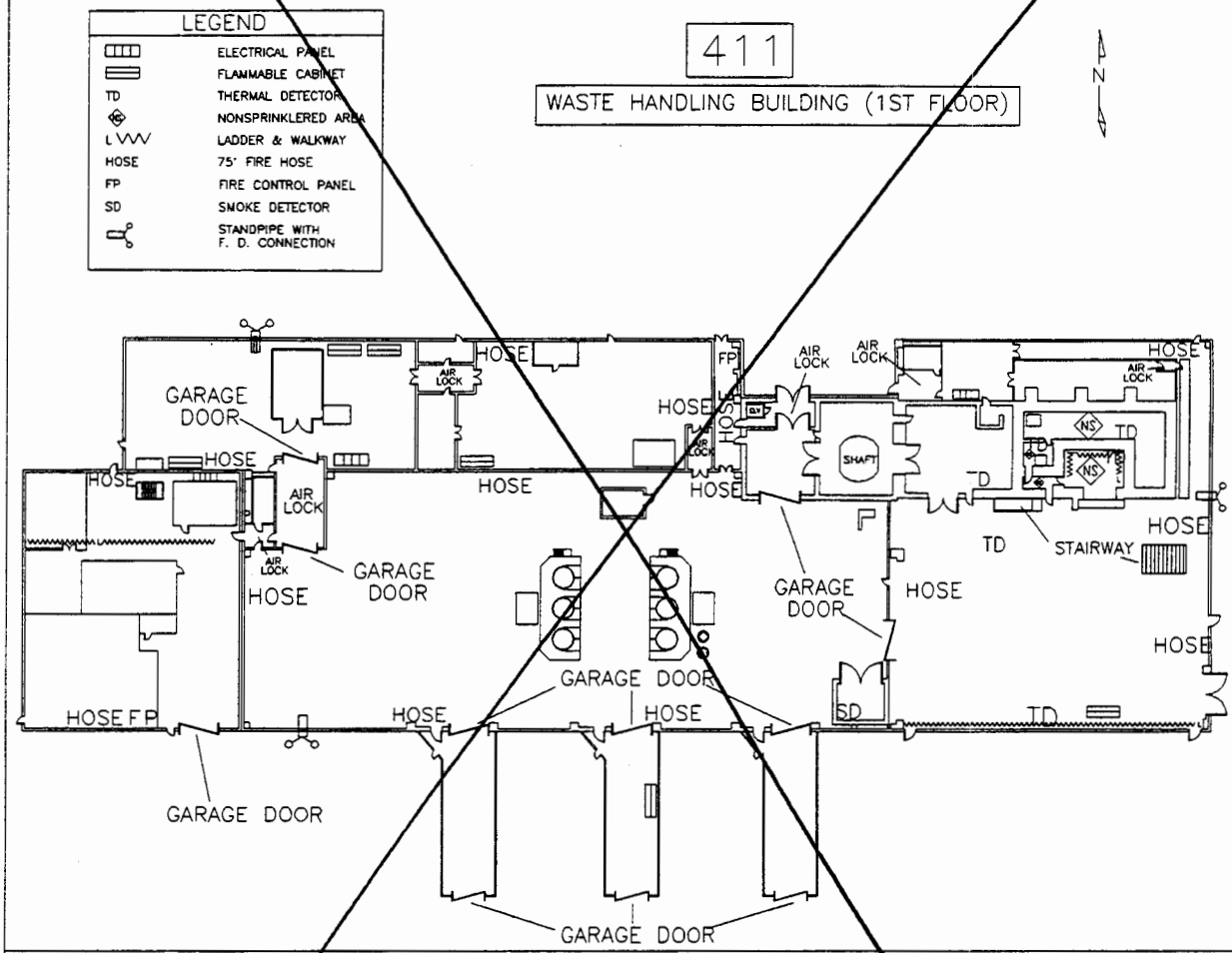


Figure G-9
Designated Underground Assembly Areas

Pre-Fire Survey

1. Bldg. Name: WASTE HANDLING BUILDING
2. Address: 411 SITE
3. Occ. Type: MAINTENANCE AND OPERATIONS PERSONNEL
4. Map #: 411-1 5. Landlord: JOE UPTERGROVE
6. Roof Const.: METAL 7. Floor Const.: CONCRETE
8. Date: 07/27/94 9. Revision Date: 07/27/95
10. Surrounding Bldgs.: 412, 463, 451, 452
11. Fire Hydrants: FH-#8 N, FH-#11 E, FH-#12 S, FH-#13 S.



12. Comments: NONE

13. Prepared By: JASON BRADLEY

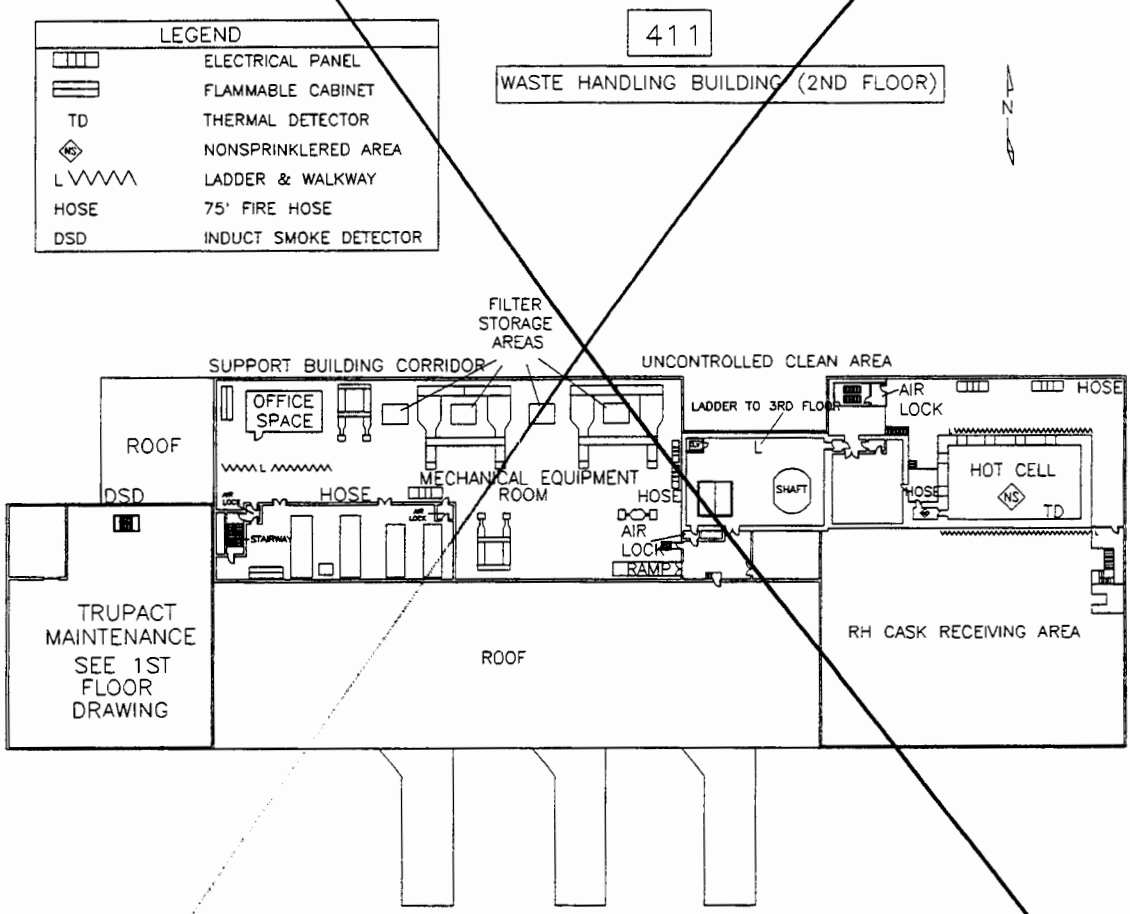
Figure G-10

Pre-Fire Survey Plan for the First Floor of the Waste Handling Building

Pre-Fire Survey

1. Bldg. Name: WASTE HANDLING BUILDING
2. Address: 411 SITE
3. Occ. Type: MAINTENANCE AND OPERATIONS PERSONNEL
4. Map #: 411-2 5. Landlord: JOE UPTERGROVE
6. Roof Const.: METAL 7. Floor Const.: CONCRETE
8. Date: 07/27/94 9. Revision Date: 07/27/95
10. Surrounding Bldgs.: 412, 463, 451, 452
11. Fire Hydrants: FH-#8 N, FH-#11 E, FH-#12 S, FH-#13 S

N



12. Comments: NONE

13. Prepared By: JASON BRADLEY

Figure G-11

Pre-Fire Survey Plan for the Second Floor of the Waste Handling Building

WIPP HAZARDOUS MATERIAL INCIDENT REPORT

Date:_____ Location:_____ Page 1 of 3

I. INITIAL INFORMATION: DATE:_____ TIME:_____

EST:_____ REPORTED LOCATION:_____

REPORTED BY:_____ DEPT.:_____

INITIALLY REPORTED TO:_____ DEPT.:_____

RESPONSIBLE MANAGER:_____ DEPT.:_____

II. WEATHER CONDITIONS: WIND DIRECTION:_____ WIND SPEED:_____mph TEMP.:_____ F

CONDITIONS (ie. icy, snowing, raining, cloudy, sunny):_____

III. TYPE OF INCIDENT (SPILL, LEAK, ETC.):_____ Fire Involved: [ ]YES [ ]NO

(If fire is involved attach a copy of the fire report)

MATERIALS INVOLVED	UN/NA NO.	QUANTITY	HAZARD CLASS	N.F.P.A. CLASS

IV. PERSONNEL INVOLVED IN CLEAN-UP ACTIVITIES

PERSONNEL/DEPT.	DECON METHOD/MEDICAL TEATMENT

V. PERSONNEL CONTAMINATED NOT INVOLVED IN THE CLEANUP ACTIVITIES

PERSONNEL/DEPT.	MATERIAL CONTACTED	DECON/MEDICAL TREATMENT

Figure G-12

WIPP Hazardous Materials Incident Report

WIPP HAZARDOUS MATERIAL INCIDENT REPORT

Date:_____ Location:_____

V. EQUIPMENT USED FOR CLEAN-UP AND CONTROL MEASURES

EQUIPMENT/MATERIAL/PPE	QUANTITY	DISPOSITION (decon or replacement)

VI. DESCRIPTION OF INCIDENT AND RESPONSE (including containment and control)

VII. TO BE COMPLETED BY ENVIRONMENTAL COMPLIANCE AND SUPPORT SECTION

Date:_____ Time:_____ of evaluation.

Waste Category_____ Disposal Method _____

Organization	DATE	TIME

EC&S Representative:_____

Print name Signature Date

Figure G-12 (Continued)

WIPP Hazardous Materials Incident Report

WIPP HAZARDOUS MATERIAL INCIDENT REPORT

Date: _____ Location: _____

VIII. TO BE COMPLETED BY THE CMRO AND FSM

DEPARTMENT	PERSON CONTACTED	TIME	NOTIFIED BY
Facility Ops. (FSM)			
Emerg. Mgmt. (EST)			
EC&S			
Industrial Safety			
Facility Ops. (FM/FMD)			

CMRO: _____
Print name Signature Date

FSM: _____
Print name Signature Date

IX. TO BE COMPLETED BY HAZARDOUS WASTE OPERATIONS

Disposition: _____

Hazardous Waste Operations Representative: _____
Print name Signature Date

X. REVIEWS

Report submitted by: _____
Print name Signature Date

Emergency Management Manager: _____
Print name Signature Date

EC&S Manager: _____
Print name Signature Date

COMMENTS: _____

Figure G-12 (Continued)
WIPP Hazardous Materials Incident Report

CHAPTER I
CLOSURE PLANS, POST-CLOSURE PLANS, AND FINANCIAL REQUIREMENTS

CHAPTER I
CLOSURE PLANS, POST-CLOSURE PLANS, AND FINANCIAL REQUIREMENTS
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CHAPTER I
CLOSURE PLANS, POST-CLOSURE PLANS, AND FINANCIAL REQUIREMENTS

Introduction

This chapter contains the Closure Plan that describes the activities necessary to close the Waste Isolation Pilot Plant (WIPP) facility after termination of the operating permit. Since the current plans for operations extend over several decades, the Department of Energy (DOE) will periodically reapply for an operating permit in accordance with Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart IX, §270.10(h). Consequently, this Closure Plan describes several types of closure. The first type is panel closure, which occurs as underground hazardous waste management units (HWMU) are filled. Secondly, final closure at the end of the Disposal Phase is described. Finally, in the event a new permit is not issued prior to expiration of an existing permit, a modification to this Closure Plan will be sought to perform contingency closure. Contingency closure defers the final closure of waste management facilities such as the Waste Handling Building (WHB), the conveyances, the shafts, and the haulage ways because these will be needed to continue operations with non-mixed Transuranic (TRU) waste.

The HWMUs addressed in this Closure Plan include the aboveground HWMU in the WHB, the parking area HWMU, and Panels 1 through 8, each consisting of seven rooms. In addition, the disposal area access drifts shown as E-300, E-140, W-30, and W-170 between S-1600 and S-3650 on Figure I-1 may, at some time in the future, be needed for waste disposal as discussed in Section D-9a(3)(f). These access drifts, if used for disposal, are also subject to the contents of this Closure Plan.

This plan is submitted to the New Mexico Environment Department (NMED) and the U.S. Environmental Protection Agency (EPA) in accordance with 20 NMAC 4.1, Subpart IX, §270.14(b)(13). Closure at the panel level will include the construction of barriers to limit the emission of hazardous waste constituents from the panel into the mine ventilation air stream below levels that meet environmental performance standards as described in Section D-9d(3)[1]

---

[1] As discussed in Section D-9d(3), the mechanism for air emissions prior to closure is different than the mechanism after closure. Prior to closure, volatile organic compounds (VOC) will diffuse through drum filters based on the concentration gradient between the disposal room and the drum headspace. These VOCs are swept away by the ventilation system, thereby maintaining a concentration gradient that is assumed to be constant. Hence, the VOCs in the ventilation stream are a function of the number of containers only. After closure, the panel air will reach an equilibrium concentration with the drum headspace and no more diffusion will occur. The only mechanism for release into the mine ventilation system is due to pressure that builds up in the closed panel. This pressure arises from the creep closure mechanism that is reducing the volume of the rooms and from the postulated generation of gas as the result of microbial degradation of organic matter in the waste. Consequently, the emissions after panel closure are a direct function of pressurization processes and rates within the panel. Details of these factors are found in Appendix I1 and in Section D-9b.

and to mitigate the impacts of methane buildup and deflagration that may be postulated for some closed panels. Closure also includes the implementation of institutional controls to limit access, the implementation of passive institutional controls, and the long-term monitoring to assess disposal system performance. Until final closure is complete and has been certified in accordance with 20 NMAC 4.1, Subpart V, §264.115, a copy of the approved plan and all approved revisions will be on file at the WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI Administrator upon request.

I-1 Closure Plan

This Closure Plan is prepared in accordance with the requirements of 20 NMAC 4.1, Subpart V, Closure and Post-Closure, Use and Management of Containers, and Miscellaneous Units. The WIPP underground HWMUs, including Panels 1 through 8 and the disposal area access drifts, designated as Panels 9 and 10 on Figure I-1, will be closed to meet the performance standards in 20 NMAC 4.1, Subpart V, §264.601. The WIPP surface facilities including Waste Handling Building Container Storage Unit and the Parking Area Container Storage Unit will be closed in accordance with 20 NMAC 4.1, Subpart V, §264.178. For final facility closure, this plan also includes closure and sealing of the facility shafts in accordance with 20 NMAC 4.1, Subpart V, §264.601.

Following completion of waste emplacement in each underground HWMU, the HWMU will be closed. The DOE will notify the NMED of the closure of each underground HWMU. For the purpose of this Closure Plan, panel closure is defined as the process of rendering HWMUs in the underground repository inactive and closed according to the facility Closure Plan. The Closure Plan addresses requirements for future monitoring that are deemed necessary for the post-closure period, including monitoring closed panels prior to final facility closure.

For the purposes of this Closure Plan, final facility closure is defined as closure that will occur when all waste disposal areas are filled or when the WIPP achieves its capacity of 6.2 million cubic feet (ft^3) (175,600 cubic meters (m^3)) of TRU waste. At final facility closure, the surface container storage areas will be closed, and equipment that can be decontaminated and used at other facilities will be cleaned and sent off site. Equipment that cannot be decontaminated plus any derived waste resulting from decontamination will be placed in the last open underground HWMU. Stockpiled salt may be placed in the underground; it may be used as the core material for the berm component of the permanent marker system; or it must be otherwise disposed of in accordance with Sections 2 and 3 of the Minerals Act of 1947 (30 U.S.C. §§602 and 603). In addition, shafts and boreholes which lie within the WIPP Site Boundary and penetrate the Salado will be plugged and sealed, and surface and subsurface facilities and equipment will be decontaminated and removed. Final facility closure will be completed to demonstrate compliance with the Closure Performance Standards contained in 20 NMAC 4.1, Subpart V §264.111, 178, and 601.

In the event the DOE fails to obtain an extension of the hazardous waste permit in accordance with 20 NMAC 4.1, Part IX, §270.51 or fails to obtain a new permit in accordance with 20 NMAC 4.1, Part IX, §270.10(h), the DOE will modify this Closure Plan to accommodate a contingency closure. Under contingency closure, storage units will undergo clean closure in accordance with

20 NMAC 4.1, Part V, §264.178 waste handling equipment, shafts, and haulage ways will be inspected for hazardous waste residues (using, among other techniques, the principle of co-detection in Appendix I3) and decontaminated as necessary, and underground HWMUs that contain radioactive mixed waste will be closed in accordance with the panel closure design described in this Closure Plan. Final facility closure, however, will be redefined and a request for a time extension for final closure will be requested. A copy of this Closure Plan will be maintained at the WIPP facility and at the DOE Carlsbad Area Office. The primary contact person at the WIPP facility is:

Manager, Carlsbad Area Office
U.S. Department of Energy
Waste Isolation Pilot Plant
P. O. Box 3090
Carlsbad, New Mexico 88221-3090
(505) 234-7300

I-1a Closure Performance Standard (20 NMAC 4.1, Subpart V, §264.111)

The closure performance standard specified in 20 NMAC 4.1, Subpart V, §264.111, states that the closure must be performed in a manner that minimizes the need for further maintenance; that minimizes, controls, or eliminates the escape of hazardous waste; and that conforms to the closure requirements of §264.178 and §264.601. These standards are discussed in the following paragraphs.

I-1a(1) Container Storage Units

Closure of the container storage units on the surface will be accomplished by removing all waste and waste residues. Identification of waste contamination will be based, among other techniques, on the principle of co-detection as described in Appendix I3. Co-detection uses very sensitive radiation detection equipment to determine if there has been a release of TRU waste, including hazardous waste components, from a container. This allows the DOE to detect releases that are not detectable from visible evidence such as stains or discoloration. Visual inspection and operating records will also be used to identify areas where decontamination is necessary. Contaminated surfaces will be decontaminated until radioactivity is below free release limits. Once surfaces are determined to be free of radioactive waste constituents, they will be tested for hazardous waste contamination. These surface decontamination activities will ensure the removal of waste residues to levels determined to be protective of human health and the environment. The facility is expected to require no decontamination at closure because any waste spilled or released during operations will be contained and removed immediately. Solid waste management units associated with the repository described in Chapter J of the permit application will be subject to closure. In the event portions of these units cannot be decontaminated, they will be remediated and the resultant wastes will be managed as derived waste.

Once the container storage units are decontaminated and certified to be clean, no further maintenance is required. The facilities and equipment in these units will be reused for other purposes as needed.

I-1a(2) Miscellaneous Unit

Post-closure migration of hazardous waste or hazardous waste constituents to ground or surface waters or to the atmosphere, above levels that will harm human health or the environment will not occur due to facility engineering and the geological isolation of the unit. The engineering aspects of closure are centered on the use of panel closures on each of the HWMUs in the underground and final facility seals placed in the shafts. The design of the panel closure system is based on the criteria that the closure system for closed HWMU panels will prevent migration of hazardous waste constituents in concentrations above health-based levels beyond the WIPP land withdrawal boundary during the 35-year operational and facility closure period and to withstand any flammable gas deflagration that may occur prior to final facility closure. The DOE has developed a design which is flexible in that components may be added or deleted to accommodate the conditions and waste characteristics encountered at the time of panel closure.

Consistent with the definitions in 20 NMAC 4.1, Subpart I, §260.10, the process of panel closure is considered partial closure because it is a process of rendering a part of the repository inactive and closed according to the approved HWMU partial closure plan. Panel closure will be considered complete when the panel closure system is emplaced and operational, when that HWMU and related equipment and structures have been decontaminated (if necessary), and when the NMED has been notified of the closure.

Shaft seals are designed to provide effective barriers to the inward migration of ground water and the outward migration of gas and contaminated brine over two discrete time periods. Several components become effective immediately and are expected to function for 100 years. Other components become effective more slowly, but provide permanent isolation of the waste. The conceptual shaft seal design is discussed in Appendix I2. Final seal designs are now undergoing final review and will be provided to the NMED by October 1, 1996. Preliminary copies of the final seal design drawings are attached to this application in Appendix I2 for NMED's review. The final seal design package, which will include final design drawings, will be certified by a professional engineer prior to submittal to the NMED.

The facility will be finally closed (i.e., decontaminated and decommissioned) to minimize the need for continued maintenance. Protection of human health and the environment includes, but is not limited to:

- Prevention of any releases that may have adverse effects on human health or the environment due to the migration of waste constituents in the groundwater or in the subsurface environment.

- Prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, in wetlands, or on the soil surface.

- Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air.

As part of final facility closure, surface recontouring and reclamation will establish a stable vegetative cover, and further surface maintenance will not be necessary to protect human health and the environment. Prior to cessation of active controls, monuments will be emplaced to serve as long-term site markers to discourage activities that would penetrate the facility or impair the ability of the salt formation to isolate the waste from the surface environment for at least 10,000 years. The federal government will maintain administrative responsibility for the repository site in perpetuity and will limit future use of the area.

If, during panel or final facility closure activities, unexpected events require modification of this Closure Plan to demonstrate compliance with closure performance standards, a Closure Plan amendment will be submitted (see Section I-1d[5]).

I-1a(3) Post-Closure Care

The post-closure care period will begin after completion of the first panel closure and will continue for 30 years after final facility closure. The post-closure care period may be shortened or lengthened at the discretion of the regulatory agency based on evidence that human health and the environment are being protected or that they are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards in 20 NMAC 4.1, Part V, §264.601. Post-closure activities are described in Section I-2.

I-1b Requirements

The DOE proposes a sequential process for the closure of individual HWMUs at the WIPP. Each underground HWMU will undergo panel closure when waste emplacement in that panel is complete. Following waste emplacement in each underground HWMU, construction-side ventilation will be terminated and waste-disposal-side ventilation will be established in the next underground HWMU to be used, and the underground HWMU containing the waste will be closed. The DOE will notify the NMED of the closure of each of the underground HWMUs as they are sequentially filled on a HWMU-by-HWMU basis. The HWMUs in the WHB and in the parking area will be closed as part of final facility closure of the WIPP facility.

The DOE will notify the Secretary of the NMED in writing at least 60 days prior to the date on which closure activities are scheduled to begin.

I-1c Maximum Waste Inventory

The WIPP will receive no more than 6.2 million ft^3 (175,600 m^3) of TRU mixed waste. Excavations are mined as needed during operations to maintain a reserve of disposal areas. The amount of waste placed in each room is limited by structural and physical considerations of equipment and design. Waste volumes include waste received from off-site generator locations as well as derived waste from disposal and decontamination operations. Maximum waste volumes in the disposal panels are calculated as follows: for 100 percent 55-gallon drums--11,502 7-packs consisting of 80,514 drums and 591,800 ft^3 (16,760 m^3) of waste; for 100 percent standard waste boxes (SWB)--11,580 SWBs and 767,750 ft^3 (21,740 m^3) of waste; for remote handled (RH)--730 canisters containing 22,940 ft^3 (650 m^3) of waste. Since the waste

can arrive in any combination of 7-packs and SWBs, a fixed volume is not set for each panel. Furthermore, the placement of backfill materials to modify chemical nature of brines over the long-term will likely result in fewer containers per panel as described in Section D-9a. For planning purposes, a maximum achievable volume is used. This equates to 662,400 ft^3 (18,750 m^3) of contact handled (CH) TRU and 22,900 ft^3 (649 m^3) of RH TRU per panel. A number of 81,000 containers is used in design calculations since for air dispersion modeling, it is important to maximize the number of container vents through which volatile organic compounds (VOC) may be released. In reality, using the 40 percent-60 percent mix, there would be only 51,000 containers in a panel, containing 56,000 vents (2 vents per SWB). The areas designated as Panels 9 and 10 in Figure I-1 will not be used for RH waste.

The maximum extent of operations during the term of this permit is expected to be Panels 1 through 4 and Panels 9 and 10 as shown on Figure I-1, the WHB container storage unit, and the parking area container storage unit. Note that panels 4, 9, and 10 are scheduled for excavation only under this permit. If other waste management units are permitted during the Disposal Phase, this Closure Plan will be revised to include the additional waste management units. At any given time during disposal operations, it is anticipated that two rooms may be receiving waste for disposal at the same time. The overlap is necessary because RH TRU mixed waste emplacement in a room will precede CH TRU mixed waste emplacement in that room. Consequently, CH TRU mixed waste may be emplaced in one room of a panel while RH TRU mixed waste is emplaced in another room of the same panel. HWMU panels in which disposal has been completed (i.e., in which RH and CH TRU mixed waste emplacement activities have ceased) will undergo panel closure.

I-1d Schedule for Closure

For the purpose of establishing a schedule for closure, an operating and closure period of no more than 35 years (25 years for disposal operations and 10 years for closure) is assumed. This operating period may be extended or shortened depending on a number of factors, including the rate of waste approved for shipment to the WIPP facility and the schedules of TRU mixed waste generator sites, and future decommissioning activities.

I-1d(1) Schedule for Panel Closure

The anticipated schedule for the closure of each of the underground HWMUs known as Panels 1 through 8, is shown in Figure I-2. This schedule assumes there will be little contamination within the exhaust drift of the panel. The following assumptions are made in estimating the time that closure will be initiated at each HWMU: RH emplacement precedes CH emplacement and does not impede CH throughput; waste operations are assumed to begin in July 1998 for planning purposes; throughput for CH waste is 784 drums per week (7 pallets per day, 4 days per week, 28 drums per pallet); and the capacity of a panel is 81,000 drums. Under these assumptions, a minimum of 104 weeks is needed to emplace the waste. Allowing a 25 percent contingency for maintenance delays and time to transition from one room to another, it is estimated that a panel will be filled 2.5 years after emplacement is initiated. This means that

underground HWMUs will be ready for closure according to the schedule in Table I-1. These dates are estimates for planning and permitting purposes. Actual dates may vary depending on the availability of waste from the generator sites. Waste availability at maximum throughput is not anticipated immediately as assumed here.

In the schedule in Figure I-2, notification of intent to close occurs 30 days before placing the final waste in a panel. Once a panel is full, the DOE will initially block ventilation through the panel as described in Section D-10a(3)(b) and then will assess the closure area for ground conditions and contamination so that a definitive schedule and closure design can be determined. If as the result of this assessment the DOE determines that a panel closure cannot be emplaced in accordance with the schedule in this Closure Plan, a modification will be submitted requesting an extension to the time for closure.

I-1d(2) Schedule for Final Facility Closure

The Disposal Phase for the WIPP facility is expected to require a period of 25 years beginning with the first receipt of TRU waste at the WIPP facility and followed by a period ranging from seven to ten years for decontamination, decommissioning, and final closure. Assuming the first waste receipt occurs in July 1998, the Disposal Phase may extend until 2023, and so the latest expected year of final closure of the WIPP facility (i.e., date of final closure certification) would be 2033. If, as is currently projected, the WIPP facility is dismantled at closure, all surface and subsurface facilities (except the hot cell portion of the WHB, which will remain as an artifact of the Permanent Marker System [PMS]) will be disassembled and either salvaged or disposed in accordance with applicable standards. In addition, asphalt and crushed caliche that was used for paving will be removed, and the area will be recontoured and revegetated in accordance with a land management plan. A detailed closure schedule will be submitted in writing to the Secretary of the NMED, along with the notification of closure. Throughout the closure period, all necessary steps will be taken to prevent threats to human health and the environment in compliance with all applicable Resource Conservation and Recovery Act (RCRA) permit requirements. Figure I-3 presents the best estimate of a final facility closure schedule .

The schedule for final facility closure is considered to be a best estimate because closure of the facility is driven by policies and practices established for the decontamination, if necessary, and decommissioning of radioactively contaminated facilities. These required activities include extensive radiological contamination surveys and hazardous constituent surveys using, among other techniques, the principle of co-detection. Surveys will be performed at all areas of the WIPP site where hazardous waste were managed. These surveys, along with historical radiological survey records, will provide the basis for release of structures, equipment, and components for disposal or decontamination for release off site. Specifications will be developed for each structure to be removed. A cost benefit analysis will be needed to evaluate decontamination options if extensive decontamination is necessary. Individual equipment surveys, structure surveys, and debris surveys will be required prior to disposition. Size-reduction techniques may be required to dispose of mixed or radioactive waste at the WIPP site. Current DOE policy, as reflected in the WIPP facility Safety Analysis Report (SAR), requires the

preparation of a final decommissioning and decontamination (D&D) plan immediately prior to final facility closure. In this way, the specific conditions of the facility at the time D&D is initiated will be addressed. Section I-1e(2) provides a more detailed discussion of final facility closure activities.

Figure I-3 shows the schedule for the final facility closure consisting of decontamination, as needed, of the TRU waste-handling equipment, and of the aboveground equipment and facilities, including closure of surface HWMUs; decontamination of the shaft and haulage ways; disposal of decontamination derived wastes in the last open underground HWMU; and subsequent closure of this underground HWMU. Subsequent activities will include installation of repository shaft seals.

An overall schedule for final facility closure, showing currently scheduled dates for the start and end of final facility closure activities is shown in Table I-2. The dates assume a start up date of June 1998 and hazardous waste permit effective dates of September 1996, September 2006, and September 2016. Details for panel closures are shown on Table I-1.

I-1d(3) Extension for Closure Time

As indicated by the closure schedule represented in Figure I-3, the activities necessary to perform facility closure of the WIPP facility will require more than 180 days to complete because of additional stringent requirements for managing radioactive materials. Therefore, the DOE is requesting an extension of the 180-day final closure requirement in accordance with 20 NMAC 4.1, Subpart V, §264.113. During the extended closure period, the DOE will continue to demonstrate compliance with applicable permit requirements and will take all steps necessary to prevent threats to human health and the environment as a result of TRU mixed waste management at the WIPP facility including all of the applicable measures in Chapter F of this application.

In addition, according to the schedules in Figure I-3, the final derived wastes that are generated as the result of decontamination activities will not be disposed of for 16 months after the initiation of final facility closure. In accordance with 20 NMAC 4.1, Subpart V, §264.113(a), the DOE requests an extension of the 90-day limit to dispose of final derived waste resulting from the closure process. This request is necessitated by the fact that the radioactive nature of the derived waste makes placement in the WIPP the best disposition, and the removal of these wastes will, by necessity, take longer than 90 days in accordance with the closure schedules. During this extended period of time, the DOE will take all steps to prevent threats to human health and the environment, including compliance with all applicable permit requirements. These steps include all of the applicable preparedness and prevention measures in Chapter F of this permit application, including Section F-4g, Flammable Gas Control.

Finally, in the event the hazardous waste permit is not renewed as assumed in the schedule, the DOE will submit a modification to the Closure Plan to implement a contingency closure that will allow the DOE to continue to operate for the disposal of non-mixed TRU waste. This modification will include a request for an extension of the time for final facility closure. This modified Closure Plan will be submitted to the NMED for approval.

I-1d(4) Amendment of the Closure Plan

If it becomes necessary to amend the Closure Plan for the WIPP facility, the DOE will submit, in accordance with 20 NMAC 4.1, Subpart IX, §270.42, a written notification of or request for a permit modification describing any change in operation or facility design that affects the Closure Plan. The written notification or request will include a copy of the amended Closure Plan for approval by the NMED. The DOE will submit a written notification of or request for a permit modification to authorize a change in the approved plan, if:

- There are changes in operating plans or in the waste management unit facility design that affect the Closure Plan
- There is a change in the expected year of closure
- Unexpected events occur during panel or final facility closure that require modification of the approved Closure Plan
- Changes in state or federal laws affect the Closure Plan
- DOE fails to obtain permits for continued operations as discussed above

The DOE will submit a written request for a permit modification with a copy of the amended Closure Plan at least 60 days prior to the proposed change in facility design or operation or within 60 days of the occurrence of an unexpected event that affects the Closure Plan. If the unexpected event occurs during final closure, the permit modification will be requested within 30 days of the occurrence. If the Secretary of the NMED requests a modification of the Closure Plan, a plan modified in accordance with the request will be submitted within 60 days of notification or within 30 days, if the change in facility condition occurs during final closure.

I-1e Closure Activities

Closure activities include those instituted for panel closure (i.e., closure of filled underground HWMUs), contingency closure (i.e., closure of surface HWMUs and decontamination of other waste handling areas), and final facility closure (i.e., closure of surface HWMUs, D&D of surface facilities and the areas surrounding the WHB, and placement of repository shaft seals). Panel closure systems will be emplaced to separate areas of the facility and to isolate panels. Appendices I1 and I2 provide panel closure system and shaft seal designs. All closure activities will meet the applicable quality assurance (QA)/quality control (QC) program standards in place at the WIPP facility. Facility monitoring procedures in place during operations will remain in place through final closure, as applicable.

I-1e(1) Panel Closure

Following completion of waste emplacement in each underground HWMU, disposal-side ventilation will be established in the next panel to be used, and the panel containing the waste will be closed. A panel closure system will be emplaced in the panel access drifts, in accordance

with the design in Appendix I1 and the schedule in Figure I-2 and Table I-1. The panel closure system is designed to meet the following requirements that were established by the DOE for the design:

- the panel closure system shall limit the migration of VOCs to the compliance point so that compliance is achieved by at least one order of magnitude
- the panel closure system shall consider potential flow of VOCs through the disturbed rock zone (DRZ) in addition to flow through closure components
- the panel closure system shall perform its intended functions under loads generated by creep closure of the tunnels
- the panel closure system shall perform its intended function under the conditions of a postulated methane explosion
- the nominal operational life of the closure system is 35 years
- the panel closure system for each individual panel shall not require routine maintenance during its operational life
- the panel closure system shall address the most severe ground conditions expected in the waste disposal area
- the design class of the panel closure system shall be IIIb (which means that it is to be built to generally accepted national design and construction standards)
- the design and construction shall follow conventional mining practices
- structural analysis shall use data acquired from the WIPP underground
- materials shall be compatible with their emplacement environment and function
- treatment of surfaces in the closure areas shall be considered in the design
- thermal cracking of concrete shall be addressed
- during construction, a QA/QC program shall be established to verify material properties and construction practices
- construction of the panel closure system shall consider shaft and underground access and services for materials handling

The performance standard for air emissions from the WIPP facility is established in Section D-9d(3) and Table D-6. These are reiterated in the detailed design report, Appendix I1, Table A-1, as the closed panel release limits. Releases must be below these limits for the facility to remain in compliance with standards to protect human health and the environment. The

following panel closure design has been shown, through analysis, to meet these standards, if emplaced in accordance with the specifications in Appendix I1.

The final panel closure design in Appendix I1 was prepared with the assumption that there would be no backfill in the disposal rooms. With the inclusion of backfill, the design has been re-examined and it has been determined that the changes are insignificant for several reasons. First, the backfill has no effect on the gas generation rate so that the values used in the design for gas generation and methane buildup remain the same. Second, the quantity of backfill is sufficient to fill one-tenth of the void volume in the room. This results in more rapid pressurization of the room, however, the effect is small and will only be important after the facility is sealed. Third, the reduced volume will result in a faster accumulation of methane. This would not result in a revision of the design. Instead, it would change the criteria for installing explosion walls. The DOE believes the 20-year criterion is still appropriate, since the design report (Figure 2-14 in Appendix I1) shows that it takes 25-years to reach explosive limits. A ten percent reduction in this time is still beyond 20 years. Furthermore, the chances that methane will be generated initially are minimized by the fact that the closed panels will be initially oxic and may remain so for a long time after facility closure.

The design for the panel closure system calls for a composite panel barrier system consisting of a rigid concrete plug with or without removal of the DRZ, and either an explosion-isolation wall or a construction-isolation wall. The design basis for this closure is such that the migration of hazardous waste constituents from closed panels during the operational and closure period would result in concentrations well below health-based standards. The source term used as the design basis included the average concentrations of VOCs from CH waste containers as measured in headspace gases through January 1995. Appendix C2 discusses the methodology for calculating average concentrations. The VOCs are assumed to have been released by diffusion through the container vents and are assumed to be in equilibrium with the air in the panel. Emissions from the closed panel occur at a rate determined by gas generation within the waste and creep closure of the panel. The derivation of the emission rate is discussed in Appendix D9. Due to the relatively small amount of RH waste (approximately 5 percent of the total waste volume), VOC emissions from RH waste are assumed to contribute insignificantly to total VOC emissions. Analysis in Appendix D9 shows that emissions result in VOC concentrations at the site boundary below health-based limits; therefore, an adequate margin of safety also exists for potential RH waste VOC emissions. This design meets the environmental performance standard.

Figures I-4 and I-5 show a diagram of the panel closure design and installation envelopes. Appendix I1 provides the detailed design and the design analysis for the panel closure system. The panel closure design is such that components can be added or removed or their shapes adjusted depending on the particular ground conditions at the time of installation. For example, in Figure I-4, Option A represents the likely closure of panels less than 20 years old at the time of final facility closure and whose entries are sufficiently intact such that DRZ removal is not needed. These would likely include Panels 6 through 8. Option B represents the preferred option for panels that will be closed for more than 20 years prior to final facility closure and whose entries are reasonably intact at time of closure. These will likely be Panels 2 through 5. Option C may be desirable for panels whose entries require DRZ removal and whose closure precedes final facility closure by less than 20 years. This is the likely configuration of the closure

for Panels 9 and 10. Finally, Option D may be appropriate for panels whose entries require significant removal of the DRZ and whose closure will precede final facility closure by more than 20 years. Panel 1 is the most likely candidate for this type of closure.

The 20-year limit in the design selection process is based on what the DOE believes to be conservative analytical results that indicate methane, being generated by waste degradation at the rate of 0.1 mole per drum per year, will not reach flammable concentrations for at least 20 years. As part of the decision making process on design selection, an investigation of the DRZ would precede the selection of the concrete component and the specification of the amount of excavation that is needed. These investigations could be done using geophysical methods (such as ground penetrating radar) or drill holes. Drill holes can be investigated using video cameras or "scratchers".

The DOE believes that design Options A through D will function adequately as panel closures given the current state of knowledge about gas generation, the understanding of the DRZ, the expected characteristics of the waste, and the inability of monitoring techniques to accurately detect extremely small concentrations of VOCs. However, in the event sufficient information is collected that allows the DOE to make less conservative assumptions regarding these items, the designs A through D may prove to be significantly more protection than is actually needed. Consequently, the DOE has retained as a design concept, Option E, which is simply the explosion wall portion of Options B and D. Option E represents a significantly simpler panel closure system that the DOE would use if either of the following criteria are met as indicated:

- Gas generation rates are smaller. Current (unreported) work being performed by Sandia National Laboratories indicates that microbial gas generation rates under humid conditions are close to zero, and/or

- Average headspace concentrations are less than the averages used in the calculations. As new wastes are generated, the use of organic solvents is expected to be reduced drastically. Some compounds, such as carbon tetrachloride, have already been banned from use at some generator sites.

As stated previously, the DOE will evaluate these criteria at the time a panel closure is needed and will select the proper closure design. If a design different from those listed above is identified, the appropriate permit modification will be sought.

I-1e(2) <u>Decontamination and Decommissioning</u>

Decontamination is defined as those activities which are performed to remove contamination from surfaces and equipment that are not intended to be disposed of. The policy at the WIPP will be to decontaminate as many areas as possible, consistent with radiation protection policy. Decontamination is part of all closure activities and is a necessary activity in the clean closure of the surface container management units. Decontamination is performed using, among other techniques, the principles of co-detection as described in Appendix I3.

Decommissioning is the process of removing equipment, facilities, or surface areas from further use and rendering a facility to a final condition. Decommissioning is part of final facility closure

only and will involve the removal of equipment, buildings, closure of the shafts, and establishing active and passive institutional controls for the facility.

The objective of D&D activities at the WIPP facility is to return the surface to as close to the preconstruction condition as reasonably possible, while protecting the health and safety of the public and the environment. D&D activities are discussed in the "Conceptual Decontamination and Decommissioning Plan for the Waste Isolation Pilot Plant" (DOE, 1995a). Major activities planned to accomplish this objective include, but are not limited to the following:

1. Review of operational records for historical information on releases
2. Visual examination of surface structures for evidence of spills or releases
3. Performance of site contamination surveys
4. Decontamination, if necessary, of usable equipment, materials, and structures including surface facilities and areas surrounding the WHB.
5. Disposal of equipment/materials that cannot be decontaminated but that meet waste acceptance criteria in an HWMU
6. Dismantling of surface facilities
7. Dismantling of underground facilities at the time the panels are closed
8. Emplacement of final panel closure system
9. Emplacement of fill material in the underground, if required[2]
10. Emplacement of shaft seals[3]
11. Regrading the surface to approximately original contours
12. Initiation of active controls which includes monitoring and installation of the PMS

These activities, in addition to common techniques such as visual inspection and records, will be performed using the best technology available at the time of closure, and will be conducted in a manner that maintains personnel exposure to radiation levels as low as reasonably achievable and exposure to hazardous constituents to levels deemed acceptable by the DOE as discussed in Section D-9d(3). This Closure Plan will be amended prior to the initiation of closure activities to specify the D&D methods to be used, if appropriate.

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[2]Recent studies have shown that fill outside the waste emplacement region has negligible benefits for minimizing subsidence. Consequently, this function has been deleted from the WIPP base design. Such fills may, however, have long-term benefits and may prove to be desirable in the future. If need be, they will be included in future revisions of the Closure Plan.

[3]For the purposes of planning, the conclusion of shaft sealing is used by the DOE as the end of closure activities and the beginning of the Post-Closure Care Period.

Health and Safety

Before final closure activities begin, health physics personnel will conduct a hazards survey of the unit(s) being closed. A release of radionuclides could also indicate a release of hazardous constituents, in accordance with co-detection principles. If radionuclides are not detected, sampling for hazardous constituents may still be performed if there is evidence that a spill or release has occurred. The purpose of the hazards survey will be to identify potential contamination concerns that may present hazards to workers during the closure activities and to specify any control measures necessary to reduce worker risk. This survey will provide the information necessary for the health physics personnel to identify worker qualifications, personal protective equipment (PPE), safety awareness, work permits, exposure control programs, and emergency coordination that will be required to perform closure related activities.

I-1e(2)(a) Determine the Extent of Contamination

The first activities performed as part of decontamination include those needed to determine the extent of any contamination that needs to be removed prior to decommissioning a facility. This includes activities 1 to 3 above and, as can be seen by the schedules in Figures I-3 and I-4 (Items B and C), these surveys are anticipated to take ten months to perform, including obtaining the results of any sample analyses. The process of identifying areas that require decontamination include three sources of information. First, operating records will be reviewed to determine where contamination has previously been found as the result of historical releases and spills. Even though releases and spills will have been cleaned up at the time of occurrence, newer equipment and technology may allow further cleaning. Second, surfaces of facilities and structures will be examined visually for evidence of spills or releases. Finally, extensive detailed contamination surveys will be performed to document the level of cleanliness for all surface structures and equipment. If equipment or areas are identified as contaminated, a plan and procedure(s) will be developed and implemented to address decontamination-related questions, including:

- Should the component be decontaminated or disposed of as waste?
- What is the most cost-effective method of decontaminating the component?
- Will the decontamination procedures adequately contain the contamination?

The principle of co-detection will be used in determining the presence of hazardous waste and hazardous waste residues in areas where spills or releases have occurred. Co-detection is described in Appendix I3 and simply means that if radioactive contamination is found, it will be assumed that hazardous constituent contamination also occurs. Once cleanup of the radioactivity has been completed, the surface will be sampled for hazardous constituents to determine that they, too, have been cleaned up. Sampling will be in accordance with written procedures in the WIPP Site Effluent Hazardous Material Sampling Plans (Westinghouse, 1994), which provides for sampling protocols including QA/QC, organizational responsibilities, sample plan development, sample control, and laboratory selection and use. Sampling is established consistent with EPA's document SW-846 (EPA, 1986).

I-1e(2)(b) Decontamination Activities

Once the extent of contamination is known, decontamination activities will be planned. Radiological control and the control of hazardous waste residues are the primary criteria used in the design of decontamination activities. Radiation control procedures require that careful planning and execution be used in decontamination activities to prevent the exposure of workers beyond reasonable occupational levels and to prevent the further spread of contamination. Careful control of entry, cleanup, and ventilation are vital components of radiation decontamination. The level of care mandated by DOE orders and occupational protection requirements is what results in closure activities that will exceed the 180-days allowed in 20 NMAC 4.1, Subpart V. Decontamination activities are included as item 4 above and is shown on the schedules for contingency closure and final facility closure (Figures I-3 and I-4) as activities D, E, and F. These activities are anticipated to have a duration of 20 months for both contingency closure and for final facility closure. The result of these activities is the clean closure of the surface container management units. Under contingency closure, the other areas that have been decontaminated will not be closed. Instead they will remain in use for continued waste management activities involving non-mixed waste. Under final facility closure, other areas that are decontaminated are eligible for closure.

The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will provide for minimum need for decontamination. However, the need for decontamination techniques may arise.

Decontamination activities will be coordinated with closure activities so that areas that have been decontaminated will not be recontaminated. All waste resulting from decontamination activities will be surveyed and analyzed for the presence of contaminants. The waste will be characterized as hazardous, mixed, or radioactive and will be packaged and handled appropriately. Mixed and radioactive waste will be classified as TRU mixed waste managed in accordance with the applicable DOE Order(s) in place at the time of closure. Derived mixed waste collected during decontamination activities that are generated before repository shafts have been sealed will be emplaced in the facility, if appropriate, or will be managed together with decontamination derived waste collected after the underground is closed. This waste will be classified and shipped off site to an appropriate, permitted facility for treatment, if necessary, and for disposal.

Removal of Hazardous Waste Residues

Because of the type of waste management activities that will occur at the WIPP facility, waste residues that may be encountered during the operation of the facility and at closure may include derived waste. Derived wastes result from the management of the waste containers or may be collected as part of the closure activities (such as those during which wipes were used to sample the containers and equipment for potential radioactive contamination or those involving solidified decontamination solutions, the handling of equipment designated for disposal, and the handling of residues collected as a result of spill cleanup). Derived wastes collected during the operation and closure of the WIPP facility will be identified and managed as TRU mixed wastes. These wastes will be disposed of in the open-disposal HWMU. D&D derived wastes and equipment designated for disposal will be placed in the last HWMU panel before closure of that unit.

Surface Container Storage Units

The procedures employed for waste receipt at the WIPP facility allow no opportunity for any waste spillage to occur outside the WHB. TRU mixed waste is shipped to the WIPP facility in approved shipping containers (e.g., TRUPACT-IIs or shielded road casks) that are not opened until they are inside the WHB. Therefore, no soil in the parking area or elsewhere in the vicinity of the WHB will become contaminated with TRU mixed waste constituents as a result of TRU mixed waste management activities, and an evaluation of the soils in the vicinity of the WHB is unnecessary.

The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will minimize the need for decontamination of the WHB during decommissioning and closure. Procedures for opening shipping containers in the WHB limit the opportunity for waste spillage.

Should the need for decontamination of the WHB arise, the following methods may be employed, as appropriate, for the hazardous constituent/contaminant type and extent:

- Chemical cleaning (e.g., water, mild detergent cleanser, and polyvinyl alcohol)
- Nonchemical cleaning (e.g., sandblasting, grinding, high-pressure water spray, scabbler pistons and needle scalers, ice-blast technology, dry-ice blasting)
- Removal of contaminated components such as pipe and ductwork

Waste generated as a result of WHB decontamination activities will be managed as derived waste in accordance with applicable permit requirements and will be emplaced in the last open HWMU for disposal.

Equipment and Underground Waste Handling Areas

The waste hoist conveyance and associated waste handling equipment, as well as waste handling areas outside the disposal areas in the underground, will be decontaminated as needed as part of both contingency and final facility closure. Procedures for detection and sampling will be as described above. Equipment cleanup will be as above using chemical or nonchemical techniques. Contaminated areas in the underground will be managed on a case-by-case basis and may either be removed or entombed.

Personnel Decontamination

PPE worn by personnel performing closure activities in areas determined to be contaminated will be disposed of appropriately. Disposable PPE used in such areas will be placed into containers and managed as TRU mixed waste. Non-disposable PPE will be decontaminated, if possible. Non-disposable PPE that cannot be decontaminated will be managed as TRU mixed waste.

In accordance with DOE policy, TRU mixed waste PPE will be considered to be contaminated with all of the hazardous waste constituents contained in the containers that have been managed within the unit being closed. Wastes collected as a result of closure activities and that may be

contaminated with radioactive and hazardous constituents will be considered TRU mixed wastes. These wastes will be managed as derived wastes, as described in Section D-10a(3)(a). Such waste, collected as the result of closure of the WIPP facility, will be disposed of in the final open HWMU.

Cleanup Criteria

Radiation decontamination will be less than or equal to the following levels, or to whatever lesser levels that may be established by DOE Order at the time of cleanup:

Contamination Type	Loose[4]	Fixed plus removable
alpha contamination (α)	20 dpm/100 cm^2	500 dpm/100 cm^2
beta-gamma contamination (β-γ)	200 dpm/100 cm^2	1000 dpm/100 cm^2

Hazardous waste decontamination will be conducted in accordance with standards in 40 CFR Part 264, Subpart S.

Final Contamination Sampling and Quality Assurance

Verification samples will be analyzed by an approved laboratory that has been qualified by the DOE according to a written program with strict criteria. The QA requirements of EPA/SW-846, "Test Methods for Evaluating Solid Waste," will be met for hazardous constituent sampling and analyses.

Quality Assurance/Quality Control

Because decisions about closure activities may be based, in part, on analyses of potentially contaminated surfaces and media, a program to ensure reliability of analytical data is essential. Data reliability will be ensured by following a QA/QC program that mandates adequate precision and accuracy of laboratory analyses. Field documentation will be used to document the conditions under which each sample is collected. The documented QA/QC program in place at the WIPP facility meets DOE QA requirements.

Field blanks and duplicate samples will be collected in the field to determine potential errors introduced in the data from sample collection and handling activities. To determine the potential for cross-contamination, rinsate blanks (consisting of rinsate from decontaminated sampling equipment) will be collected and analyzed. At least one rinsate blank will be collected for every 20 field samples. Duplicate samples will be collected at a frequency of one duplicate sample for every ten field samples. In no case will less than one rinsate blank or duplicate sample be collected for a field-sampling effort. These blank and duplicate samples will be identified and

[4]The unit "dpm" stands for "disintegration per minute" and is the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

treated as separate samples. Acceptance criteria for QA/QC hazardous constituent sample analyses will be compatible with the most recent version of EPA SW-846 or other applicable EPA guidance.

I-1e(2)(c) Dismantling

Final facility closure will include dismantling of structures on the surface and in the underground. These are items 6 and 7 above and are represented as Activity G in the final facility closure schedule in Figure I-4. During dismantling, priority will be given to contaminated structures and equipment that cannot be decontaminated to assure these are properly disposed of in the remaining open underground HWMU in a timely manner. All such facilities and equipment are expected to be removed and disposed of 16 months after the initiation of closure. Dismantling of the balance of the facility, including those structures and equipment that are not included in the application and are not used for TRU mixed waste management, is anticipated to take an additional 66 months. It should be noted that the placement of D&D waste into the final underground HWMU may, by necessity, involve the placement of uncontainerized bulk materials such as concrete components, building framing, structural members, disassembled or partially disassembled equipment, or containerized materials in non-standard waste boxes. Such placement will only occur if it can be shown that it is protective of human health and the environment and all items are described in an amendment to the Closure Plan. Identification of bulk items is not possible at this time since their size and quantity will depend on the extent of non-removable contamination.

I-1e(2)(d) Closure of Open Underground HWMU

The closure of the final underground HWMU is shown by Activity H in Figure I-3. This closure will be consistent with the description in Section I-1e(1) and the design in Appendix I1. Detailed closure schedules for underground HWMUs are given in Figure I-2 and Table I1.

I-1e(2)(e) Final Facility Closure

Final facility closure includes several activities designed to assure both the short-term isolation of the waste and the long-term integrity of the disposal system. These include the placement of plugs in boreholes that penetrate the salt and the placement of the repository sealing system. In addition, the surface will be returned to as near its original condition as practicable, and will be readied for the construction of markers and monuments that will provide permanent marking of the repository location and contents.

Figure I-6 identifies where ten existing boreholes overlie the proximate area of the repository footprint. Of these identified boreholes in Figure I-6, all but ERDA-9 are terminated hundreds of feet above the repository horizon. Only ERDA-9, which is accounted for in long-term performance modeling, is drilled through the repository horizon, near the WIPP excavations.

To mitigate the potential for migration beyond the repository horizon, the DOE has specified that borehole seals be designed to limit the volume of water that could be introduced to the repository from the overlying water-bearing zones and to limit the volume of contaminated brine released from the repository to the surface or water-bearing zones.

Borehole plugging activities have been underway since the 1970s, from the early days of the development of the WIPP facility. Early in the exploratory phase of the project, a number of boreholes were sunk in Lea and Eddy counties. After the WIPP site was situated in its current location, an evaluation of all vertical penetrations was made by Christensen and Peterson (1981).

As an initial criterion, any borehole that connects a fluid-producing zone with the repository horizon becomes a plugging candidate.

Grout plugging procedures are routinely performed in standard oil-field operations; however, quantitative measurements of plug performance are rarely obtained. The Bell Canyon Test reported by Christensen and Peterson (1981) was a field test demonstration of the use of cementitious plugging materials and modification of existing industrial emplacement techniques to suit repository plugging requirements. Cement emplacement technology was found to be "generally adequate to satisfy repository plugging requirements." Christensen and Peterson (1981) also report "that grouts can be effective in sealing boreholes, if proper care is exercised in matching physical properties of the local rock with grout mixtures. Further, the reduction in fluid flow provided by even limited length plugs is far in excess of that required by bounding safety assessments for the WIPP." The governing regulations for plugging and/or abandonment of boreholes are summarized in Table I-3.

The proposed repository sealing system design will prevent water from entering the repository and will prevent gases or brines from migrating out of the repository. The proposed design includes the following subsystems and associated principal functions:

- Near-surface: to prevent subsidence at and around the shafts
- Rustler Formation: to prevent subsidence at and around the shafts and to ensure compliance with federal and State of New Mexico groundwater protection requirements
- Salado Formation: to prevent transporting hazardous waste constituents from the WIPP repository beyond the unit boundary

The repository sealing system will consist of natural and engineered barriers within the WIPP repository that will withstand forces expected to be present because of rock creep, hydraulic pressure, and probable collapses in the repository and will meet the closure requirements of 20 NMAC 4.1, Subpart V. Appendix I2 presents the repository sealing system design basis and performance evaluations. The design in Appendix I2 is conceptual. The DOE is currently preparing a final seal design report. This report will be provided to the NMED by October 1, 1996. The design drawings that will be included in the final design report are included in Appendix I2. These drawings are stamped preliminary because the final peer review has not been conducted. These drawings, in their final form, will accompany the final design report.

Once shaft sealing is completed, the DOE will consider closure complete and will provide the NMED with a certification of such within 60 days.

I-1e(2)(f) Final Contouring and Revegetation

In the preparation of its Final Environmental Impact Statement (DOE, 1980), the DOE committed to restore the site to as near to its original condition as is practicable. This involves removal of access roads, unneeded utilities, fences, and any other structures built by the DOE to support WIPP operations. Provisions would be left for active post-closure controls of the site and for the installation of long-term markers and monuments for the purpose of permanently marking the location of the repository and waste. Section I-1e(3) discusses the active and long-term controls proposed for the WIPP. Installation of borehole seals are anticipated to take 12 months, shaft seals 52 months, and final surface contouring 8 months.

I-1e(2)(g) Closure, Monuments, and Records

A record of the WIPP Project shall be listed in the public domain in accordance with the requirements of 20 NMAC 4.1, Subpart V, §264.116. Active access controls will be employed for at least the first 100 years after final facility closure. In addition, a passive control system consisting of monuments or markers shall be erected at the site to inform future generations of the location of the WIPP repository (see "Permanent Marker Conceptual Design Report" [DOE, 1995b]).

Closure of the WIPP facility will contribute to the following:

- Prevention of the intrusion of fluids into the repository by sealing the shafts
- Prevention of human intrusion after closure
- Minimization of future physical and environmental surveillance

Detailed records shall be filed with local, state, and federal government agencies to ensure that the location of the WIPP facility is easily determined and that appropriate notifications and restrictions are given to anyone who applies to drill in the area. This information, together with land survey data, will be on record with the U.S. Geological Survey and other agencies. The federal government will maintain permanent administrative authority over those aspects of land management assigned by law. Details of post-closure activities are in Section I-2.

I-1e(3) Performance of the Closed Facility

20 NMAC 4.1, Subpart V, §264.601 requires that a miscellaneous unit be closed in a manner that protects human health and the environment. The following addresses the performance of the closed facility during the 30-year post closure period.

The principal barriers to the movement of hazardous constituents from the facility or the movement of waters into the facility are the halite of the Salado Formation (natural barrier) and the repository seals (engineered barrier). Data and calculations that support this discussion and presented The majority of the calculations performed for the repository are focused on long-term performance and making predictions of performance over 10,000 years. In the short term, the repository is reaching a steady state configuration where the hypothetical brine inflow rate is

affected by the increasing pressure in the repository due to gas generation and creep closure. These three phenomena are related in the numerical modeling.

I-1e(3)(a) Gas Generation

Gas generation affects repository pressure, which in turn is an important parameter in other processes such as creep closure, interbed fracture, and two-phase flow. The computer simulation of this process[5] uses an average-stoichiometry model to estimate the potential for gas generation in the waste disposal region. Parameter values for the average-stoichiometry gas generation model are summarized in Table I-4 and detailed in Appendix D16, §D16-5.

Gas generation processes considered in the simulation include anoxic corrosion and microbial degradation. Radiolysis is not included in the model on the basis of laboratory experiments and model calculations that demonstrate the process to be an insignificant gas generation mechanism compared to corrosion and biodegradation. For the purpose of calculating repository pressure and fluid flow, the properties of the generated gas are assumed to be those of H_2.

Specific to the simulation, anoxic corrosion of ferrous metals and microbial degradation of cellulosics, plastics, and rubbers is assumed to occur and generate gas at rates limited only by the availability of brine and solid reactants. Assuming that all cellulosics, plastics, and rubbers are available to degrade and participate in the gas generation process is a conservative assumption. This is because there are no reasonable mechanisms to mix microbes, moisture, cellulosics and nutrients in order to sustain degradation. Biodegradation is considered to have a 50 percent chance of occurring, primarily due to uncertainties in the long-term survival of microbes (Brush, 1995, pp. B-19 to B-24). These assumptions serve to maximize gas generation rates.

Anoxic corrosion is represented by an equation that accounts for corrosion only of the steel content in the repository by the two reactions expected to dominate corrosion rates. Because the total quantity of aluminum and aluminum alloys is a small fraction of the quantity of iron-based metals, corrosion of aluminum is omitted for simplicity. As corrosion proceeds the steel content of the repository is depleted over time. Brine is also consumed as gas generation proceeds. Effects of wicking (the retention of brine in a capillary fringe) on the corrosion gas generation rates are incorporated in the analysis through the use of a wicking parameter, as explained in Appendix D16, §D16-5. The DOE assumes no passivation of steel by interaction with microbial degradation reactions, a process capable of preventing anoxic corrosion. Important parameters in the corrosion equation are assigned fixed values, as summarized in Table I-4.

Similar to modeling anoxic corrosion, microbial degradation is represented by an equation with the inventory of cellulosics, plastic, and rubber material also depleted with time. Biodegradable materials are depleted at a rate dependent on the amount of liquid present. It is assumed that

[5]The DOE uses the code BRAGFLO to simulate repository. This code was developed by the Sandia National Laboratories specifically for the WIPP and is being used for the DOE's demonstration of compliance to long-term repository performance standards.

the microbial degradation process neither produces nor consumes water. Depending on parameter values, gas generation by microbial degradation in the computer simulation can continue until all degradable materials or available brine are consumed. Important parameters used to model microbial degradation are summarized in Table I-4 and discussed further in Appendix D16, §D16-5.

I-1e(3)(b) Brine Inflow

For the computer simulation used in this analysis, the DOE conceptualized the Salado as a porous medium composed of several rock types arranged in layers, through which fluid flow occurs according to Darcy's Law. This model was chosen because it can be simulated using standard numerical techniques and because it is the most conservative of the three mechanisms in that is predicts the maximum rate and cumulative volume of brine inflow. Two rock types, impure halite and anhydrite, are used to represent the intact Salado. Near the repository, the DRZ has increased permeability compared to intact rock and offers little resistance to flow between anhydrite interbeds and the repository. Except for the DRZ and anhydrite interbeds, under certain circumstances, this simulation assumes spatially constant properties for Salado rock types based on observations of compositional and structural regularity in layers exposed by the repository. The inference is that there is little variation in large-scale averages of rock or flow properties across the disposal system. Assumptions about Salado flow in general are presented in Appendix D16, §D16-6. This model serves to maximize the potential brine inflow to the repository.

Table I-5 shows various parameter values used in modeling the impure halite. Supported by four hydraulic tests in the WIPP underground believed to represent far-field conditions and stratigraphic variation in the Salado, the median value for permeability calculated for this region is 3.4×10^{-22} square feet (3.16×10^{-23} square meters [m^2]). Additional information on parameter values is contained in Appendix D16, §D16-6, including the distinction between rock compressibility and pore compressibility used in the simulation.

Gas may not be able to flow through or into intact, halite-rich strata of the Salado under realistic conditions for the repository. As halite is modeled as 100 percent brine saturated, the capillary resistance of the rock must be overcome to displace brine from pores and drive gas into the rock. This condition represents the concept of threshold pressure. While the permeability of halite is known to be low, its threshold pressure has never been measured. An empirical relationship between threshold pressure and permeability in non-WIPP rocks (Davies, 1991, pp.17–19) suggests that threshold pressure will be sufficiently high and gas will not be able to flow into the halite-rich strata of the Salado under any conditions foreseeable for the WIPP. Values used by the DOE for impure halite threshold pressure are set to prevent the flow of gas into this material. This is a conservative assumption, because gas flow into impure or pure halite would decrease the pressure in the repository and the driving force available for flow.

Three distinct anhydrite interbeds are modeled in the computer simulation representing MB 138, anhydrite layers a and b, and MB 139. The three interbeds are assigned identical parameter values, and these values are initially spatially constant. The interbeds differ only in stratigraphic location and thickness. The three interbeds are included in the model simulation, because they exist in the disturbed region around the repository within which fluid is expected to be able to

flow with relative ease compared to the surrounding formation. MB 139 and anhydrite layers a and b are present within the DRZ that forms around excavations; MB 138 may be above the DRZ, and is of no consequence during the post-closure period.

In the computer simulation, brine flows from the Salado and into the repository in response to fluid potential gradients that form over time. Due to the low permeability of the impure halite and relatively small surface area of the excavation, direct brine flow between the impure halite and the repository is limited. The interbeds, however, can serve as conduits for brine flow between the impure halite and the repository. Conceptually, brine flows laterally along higher-permeability interbeds towards or away from the repository and vertically between the interbeds and the lower-permeability halite. Because the interbeds have a very large contact area with adjacent halite-rich rock, even very small flux from the halite into the interbeds (for brine inflow) or to the halite from the interbeds (for brine outflow) can accumulate into a significant quantity of brine. In this manner, halite serves as a source or sink for brine in the repository. It is expected that, due to density differences between gas and brine and their stratification within the repository, brine outflow will dominate in underlying MB 139, and gas outflow will occur in anhydrite a and b or overlying MB 138. Parameters associated with the interbeds are shown in Table I-6.

I-1e(3)(c) Rock Properties

Creep closure is the focus of the computer model that implements the repository processes associated with rock properties in the repository rooms and the shafts. The amount of waste consolidation resulting from creep closure, and the time it takes to consolidate the waste, are governed by properties of the waste (waste strength), properties of the surrounding rock, the dimensions and location of the room, and the quantities and pressure of fluids present in the room. Creep closure of waste disposal areas will cause their volume to decrease as the Salado deforms to consolidate and encapsulate the waste, changing waste porosity and permeability. Waste strength and fluid pressure may act to resist creep closure.

Fluids that could affect closure are brine that may enter the repository from the Salado, air present in the repository when it is sealed, and gas produced by reactions occurring during waste degradation. Closure and consolidation slowed by fluid pressure in the repository can be quantified according to the principle of effective stress:

$$\sigma_T = \sigma_e + p \qquad (1)$$

where σ_T is the stress caused by the weight of the overlying rock and brine (an essentially constant value), p is the pressure of the repository pore fluid, and σ_e is the stress that is applied to the waste skeleton or matrix. In this formulation, the waste is considered a skeleton structure immersed in pore fluids. As the pore pressure increases, an increasing amount of overburden stress is supported by pore fluid pressure, and less overburden stress is supported by the strength of the waste matrix. Due to waste strength, waste consolidation can cease even if pore fluid pressures do not reach lithostatic. If gas and brine quantities in the repository stabilize, creep closure will act to establish a constant pressure and void volume.

Two material-response models are required for closure analyses within the disposal room. The first describes how the halite in the formation surrounding the waste deforms (creeps) as a function of time and stress. The second model describes the state of consolidation of the waste as a function of applied stress.

Halite deformation is predicted using a multimechanism deformation (M-D) steady-state creep model with workhardening/recovery transient response (Model 1). At the WIPP, there are potentially three distinct creep mechanisms involved, which are governed by the temperature and shear stress at a given location in the surroundings at any given time. WIPP conditions are expected to be isothermal so temperature is treated as a constant value. All three mechanisms can be active at the same time because of the large range of stress states that occur around underground rooms and shafts.

The focus of the mechanistic part of the model is definition of steady-state creep strain, with transient creep strain described through a multiplier on the steady-state rate, thus accommodating both transient changes in stress loading and loading. More information is presented in Munson et al. (1995).

The volumetric plasticity part of the model is the mathematical model for room closure and waste consolidation. The experimental data used in this model are summarized and interpreted in Butcher et al. (1991, pp. 65-76) and Luker et al. (1991). The volumetric plasticity model and M-D model are numerically implemented.

As a boundary condition, the computer code requires estimates of the fluid pressure and, hence, the initial quantity of gas present in a disposal room. These estimates are obtained using the average-stoichiometry model of gas generation with different rates of gas generation that reflect different assumptions about the quantity of brine that might be available in a waste disposal room. The different rates of gas generation used in the analysis bound the possible conditions for gas content in the repository. With the volumetric plasticity model and the fluid pressure boundary condition, the code calculates the void volume of the disposal room through time.

In the computer simulation, the time-dependent effects of creep closure on volume are linked to the fluid flow via a look-up table, which relates porosity or void volume to: a) time after sealing, and b) gas pressure. At the beginning of a time step, the fluid flow code evaluates the pressure of a cell in the waste disposal region. The code then consults the look-up table to find the void volume of the cell appropriate for a given time and pressure. The void volume in the cell is iteratively adjusted during a time step solution for consistency with gas generation, fluid movement, and repository pressure. The look-up table method of incorporating the dynamic effect of creep closure in the simulation has been compared to more complex techniques that are computationally impractical. In these comparisons, the porosity surface method was found to be a reasonable representation of behavior observed in more complex models. Parameter values used in the computer simulation for repository and panel closure are given in Appendix D16, Section D16-7.

The four shafts connecting the repository to the surface are represented in the computer simulation with a single shaft. This single shaft has a cross section and volume equal to the total cross section and volume of the four actual shafts and is separated from the waste disposal

region in the model by the true north-south distance from the waste to the nearest shaft (the Waste Shaft).

Seal component materials and properties used in the simulation are given in Table I-7. From top to bottom, the seal system is represented in the simulation by the following materials (see Appendix I2):

- an earthen fill region above the Rustler Formation
- a clay region in the Rustler Formation (designated Rustler Compacted Clay in Table I-7)
- an asphalt region at the top of the Salado
- three concrete sections (upper, middle, lower) within the Salado
- a thick section of compacted crushed salt within the Salado
- an upper compacted clay region within the Salado (designated Upper Salado Compacted Clay in Table I-7)
- a lower compacted clay region within the Salado (designated Lower Salado Compacted Clay in Table I-7)
- a basal clay component below MB 138 (designated Bottom Clay in Table I-7)
- a lower concrete section at the repository horizon (shaft station concrete monolith)

Conceptually, the simulation considers the maturation of the DRZ surrounding the shaft with respect to variation in the rate of DRZ healing with depth, time, and the type of adjacent seal material. For example, the DRZ in the halite adjacent to concrete members is assumed to heal very rapidly because of the rigidity of the concrete and the high lithostatic stress. Against less rigid seal components and at higher elevations in the shaft, the DRZ is assumed to heal more slowly. Depending on shaft material properties and depth of emplacement, the simulation also considers potential time-dependent consolidation.

To reflect shaft material consolidation and DRZ maturation, effective permeabilities of selected shaft regions are adjusted with time in a stepwise fashion (Table I-7). In some halite shaft regions enhanced flow is expected through the surrounding DRZ, before healing occurs. In this case, the increased permeability is modeled by increasing the permeability of the adjacent shaft seal component. In some cases, this adjustment acts to counteract the expected decrease in permeability resulting from consolidation. The increase in permeability noted for concrete from 1.8×10^{-19} to 10^{-14} m^2 is conservative; the permeability of concrete within the Salado section of the shaft is not expected to degrade to the permeability of silty-sand, and, in fact, physical and hydraulic properties of concrete seals are expected to remain stable over the long-term. Note that Appendix D16, §D16-8 lists only the initial permeability for shaft materials within the Salado and not the effective permeabilities calculated for each time step presented in Table I-7.

I-1e(3)(d) Contaminant Transport Calculations

A computer simulation of disposal system performance has been completed for the DOE's demonstration of no-migration. This simulation, along with supporting documentation, is due to be submitted to the EPA in June 1996. Those portions of the simulation that are applicable to the closed panel and sealed shaft configurations, are summarized here as background for the subsequent discussions of pathways and environmental protection and to support the DOE's demonstration of compliance with the environmental performance standards in 20 NMAC 4.1, Subpart V, §264.601.

The computer simulation for the no-migration determination was conducted to predict disposal system performance over 10,000 years. Only the first 300 years are discussed here. This period goes sufficiently beyond the post-closure period to depict trends in the calculations.

Caution should to be exercised in using this simulation for interpreting repository performance prior to shaft sealing and during the first 100 years of the simulation. This is due to several reasons:

- The simulation assumes higher gas generation rates than anticipated in order to assure sufficient gas is present to evaluate the disposal system performance.
- The simulation assumes anoxic conditions exist from the outset and the gas generation rates are those observed for anoxic conditions. It is anticipated that oxic conditions will prevail during the initial closure period, during which time there will likely be no gas generation.
- The model does not account for any dewatering of the DRZ that may have occurred during operations when the excavated surfaces were exposed to the ventilation system.
- The model assumes the repository is filled instantaneously.

These limitations notwithstanding, the modeling process and the results, along with the raw and interpreted data, are useful in the discussion of repository performance during the period covered by the hazardous waste permits. A summary of the output for the first 300 years is shown in Table I-8.

The conceptual model used in this simulation includes creep closure of the waste-disposal panels, a process that will act to consolidate waste in the disposal areas. The altered stress field created by the excavation will also result in a system of fractures surrounding the excavation and the shaft, referred to as a DRZ. The conceptual model considers brine inflow to the waste-disposal panels in response to pressure gradients created by the excavation. Opposing brine inflow is the pressure increase expected in the repository resulting from creep closure and waste-generated gas. In general pressure increases due to closure and gas generation, may retard consolidation of the waste region and cause brine and gas to migrate away from the repository. The conceptual model includes two-phase flow from the repository and dilation or fracturing of interbeds, a process capable of accelerating the mass transport of contaminants.

The primary software code used in the simulation is BRAGFLO (BRine And Gas FLOw). BRAGFLO calculates the overall movement of gas and brine in the disposal unit formations and defines the flow fields for contaminant migration post-processing codes. BRAGFLO also contains the submodels for estimating gas generation in the repository, disposal room closure and consolidation, and interbed fracturing. Changes in void volume of the waste resulting from creep closure are coupled to BRAGFLO through SANTOS, a code that provides a look-up table used as a reference to track changes in room volume.

Actual quantities of hazardous constituents in waste containers can only be approximated from available waste characterization data. Furthermore, actual quantities available for transport are controlled by both the waste form and hazardous constituent mobility or immobility in the post-closure environment. Mobility is in turn controlled by long-term physical and chemical processes (e.g., availability of transport media and release mechanisms). Given these constraints, this simulation defines the source term, where appropriate, as the maximum concentration of hazardous constituents in a particular phase.

For the sealed shaft configuration, weighted average concentration for each VOC is used as the source term concentration in cases where waste characterization data are available. Weighted headspace concentrations are corrected for void volume conditions expected in the repository. In cases where no waste characterization data are available, saturated vapor concentrations are used to represent source term concentrations for VOCs. Because waste characterization data are also not available for semi-volatile compounds, saturated vapor concentrations are also assumed for this class of organic constituents. Releases of gas to the soil is modeled, therefore soil-based concentrations are calculated assuming gas-available porosity within shaft seals and within anhydrite markers beds at the subsurface disposal unit boundaries and then compared to health based limits for soil.

The DOE concludes that an organic liquid-phase source term is required only if compliance cannot be demonstrated for organic gas-phase compounds using bounding calculations. For these bounding calculations, the assumptions of no partitioning between the gas and the liquid phases ensures that maximum concentrations are used for the gas-phase source term. Because organic constituents must partition into the liquid phase from the gas phase according to Henry's Law, the concentrations in the brine phase must be less than that for the gas phase. If compliance can be demonstrated for the organic gas phase, liquid-phase compliance is also demonstrated.

The simulation results presented in Figures I-7 to I-12 and discussed below are based on a conservative assumption of higher than expected gas generation rates. Gas generation is purposely modeled in this manner to maximize the potential for migration of brine and gas away from the repository and into the anhydrite interbeds and sealed shaft. The modeling approach implemented is conservative, based on the assumption that the entire inventory of ferrous metals, cellulosics, plastics, and rubbers in the waste is available to generate gas. No credit is taken for the 50 percent probability that biodegradation may not occur and result in lower gas generation rates.

The simulation indicates that average pressure in the waste disposal region increases with time (Figure I-7). The pressure increase is primarily attributed to gas being generated more quickly

than pressure can be relieved by fluids flowing out of the anhydrite layers or up the sealed shaft. Smaller contributions to the pressure build-up occur through reduction of void volume by creep closure. For the high gas generation conditions assumed, pressure rises rapidly from atmospheric pressure to about 725 lb/in.^{2} (5 MPa) over the first 100 years after shaft seal placement. The total amount of gas generated by biodegradation and by anoxic corrosion during 300 years is shown in Figure I-8. Approximately 420 moles of gas per drum are generated during the first 100 years.

The simulation shows that brine flows into the repository from the DRZ and the far field (Figure I-9). At the same time, the pore volume (void space) present in the repository is being reduced by creep closure, as shown in Figure I-10. Eighty-nine percent of the brine inflow occurs during the first 50 years, (562 m^3 of brine per panel). Total void volume in a panel decreases from 37,099 to 16,709 m^3 during the first 50 years. The closure rate subsequently slows. (The minimum pore volume is achieved after 1060 years.)

The average brine saturation in the panel is depicted in Figure I-11. The initial increase in brine saturation during the first 50 years is due to brine inflow, to rapid creep closure, and a sharp reduction in pore volume in the waste. Once the repository ceases to close, brine consumption due to corrosion causes brine saturation to decrease. Figure I-11 shows this transition as a sharp increase in average brine saturation to just above five percent (at 50 years) followed by a steady decrease.

The simulation indicates the consumption of ferrous metals occurs by corrosion (Figure I-12). Figure I-12 shows similar behavior involving consumption of the inventory of biodegradable materials. In order for biodegradation and corrosion to take place sufficient brine must be present to inundate the waste. However, microbial degradation is assumed to proceed at inundated rates even in the absence of brine. The moisture originally present in the waste, together with the brine flowing into the repository, are consumed by the ongoing corrosion but is not consumed by biodegradation processes. Both processes eventually are limited by the lack of brine and proceed at much lower rates. As noted earlier, the reduction in brine inflow (and resulting brine availability) is a direct consequence of the pressure increase from gas generation and creep closure.

The simulation indicates no brine leaving the waste disposal region during the post-closure period. This conclusion results from two factors. First, the pressure never gets high enough to drive brine or gas from the disposal zone. Second, a comparison of calculated brine saturation in the waste region (see Appendix D16, §D16-7) with the estimated residual brine saturation (S_{br}) of the waste. As described in Appendix D16, §D16-7, S_{br} is the brine saturation required to permeate the waste matrix sufficiently to create an incipient network of interconnected pores. Wetting phase relative permeability begins at the residual brine saturation; below this point, brine existing in the waste matrix remains immobile.

Appendix D16, §D16-7 discusses the bases for the residual brine saturation of the post-closure waste region. Essentially, this demonstration takes advantage of literature-based data of residual brine saturations measured for unconsolidated analog materials. As an analog, the waste region is initially unconsolidated; the degree of consolidation increases rapidly with decreasing pore volume relatively early into the simulation, as indicated in Figure I-10.

I-2 Post-Closure Plan

The post-closure care period begins after completion of closure of the first HWMU unit and continues for 30 years after final facility closure. The DOE's post-closure care period may be shortened or lengthened at the discretion of the NMED, based on evidence that human health and the environment are being protected or are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards applicable to the facility. During this period, the DOE will employ active institutional controls as necessary.

This post-closure plan focuses on activities following final facility closure. However, some discussion of post-closure following panel closure is warranted since some panel closures will occur long before final facility closure. As discussed in Section I-1e(1), panel closures have been designed to require no post-closure maintenance. The DOE has defined a post-closure care program for closed panels that has three aspects. These are routine inspection of the openings in the vicinity of the closures, the sampling of ventilation air for harmful constituents, and a VOC Confirmatory Monitoring Program. The rules of the Mine Safety Health and Administration drive the implementation of the first two programs. These rules require that underground mines monitor air quality to assure good breathing air whenever personnel are underground and that mine operators provide safe ground conditions for personnel in areas that require access. Routine monitoring of the openings in the access ways to panels will be continued and these openings will be maintained for as long as access into them is needed. This includes continued reading of installed geomechanical instrumentation, sounding the areas, visual inspection and maintenance activities such as scaling, mining, or bolting as required and as described in Section D-10d(1). In addition, all areas in the underground that are occupied by personnel are checked prior to each day's work activities for accumulations of harmful gases, including methane. Action levels for increasing ventilation to areas that show high levels of harmful gases are specified as described in Section F-4g.

These monitoring programs will be carried out during the period between the closure of the first panel and the initiation of final facility closure for the underground facility. The DOE has prepared a VOC Confirmatory Monitoring Plan (VCMP) which will be implemented to confirm that the assumptions and predictions used to demonstrate compliance to the environmental performance standards are valid. Validity is shown when observed emissions are equal to or less than those predicted. The VCMP is provided in Appendix D20. The VCMP includes monitoring design, sampling and analysis procedures and quality assurance objectives. This plan is submitted in compliance with 20 NMAC 4.1, Subpart V, §264.602 and §270.23(a)(2).

In this application, the DOE demonstrates the theoretical compliance with the environmental performance standards of 20 NMAC 4.1, Subpart V, §264.601(c). This VCMP describes a sampling and analysis program to confirm the theoretical calculations. The monitoring program is capable of quantifying VOC concentrations in the ambient mine air at the WIPP. The VCMP addresses the following information requirements:

- Rationale for the design of the monitoring program, based on possible pathways, operations, engineered and natural barriers, and monitoring locations optimized for detection.

- Descriptions of the specific elements of the monitoring program including the type of monitoring, the location of stations, the frequency of sampling, the target analytes, the schedule for implementation, the equipment used, the sampling and analytical techniques, and the data recording and reporting procedures.

The DOE's intent is to collect air samples upstream and down stream of Panel 1 beginning just prior to waste emplacement and proceeding until at least six months following completion of panel closure. The DOE will continue monitoring until the criterion for terminating monitoring are met. These criterion are established in Appendix D20 for each target analyte.

The current VOC monitoring program uses EPA Compendium Method TO-14. The DOE has had success with TO-14 at the WIPP if care is taken in placing sampler to avoid high dust and if stringent cleaning requirements are imposed for the clean canisters. This is necessary because of the extremely low concentrations that are being monitored. The DOE is evaluating the use of the Fourier Transform Infra-Red (FTIR) technique for monitoring VOCs at WIPP. This method is being used successfully at other locations and has recently been approved by the EPA for measuring the concentration of VOCs in the headspace gases of drums of TRU waste. If FTIR becomes viable, the monitoring plan will be revised and the revisions will be submitted to the NMED for approval prior to implementation.

The VCMP will be run under a Quality Assurance Plan that conforms to the document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations". Quality Assurance criteria for the target analytes are presented in Table D-10. Definitions of these criteria are given in Appendix D20 along with a discussion of other aspects of the Quality Assurance Program including sample handling, calibration, analytical procedures, data reduction, validation and reporting, performance and system audits, preventive maintenance, and corrective actions.

I-2a Post-Closure Plan after Final Facility Closure

A number of regulations deal with the period of time that begins once the WIPP has undergone final facility closure and decommissioning. Under 40 CFR Part 191, the period consists of an active control period and a passive control period; only 100 years of the active control period can be used in performance assessment. Under the no-migration standard in 40 CFR §268.6, the EPA is interested in the measures the DOE will take in terms of long-term passive institutional controls "...such as land withdrawal, records, and markers--to ensure that the likelihood of human intrusion is appropriately reduced, even after active control of the facility has ceased and any permits at the site may have terminated." (EPA, 1990) The Land Withdrawal Act (LWA) of 1992 requires that the DOE prepare and submit a post-decommissioning land management plan. 20 NMAC 4.1, Subpart V, §264.117 requires post-closure care, including monitoring, security, and property use. Because of the numerous regulations, the DOE has prepared a single strategy for post-closure management of the WIPP. This strategy consists of three elements: 1) active controls, 2) monitoring, and 3) passive controls. Although only the first and second elements occur within the post-closure period covered by this permit, all three elements are described.

I-2a(1) Active Institutional Controls

Once a facility is decommissioned, positive actions (referred to as "active institutional controls") should be taken to assure proper maintenance and monitoring. The EPA, in 40 CFR Part 191, §191.14(a) has specified that active controls should be maintained for as long as practicable and that no more than 100 years of active institutional control can be assumed in predictions of long-term performance. This assumption assures that future protection and control does not rely on positive actions by future generations.

The DOE's active institutional control program has a primary objective of addressing all applicable requirements, including restoring the WIPP site as nearly as possible to its original condition, and thereby equalizing any preference over other areas for development by humans in the future. Restoration of the WIPP site includes any necessary remedial actions or cleanup of releases resulting from decommissioning. In addition, as part of the active institutional control program, the DOE will implement monitoring systems suitable for assessing disposal system performance if such monitoring is feasible.

The DOE currently plans to implement the active institutional control program in five steps, each of which are described in more detail below:

Step 1 - Identification of Active Institutional Control Measures

The first step in the process of implementing the active institutional control program is to identify measures needed to satisfy the active institutional control requirements. It is anticipated that certain characteristics of active institutional control measures, such as minimizing bias toward the site, warning of potential hazards, providing meaningful data, preserving knowledge, using state-of-the-art technology, implementing such measures for at least 100 years, addressing the standards, and deterring systematic development, will be identified and used to judge the usefulness of active institutional control programs.

A detailed explanation of the active institutional controls selected by the DOE as part of this first step is provided in Appendix I4, entitled WIPP Active Access Controls after Disposal, Design Concept Description. This is the DOE's reference design for active institutional controls. The reference design will be reviewed periodically and updated as appropriate during WIPP disposal operations. The ongoing review and evaluation ensure that the active institutional controls implemented are appropriate for the conditions that may exist at that time. The DOE will review the reference design prior to implementation and all affected regulatory agencies will be consulted as part of this review.

As part of the active institutional controls program, the DOE has developed a set of design criteria upon which the reference design is based. These design criteria provide a description of how the active institutional controls will be implemented. These are as follows:

- A fence line shall be established to control access to the repository's footprint area (the waste disposal area projected to the surface). A standard wire fence shall be erected along the perimeter of the repository surface footprint. The fence shall have gates placed approximately midway along each of the four sides.

- An unpaved roadway along the perimeter of the barbed wire fence shall be constructed to provide ready vehicle access to any point around the fenced perimeter, to facilitate inspection and maintenance of the fence line, and to permit visual observation of the repository footprint to the extent permitted by the lay of the land. This roadway shall connect to the paved south access road.

- To ensure visual notification, the fence line shall be posted with signs having as a minimum, a legend reading "Danger—Unauthorized Personnel Keep Out" and a warning against entering the area without specific permission of the DOE (or other local authority such as the Eddy County Sheriff's Office).

- Contractual arrangements shall be developed to ensure that periodic inspection and necessary corrective maintenance is conducted on the fence line, its associated warning signs, and the roadway. The DOE will maintain control over all contractual work and will maintain, in the operating record, the results of all inspections and maintenance activities.

- Through direct DOE staffing support and/or contractual arrangements, procedures shall be established to provide routine periodic patrols and surveillances of the protected area by personnel trained in security surveillance and investigation.

- Processes will be developed for monitoring and controlling the long-term testing requirements of the PMS.

- Processes will be developed for implementing the periodic monitoring requirements of the disposal system's monitoring program. Initially, the procedures currently in place in such documents as the Environmental Monitoring Plan (DOE, 1994) will be used.

- Recommendations will be developed for modifications to the active institutional controls appropriate for access control and surveillance upon installation of the PMS.

- Guidelines will be developed for recommending mitigating actions to be taken to address any abnormal conditions identified during periodic surveillance and inspections.

- Reports of activities associated with the post-disposal active access controls shall be prepared in accordance with regulatory requirements for submittal to the appropriate regulatory and legislative authority.

Details on meeting these criteria are found in Appendix I4.

Step 2 - Preparation of a Post-Decommissioning Land Management Plan

Section 13(b) of the LWA requires the DOE to prepare and submit by October 30, 1997, a plan for managing the land withdrawal area after decommissioning the WIPP facility. This plan will include a description of both the active and passive institutional controls that will be imposed

after decommissioning is complete. This plan will be prepared in consultation with the Department of Interior and the state of New Mexico.

Step 3 - Gathering of Data Necessary for Implementing Active Institutional Control Measures

It may be useful to gather additional data to support implementation of the referenced Active Institutional Control Design. This includes an ongoing assessment of conditions that could affect active institutional controls. Information regarding land use and population trends gathered during the Disposal Phase will be taken into account in implementing post-closure surveillance.

Step 4 - Preparation of the Active Institutional Control Plan

An active institutional control plan will be prepared as part of the overall site D&D strategy. This will be done in accordance with a written plan, which will be initiated prior to actual plant closure, and will contain all the information needed to implement the active and passive institutional controls for the WIPP facility. Active institutional control planning will be based on the reference design and will take into account the most current information regarding the facility and its vicinity and will make use of state-of-the-art materials and techniques. This plan will include acceptable decontamination levels, sampling and analysis plans, and QA/QC specifications.

Step 5 - Implementation of Active Institutional Control Measures

Most of the active institutional control measures, such as long-term site monitoring and site remedial actions, will be implemented simultaneously with decommissioning. However, it may be possible to implement some measures earlier. For example, salt disposal may begin prior to final plant closure. Reclamation and restoration of unused disturbed surface areas has already begun. Guarding and maintenance activities, which are already in place, could evolve into an appropriate type of post-closure activity.

I-2a(2) Monitoring

Because the WIPP is a mined geological repository that is designed to permanently isolate contaminants, no post-closure monitoring for the detection of releases is needed since the migration of contaminants is unlikely during the disposal and Post-Closure Care Periods. This is substantiated by the analysis of closure system performance as described in Section I-1e(6). However, the NMED has indicated that it is their policy to require the DOE to perform groundwater monitoring regardless of whether or not the WIPP is eligible for a groundwater monitoring waiver. Because of this, the DOE has prepared a post closure groundwater monitoring plan for implementation after the completion of final facility closure. Post-closure groundwater monitoring will involve a continuation of the monitoring plan in Appendix D18 as described in Section D-10d(1)(a). The frequency will be changed to biannually after final facility closure is complete. In addition, the final target analyte list shown in Table D-12 may be adjusted based on final volume of waste.

I-2a(3) Passive Institutional Controls

Passive institutional controls include markers that warn of the presence of buried nuclear waste and identify: 1) the boundary of the disposal area footprint, 2) external records about the WIPP repository, and 3) continued federal ownership.

Passive institutional controls, as opposed to active institutional controls, are controls that once established, can be expected to remain effective with minimal human surveillance and maintenance, or maintenance resulting from normal governmental activities. Passive controls may be instituted at the site, a remote location, or both.

With regards to passive controls, the DOE interprets the phrase "federal ownership and regulations regarding land or resource use" to mean that the DOE or some successor agency with nuclear waste management expertise will retain administrative control over the land. "Administrative control" means that the federal agency responsible for the land will institute regulations that impose appropriate restriction on land use and development. Regarding the WIPP facility, the DOE interprets the term "markers" to include any on-site structures engineered and constructed as a means of preserving knowledge of the location of the wastes and conveying associated hazards. The DOE interprets "records" to include any written information regarding the site and its contents, which are maintained to preserve knowledge of the site. The DOE intends to use passive institutional controls (ownership, markers, and records) throughout the entire controlled area.

In the proposed No-Migration Determination for the WIPP facility (EPA, 1990), the EPA discussed the use of passive controls as part of an overall strategy to protect a land disposal facility and to decrease the likelihood of human disruption. The EPA believes that, in the context of RCRA no-migration variance decisions, the question of human intrusion, either during operations or after closure, is best addressed through a consideration of the likelihood of intrusion, and the imposition of controls to make such intrusions unlikely events. The EPA emphasizes that this approach to human intrusion is consistent with its general approach under RCRA, both in permitting and variances. Under RCRA, the EPA typically relies on institutional controls (both active and passive) imposed through general regulatory standards and site-specific conditions (e.g., in RCRA permits) to ensure that access to a hazardous waste disposal site is appropriately restricted. The EPA believes that any permanent no-migration variance for the WIPP will have to impose long-term passive institutional controls, such as land withdrawal, records, and markers—to ensure that the likelihood of human intrusion is appropriately reduced, even after active control of the facility has ceased and any permits at the site may have terminated.

The DOE is committed to retaining control over the WIPP site for as long as possible. Accordingly, an extensive system of explanatory markers and records will be instituted to warn future generations about the location and dangers of these wastes. The agency assumed that society in general will retain knowledge about these wastes and that future societies should be able to deter systematic or persistent exploitation of a disposal site.

The objective of the DOE's passive institutional control program for the WIPP is to accomplish the following:

- Ensure a record of the disposal site and its contents are preserved
- Warn those who attempt to enter the disposal site vicinity of the hazards associated with activities that would disturb the subsurface

The DOE believes that passive institutional controls will render human intrusion sufficiently unlikely so that the possibility need not be included in the long-term performance calculations.

A substantial amount of work has been completed in the area of passive institutional controls at the WIPP facility.

- *DOE Ownership.* The DOE has been successful in gaining control of the entire surface of the 16-section WIPP site and the entire subsurface, except for Section 31 where DOE control extends over the surface and the first 6,000 feet (ft) (1,829 meters [m]) of the subsurface, including the acquisition of oil, gas, and potash leases. The area now under the control of the DOE includes the following sections in Township 22 South, Range 31 East: 15, 16, 17, 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32, 33, and 34.

- *Land Use Controls.* Land use controls have been implemented addressing allowable uses of the withdrawal area.

Beyond land ownership and implementation of use controls, which are the key preclosure passive controls, there are six steps that have been identified for the WIPP passive institutional control program.

<u>Step 1 - Definition of Passive Institutional Controls Appropriate for the WIPP</u>

The process of defining the passive institutional controls for the WIPP disposal site is based on the controls identified in 40 CFR Part 191, §191.12. This includes items such as records, markers, monuments, legal documentation, federal control, land use restrictions, and other methods of preserving knowledge.

The current conceptual design for post-closure passive institutional controls is described in the Permanent Marker Design Report (DOE, 1995b). The design includes:

- Large surface monuments and earthen structures to mark the repository footprint
- One or more on-site buried rooms for the long-term storage of messages describing the nature of the repository
- Small subsurface markers
- Off-site archival storage of information pertaining to the WIPP, including its potential hazards

Shaft-Location Markers

The controlled area will be identified by these passive institutional controls. Markers showing the locations of shafts will consist of permanent surveyor markings engraved with the site elevation and coordinates. The markers will be firmly anchored to the shaft plug and will also contain site description, date of closure, land survey data, and other information required by applicable regulations. A uniform system of coordinates will be adopted. The definitions of these coordinates will be included in the permanent records.

Permanent Marker System

A PMS designed to minimize the possibility of inadvertent human intrusion into the repository over the long-term, following the cessation of active controls, will be implemented at the WIPP facility. The PMS will be comprised of messages, surface monument markers, small subsurface warning markers, on-site rooms for long-term storage of messages, archival storage of WIPP information off-site, and large earthen structures marking the WIPP repository footprint on the surface. The PMS is still in the conceptual design process and will evolve prior to closure, based on activities to test marker effectiveness during disposal, decommissioning, and active access controls periods. Actual construction of the PMS will be completed 100 years following closure of the WIPP facility, in accordance with WIPP Active Access Controls After Disposal Design Concept Description (March 1995b).

The PMS will provide a durable record of the repository's existence, and its design will provide reasonable assurance that it will endure for at least 10,000 years. The system will be clearly visible from any portion of the repository's surface footprint. The current PMS design basis, proposed for detailed design, consists of a large earthen berm enclosing the perimeter of the repository's surface footprint. The design basis for the berm is for a minimum width of 100 ft (30 m) and a height of 31 ft (10 m), with a 1.3 horizontal to 1.0 vertical slope. The berm would be designed to provide a dielectric or magnetic anomaly when compared to the local surface characteristics. Large monoliths would be arranged just inside the berm. The number of monoliths would be sufficient to allow future generations to reconstruct monolith orientation with several monoliths missing. An information center would be placed at the center of the monoliths, and two storage rooms would be buried about 20 ft (6 m) below the footprint. The PMS components will be designed and constructed to resist erosional and depositional effects. Construction materials will be selected for durability under the local climatic conditions and the predicted changes to those conditions in the long term.

Monuments will be engraved with the most critical warning information in a concise format, inscribed to a minimum depth of 0.5 inches (1.3 centimeters). More detailed information regarding the repository content, caution against intrusion, and the time of emplacement will be provided in protected vaults buried underground and in a surface information center. The information will be provided in multi-language translation and will include an assortment of symbols, pictographs, and diagrams to convey danger of intrusion. Universal symbols will enhance the likelihood of understanding by people of different backgrounds. To minimize the likelihood of future salvaging, the marking system will use materials with as little intrinsic value as is reasonable.

Subsurface markers would be less than 2 ft (0.6 m) in the longest dimension, made of inert material, and spaced so that they are likely to be discovered by drilling crews and professional archaeologists. The warning message would be engraved so that slight erosion or fracture of the marker would not render it completely unintelligible. In addition, the markers would be buried at a greater depth than that used for plowing/tilling operations or for amateur archaeological excavation, so that such activities would be unlikely to disturb them. Further details on the subsurface markers may be obtained from the WIPP Active Access Controls After Disposal Design Concept Description (March 1995b).

Written Records

Written documentation of the WIPP will be placed in local, state, and federal agencies. Documentation will also be provided to international entities and commercial organizations that act as resource information centers for the petroleum and gas industries. Records will use the most stable and durable media available at the time that the record deposits are made. These records will describe the location of the repository; the nature and hazard of the waste; the geologic, geochemical, and hydrologic data pertinent to waste containment; and environmental monitoring data from preoperational baseline and summaries of data collected during D&D activities. Overall record selection for storage at the agencies selected will be in accordance with federal, state, and local regulations.

Specific documents which will be included in the archived information portfolio include:

- Detailed maps describing the exact location of the repository
- The SAR and the addenda which describes the disposal phase of the WIPP
- The Final Environmental Impact Statement for WIPP and the Supplement(s) to the Environmental Impact Statement
- The No-Migration Variance Petition and the No-Migration Determination for Disposal
- The RCRA Permit
- The Certification of Compliance with 40 CFR Part 191 and associated application
- Environmental and ecological background data collected during the preoperational phase of WIPP and summaries of data collected during the disposal and decommissioning phases of WIPP
- Records of the waste containers' contents and disposal locations within the WIPP repository
- Drawings defining the construction and configuration of the repository and shafts

- Drawings, procedures, and the design report(s) describing how the waste was emplaced; how the repository was decommissioned, closed and sealed; and how the shafts were sealed

The organization identified as the record holder responsible for the permanent storage of this information is the National Archives. In addition, other locations for this information will include publicly funded organizations which may expend the resources necessary to preserve the documents in well-controlled environments. However, the most likely strategy for long-term protection of the information is through widespread distribution. The information will be submitted to the following facilities and organizations for archiving:

- Library of Congress

- Within the states of New Mexico and Texas

  - The state archives
  - The state library
  - The city libraries of population centers exceeding 15,000 within 150 miles of Carlsbad

- The state libraries of the remaining 48 states

- The local office of the Bureau of Land Management

- The local office of the Bureau of Mines

- The local office of the Bureau of Reclamation

- The national library and national archives of the nations worldwide which possess nuclear weapons and/or operate nuclear power generating plants

- The archive of the United Nations

- The national archive and libraries of the signatory nations to the nuclear non-proliferation treaty

- The U.S. Nuclear Regulatory Commission

- The 53 federal regional depository libraries

- The American Nuclear Society

This list of receiving organizations will be reviewed and expanded, as appropriate, as the time of the actual transfer of the information approaches.

Location and hazards information will be submitted to various federal and state of New Mexico mapping agencies to ensure that the WIPP location and drilling or mining restrictions are

identified on widely distributed maps used by almost all public and private organizations. These agencies include:

- Bureau of Land Management
- U.S. Geological Survey
- Library of Congress
- National Archives and Records Service
- Defense Mapping Agency
- International Boundary Commission
- Federal Highway Administration
- New Mexico State Highway Department Planning and Research Division, Cartography Section

To ensure widespread of location information on the WIPP site and the hazards associated with the emplaced waste, detailed maps and descriptions of the hazardous material will be sent to national and international professional societies of cartographers and geographers. Weitzberg (1982) suggests the following organizations and societies receive this location and hazards information:

- The American Congress on Surveying and Mapping
- The American Society of Cartographers
- The Commission for the Geological Map of the World
- The International Cartographic Association
- The American Geographical Society
- The Association of American Geographers
- The International Geographical Union
- The Society of Women Geographers
- The American Geological Institute
- The American Geophysical Union
- The American Society of Professional Geographers

- The National Geographic Society
- The Federal Aviation Administration

Step 2 - Development of a Passive Institutional Control Implementation Plan

Once the appropriate passive institutional controls have been defined, a strategy will be prepared that includes final design, construction, and implementation. The strategy will identify site-specific information needs and approaches to obtaining needed technical and non-technical information.

There are some passive institutional control activities that can be implemented prior to the end of operations. For example, once wastes are permanently placed in the repository, appropriate notations can be made in land records.

Step 3 - Design and Implementation of Pre-decommissioning Passive Controls

Pre-decommissioning passive controls, such as land records, will be implemented and evaluated to the extent possible. For example, the effectiveness of DOE's land management plans will be assessed periodically to assure only acceptable land use is in effect. Closure records and plots for panel closures will be filed with Eddy County, New Mexico.

Step 4 - Implementation of Programs to Collect Needed Information

Programs may be necessary to support implementation of passive institutional control activities with site-specific information.

Planned Evaluations. Upon closure of the WIPP at the conclusion of the Disposal Phase, active controls will be implemented to control access to the site. In addition, monitoring systems will be managed to detect significant deviations in repository performance. With active control provided over the site, the schedule for construction of the PMS is a management option which could be extended for decades. In that the design of the PMS has a 10,000-year lifetime goal, it is prudent that the DOE conduct some testing of the construction materials planned for use as permanent marker material.

Berms. One aspect of the testing is the construction of a section of the berm. The overall size (height and width) of the test section of the berm will match the design of the permanent marker berm. However, the test berm length will be shorter than the full-sized berm. A section approximately 164 to 328 ft (50 to 100 m) long will be sufficient to test a number of different configurations. Included within the test section will be varying thicknesses of the salt core, the caliche layer, and the top layer of riprap and soil material. The DOE will construct a section of the berm for the purpose of evaluating materials and construction techniques. Actual construction and testing will be initiated during the Disposal Phase to provide sufficient time for testing.

Monuments. Another aspect of passive institutional controls to be evaluated during testing is monuments. The major considerations that will be evaluated include the following:

- Procuring, shipping, erecting test monuments, and evaluating long-term environmental effects of wind, rain, and shifting sand for various types of dimensional stone
- Evaluating the magnetic signature provided by sample permanent magnets buried within the berm to determine optimum locations and spacing
- Evaluating the affects of various soils used as protective backfill for dimensional stone
- Evaluating the effects of chemical interaction with the backfill material
- Evaluating the environmental effects on the berm caused by wind, rain, and shifting sand
- Evaluating the effects of plant root intrusion into the berm and potential for salt dissolution and berm slumping
- Evaluating the effectiveness of sample radar reflectors buried within the berm at various distances

Messages. Messages will also need to be evaluated during the testing program. The primary aspects of the messages program to be evaluated include the following:

- Evaluation of message text by presenting it to groups indigenous to the countries whose language is represented in the message
- Evaluation of message text by presenting it to linguists to assess the likelihood that the messages will continue to be understood through time

Step 5 - Design of Post-Decommissioning Passive Institutional Controls

This activity will use results derived from information gathering programs to make final decisions on passive institutional control measures. Passive institutional control implementation plans will be included as a portion of the WIPP long-term protection strategy and will include maintaining federal ownership, markers and monuments, surface modifications and controls, permanent written records, legal records, and land use identification and restriction.

Step 6 - Implementation of Post-Decommissioning Passive Institutional Controls

The final step involves constructing and installing the post-decommissioning passive institutional control measures. Additionally, a system for reviewing and approving the markers and other passive measures would be established.

I-3 Notices Required for Disposal Facilities

I-3a Certification of Closure

Within 60 days after completion of closure activities for an HWMU, the DOE will submit to the Secretary of the NMED, via certified mail, a certification that the unit (or, at final closure, the

facility) has been closed in accordance with the specifications of this Closure Plan. The certification will be signed by the cognizant DOE Manager and by an independent registered professional engineer. Documentation supporting the independent registered engineer's certification will be furnished to the Secretary of the NMED with the certification.

I-3b Survey Plat

Within 60 days of closure activities for an HWMU or within 60 days of final facility closure, the DOE will submit to the Secretary of the NMED, via certified mail, a survey plat indicating the location and dimensions of hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat will be prepared and certified by a professional land surveyor and will contain a prominently displayed note that states the DOE's obligation to restrict disturbance of the hazardous waste disposal unit. In addition, the land records in the Eddy County Courthouse, Carlsbad, New Mexico, will be updated through filing of the final survey plats.

I-3c Post-Closure Certification

Within 60 days of completion of the post-closure care period for each hazardous waste disposal unit and for final facility closure, the DOE will submit to the Secretary of the NMED, via certified mail, documentation that post-closure care was performed in accordance with the specifications of the approved post-closure plan. The certification will be signed by the cognizant DOE Manager and by an independent registered professional engineer. Documentation supporting the independent registered engineer's certification and a copy of the certification will be furnished to the Secretary of the NMED.

I-3d Post-Closure Notices

Within 60 days after certification of closure of each hazardous waste disposal unit or final facility closure, the DOE will submit to the Secretary of the NMED, and other applicable local and federal government agencies, a record of the type, location, and quantity of hazardous wastes disposed of in the disposal unit of the facility. Plans exist for extensive archiving of records beyond those required in 20 NMAC 4.1, Subpart V, §264.119. These are discussed in I-2a(3).

I-4 Closure Cost Estimates

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide cost estimates for closure actions.

I-5 Financial Assurance Mechanism for Closure

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide financial assurance mechanisms for closure actions.

I-6 Post-Closure Cost Estimate

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide cost estimates for post-closure actions.

I-7 Financial Assurance Mechanism for Post-Closure Care

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide financial assurance mechanisms for post-closure actions.

I-8 Liability Requirement

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide liability insurance.

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TABLES

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TABLE I-1
ANTICIPATED EARLIEST CLOSURE DATES FOR THE UNDERGROUND HWMUS

HWMU	OPERATIONS START	OPERATIONS END	CLOSURE START	CLOSURE END
PANEL 1	7/98	1/01	2/01	6/01
PANEL 2	1/01	7/03	8/03	12/04
PANEL 3	7/03	1/06	2/06	6/06
PANEL 4	1/06	7/08	8/08	12/09
PANEL 5	7/08	1/11	2/11	6/11
PANEL 6	1/11	7/13	8/13	12/14
PANEL 7	7/13	1/16	2/16	6/16
PANEL 8	1/16	7/18	8/18	12/19
PANEL 9	7/18	1/21	2/21	SEE NOTE 4
PANEL 10	1/21	7/23	8/23	SEE NOTE 4

NOTE 1: Only Panels 1 to 3 will be closed under the permit covered by this application. Closure schedules for Panels 4 through 10 are projected assuming new permits will be issued in 2005 and 2015.

NOTE 2: The point of closure start is defined as 60-days following notification to the NMED of closure.

NOTE 3: The point of closure end is defined as 180-days following placement of final waste in the panel.

NOTE 4: The time to close these areas may be extended depending on the nature and extent of the disturbed rock zone. The excavations that constitute these panels will have been opened for as many as 40 years so that the preparation for closure may take longer than the time allotted in Figure I-2. If this extension is needed, it will be requested as an amendment to the Closure Plan.

TABLE I-2
ANTICIPATED OVERALL SCHEDULE FOR CLOSURE ACTIVITIES

ACTIVITY	FINAL FACILITY CLOSURE	
	START	STOP
Notify NMED of Intent to Close WIPP (or to Implement Contingency Closure)	August 2023	N/A
Perform Contamination Surveys in both Surface Storage Areas	August 2023	February 2024
Sample Analysis	October 2023	May 2024
Decontamination as Necessary of both Surface Storage Areas	April 2024	November 2024
Final Contamination Surveys of both Surface Storage Areas	December 2024	July 2025
Sample Analysis	April 2025	November 2025
Prepare and Submit Container Management Unit Closure Certification	December 2025	March 2026
Dispose of Closure-Derived Waste	September 2023	November 2024
Closure of Open HWMU Panel	December 2024*	July 2025
Install Borehole Seals	August 2025	July 2026
Install Repository Seals	April 2026	July 2030
Recontour and Revegetate	August 2030	March 2031
Prepare and Submit Final (Contingency) Closure Certification	August 2030	March 2031
Post-closure Monitoring	May 2031	N/A

N/A--Not Applicable
Refer to Figures I-3 and I-4 for precise activity titles.

*This assumes the final waste is placed in this unit in November 2024 and notification of closure for this HWMU is submitted to the NMED in October 2024.

TABLE I-3
GOVERNING REGULATIONS FOR BOREHOLE ABANDONMENT

Federal or State Land	Type of Well or Borehole	Governing Regulation	Summary of Requirements
Both	Groundwater Surveillance	State and federal regulation in effect at time of abandonment	Monitor wells no longer in use shall be plugged in such a manner as to preclude migration of surface runoff or groundwater along the length of the well. Where possible, this shall be accomplished by removing the well casing and pumping expanding cement from the bottom to the top of the well. If the casing cannot be removed, the casing shall be ripped or perforated along its entire length if possible, and grouted. Filling with bentonite pellets from the bottom to the top is an acceptable alternative to pressure grouting.
Federal	Oil and Gas Wells	40 CFR Part 3160, §§ 3162.3-4	The operator shall promptly plug and abandon, in accordance with a plan first approved in writing or prescribed by the authorized officer.
Federal	Potash	40 CFR Part 3590, § 3593.1	(b) Surface boreholes for development or holes for prospecting shall be abandoned to the satisfaction of the authorizing officer by cementing and/or casing or by other methods approved in advance by the authorized officer. The holes shall also be abandoned in a manner to protect the surface and not endanger any present or future underground operation, any deposit of oil, gas, or other mineral substances, or any aquifer.
State	Oil and Gas Well Outside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Rule 202 (eff. 3-1-91)	B. Plugging (1) Prior to abandonment, the well shall be plugged in a manner to permanently confine all oil, gas, and water in the separate strata where they were originally found. This can be accomplished by using mud-laden fluid, cement, and plugs singly or in combination as approved by the Division on the notice of intention to plug. (2) The exact location of plugged and abandoned wells shall be marked by the operator with a steel marker not less than four inches (4") in diameter, set in cement, and extending at least four feet (4') above mean ground level. The metal of the marker shall be permanently engraved, welded, or stamped with the operator name, lease name, and well number and location, including unit letter, section, township, and range.
State	Oil and Gas Wells Inside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Order No. R-111-P (eff. 4-21-88)	F. Plugging and Abandonment of Wells (1) All existing and future wells that are drilled within the potash area, shall be plugged in accordance with the general rules established by the Division. A solid cement plug shall be provided through the salt section and any water-bearing horizon to prevent liquids or gases from entering the hole above or below the salt selection. It shall have suitable proportions—but no greater than three (3) percent of calcium chloride by weight—of cement considered to be the desired mixture when possible.

TABLE I-4
AVERAGE-STOICHIOMETRY GAS GENERATION MODEL PARAMETER VALUES

Parameter (units)	Values Used in Calculation[a]
Inundated Corrosion Rate for Steel without CO_2 Present (m/s)	7.94×10^{-15}
Inundated Corrosion Rate for Steel with CO_2 Present (m/s)	1.03×10^{-13}
Humid Corrosion Rate for Steel	0
Gas Generation Rate for Microbial Degradation Under Humid Conditions (mol/kg * s)	6.34×10^{-10}
Gas Generation Rate for Microbial Degradation under Brine-Inundated Conditions (mol/kg * s)	4.92×10^{-9}
Factor β for Microbial Reaction Rates (unitless)	0.5
Anoxic Corrosion Stoichiometric Factor X (unitless)	1.0
Average Density of Cellulosics in CH Waste (kg/m^3)	54.0
Average Density of Cellulosics in RH Waste (kg/m^3)	17.0
Average Density of Iron-Based Materials in CH Waste (kg/m^3)	170.0
Average Density of Iron-Based Materials in RH Waste (kg/m^3)	100.0
Average Density of Plastics in CH Waste (kg/m^3)	34.0
Average Density of Plastics in RH Waste (kg/m^3)	15.0
Average Density of Rubber in CH Waste (kg/m^3)	10.0
Average Density of Rubber in RH Waste (kg/m^3)	3.3
Bulk Density of Iron Containers, CH Waste (kg/m^3)	139.0
Bulk Density of Iron Containers, RH Waste (kg/m^3)	2.59×10^3
Bulk Density of Plastic Liners, CH Waste (kg/m^3)	26.0
Bulk Density of Plastic Liners, RH Waste (kg/m^3)	3.1
BIR Total Volume of RH Waste (m^3)	7.08×10^3
BIR Total Volume of CH Waste (m^3)	1.69×10^5
Wicking Saturation (unitless)	0.5

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, §D16-5

TABLE I-5
SALADO FORMATION HALITE PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
Permeability (m^2)	3.16×10^{-23}
Effective Porosity (%)	1.0
Threshold Pressure, P_t (Pa)[b]	3.41×10^{7}
Residual Brine Saturation, S_{br} (unitless)[c]	0.3
Residual Gas Saturation, S_{gr} (unitless)[c]	0.2
Pore Distribution, λ (unitless)[c]	0.7
Maximum Capillary Pressure (Pa)	10^{8}
Rock Compressibility[d] (1/Pa)	9.75×10^{-11}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section D16-6.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model used in this simulation.

[d] Pore compressibility = Rock compressibility/effective porosity.

TABLE I-6
SALADO FORMATION ANHYDRITE INTERBEDS A AND B AND MARKER BEDS 138 AND 139 PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
Permeability (m^2)	1.29×10^{-19}
Effective Porosity (%)	1.1
Threshold Pressure, P_t (Pa)[b]	9.74×10^5
Residual Brine Saturation, S_{br} (unitless)[c]	0.084
Residual Gas Saturation, S_{gr} (unitless)[c]	0.077
Pore Distribution, λ (unitless)[c]	0.644
Maximum Capillary Pressure (Pa)	10^8
Rock Compressibility[d] (1/Pa)	8.26×10^{-11}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section D16-6.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model used in this simulation.

[d] Pore compressibility = Rock compressibility/effective porosity.

TABLE I-7
SHAFT MATERIALS PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
All Shaft Materials	
Residual Brine Saturation, S_{br} (unitless)[c]	0.2
Residual Gas Saturation, S_{gr} (unitless)[c]	0.2
Pore Distribution, λ (unitless)[c]	0.94
Maximum Capillary Pressure (Pa)	10^8
Clay Shaft Materials	
Permeability (m^2) - Rustler Compacted Clay (T = 0 - 10,000 yrs.)	5.00×10^{-19}
Permeability (m^2) - Upper Salado Compacted Clay (T = 0 - 10 yrs.)	7.65×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 10 - 25 yrs.)	5.02×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 25 - 50 yrs.)	3.02×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 50 - 100 yrs.)	1.16×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T > 100 yrs.)	5.00×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 0 - 10 yrs.)	9.32×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 10 - 25 yrs.)	1.74×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 25 - 50 yrs.)	7.07×10^{-19}
Permeability (m^2) - Lower Salado Compacted Clay (T > 50 yrs.)	5.00×10^{-19}
Permeability (m^2) - Bottom Clay (T = 0 - 10,000 yrs.)	5.00×10^{-19}
Thickness (m) - Rustler Compacted Clay	94.3
Thickness (m) - Upper Salado Compacted Clay	104.85
Thickness (m) - Lower Salado Compacted Clay	23.9
Thickness (m) - Bottom Clay	9.24
Effective Porosity (%) - Rustler Compacted Clay	24.0
Effective Porosity (%) - Upper and Lower Salado Compacted Clays and Bottom Clay	24.0
Threshold Pressure P_t (Pa) - All Clays[b]	2.0×10^5 to 1.20×10^6
Pore-Volume Compressibility (1/Pa) - Rustler Compacted Clay	1.96×10^{-9}
Pore-Volume Compressibility (1/Pa) - Upper Salado Compacted Clay	1.81×10^{-9}
Pore-Volume Compressibility (1/Pa) - Lower Salado Compacted Clay and Bottom Clay	1.59×10^{-9}
Salt Shaft Material	
Permeability (m^2) - Salt (T = 0 - 10 yrs.)	1.74×10^{-15}
Permeability (m^2) - Salt (T = 10 - 25 yrs.)	1.66×10^{-15}
Permeability (m^2) - Salt (T = 25 - 50 yrs.)	1.65×10^{-15}
Permeability (m^2) - Salt (T = 50 - 100 yrs.)	6.83×10^{-18}
Permeability (m^2) - Salt (T = 100 - 200 yrs.)	5.27×10^{-20}
Permeability (m^2) - Salt (T > 200 yrs.)	5.35×10^{-21}
Thickness (m) - Salt	171.37
Effective Porosity (%) - Salt	5.0
Threshold Pressure P_t (Pa) - Salt (T = 0 - 10 yrs.)[b]	7.16×10^4
Threshold Pressure P_t (Pa) - Salt (T = 10 - 25 yrs.)[b]	7.28×10^4

TABLE I-7
SHAFT MATERIALS PARAMETER VALUES
(CONTINUED)

Parameter (units)	Value Used in Calculation[a]
Threshold Pressure P_t (Pa) - Salt (T = 25 - 50 yrs.)[b]	7.29×10^{4}
Threshold Pressure P_t (Pa) - Salt (T = 50 - 100 yrs.)[b]	4.87×10^{5}
Threshold Pressure P_t (Pa) - Salt (T = 100 - 200 yrs.)[b]	2.62×10^{6}
Threshold Pressure P_t (Pa) - Salt (T > 200 yrs.)[b]	5.78×10^{6}
Pore-Volume Compressibility (1/Pa) - Salt	1.60×10^{-9}
Concrete Shaft Materials	
Permeability (m^2) - Concrete (T = 0 - 400 yrs.)	1.78×10^{-19}
Permeability (m^2) - Concrete (T > 400 yrs.) and Concrete Monolith (T = 0 - 10,000 yrs.)	10^{-14}
Thickness (m) - Concrete	45.72
Thickness (m) - Concrete Monolith	9.08
Effective Porosity (%)	5.00
Threshold Pressure P_t (Pa) - Concrete (T = 0 - 400 yrs.) [b]	1.72×10^{6}
Threshold Pressure P_t (Pa) - Concrete (T > 400 yrs.)[b] and Concrete Monolith (T = 0 - 10,000 yrs.)	3.91×10^{4}
Pore-Volume Compressibility (1/Pa) - Concrete and Concrete Monolith	2.64×10^{-9}
Asphalt Shaft Material	
Permeability (m^2) - (T = 0 - 10,000 yrs.)	1×10^{-20}
Thickness (m)	37.28
Effective Porosity (%)	1.00
Threshold Pressure P_t (Pa)[b]	0.00
Pore-Volume Compressibility (1/Pa)	2.97×10^{-8}
Earthen Fill Material Above Rustler	
Permeability (m^2) (T = 0 - 10,000 yrs.)	10^{-14}
Thickness (m)	165.06
Effective Porosity (%)	32.0
Threshold Pressure P_t (Pa)[b]	3.91×10^{4}
Maximum Capillary Pressure (Pa)	10^{8}
Pore-Volume Compressibility (1/Pa)	3.1×10^{-8}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section 16-8.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model is used in this simulation.

FIGURES

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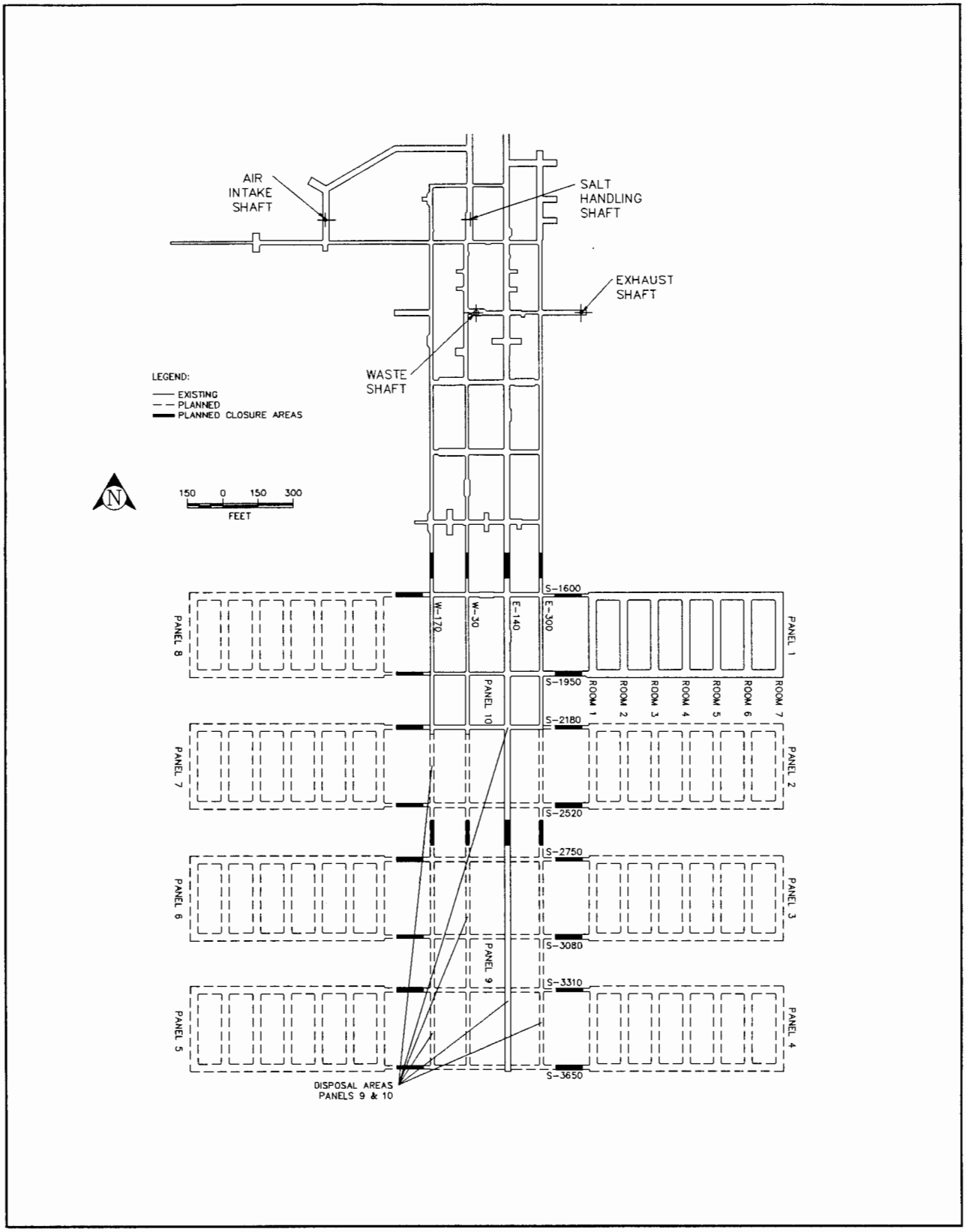

Figure I-1
Location of Underground HWMUs and Anticipated Closure Locations

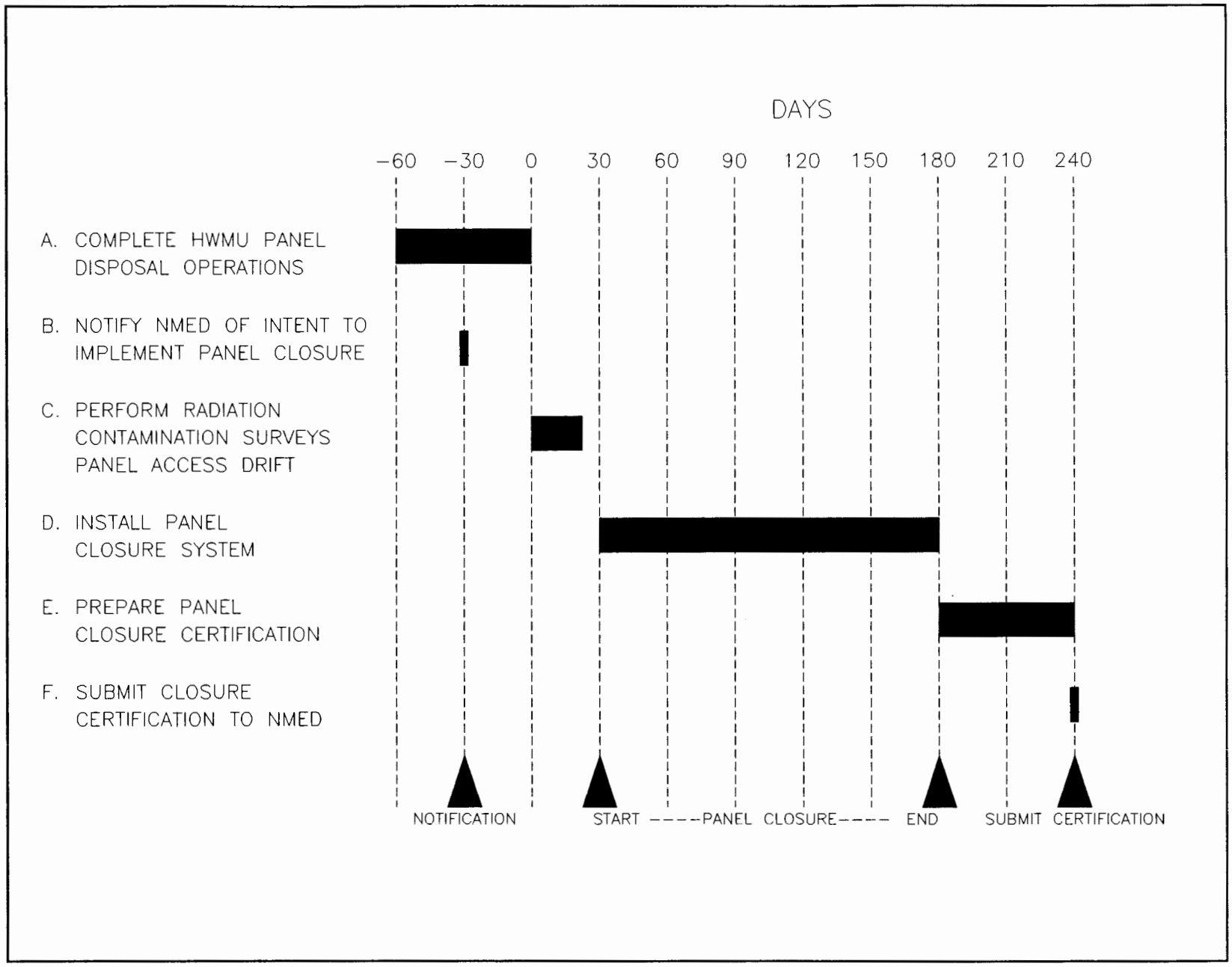

Figure I-2
WIPP Panel Closure Schedule

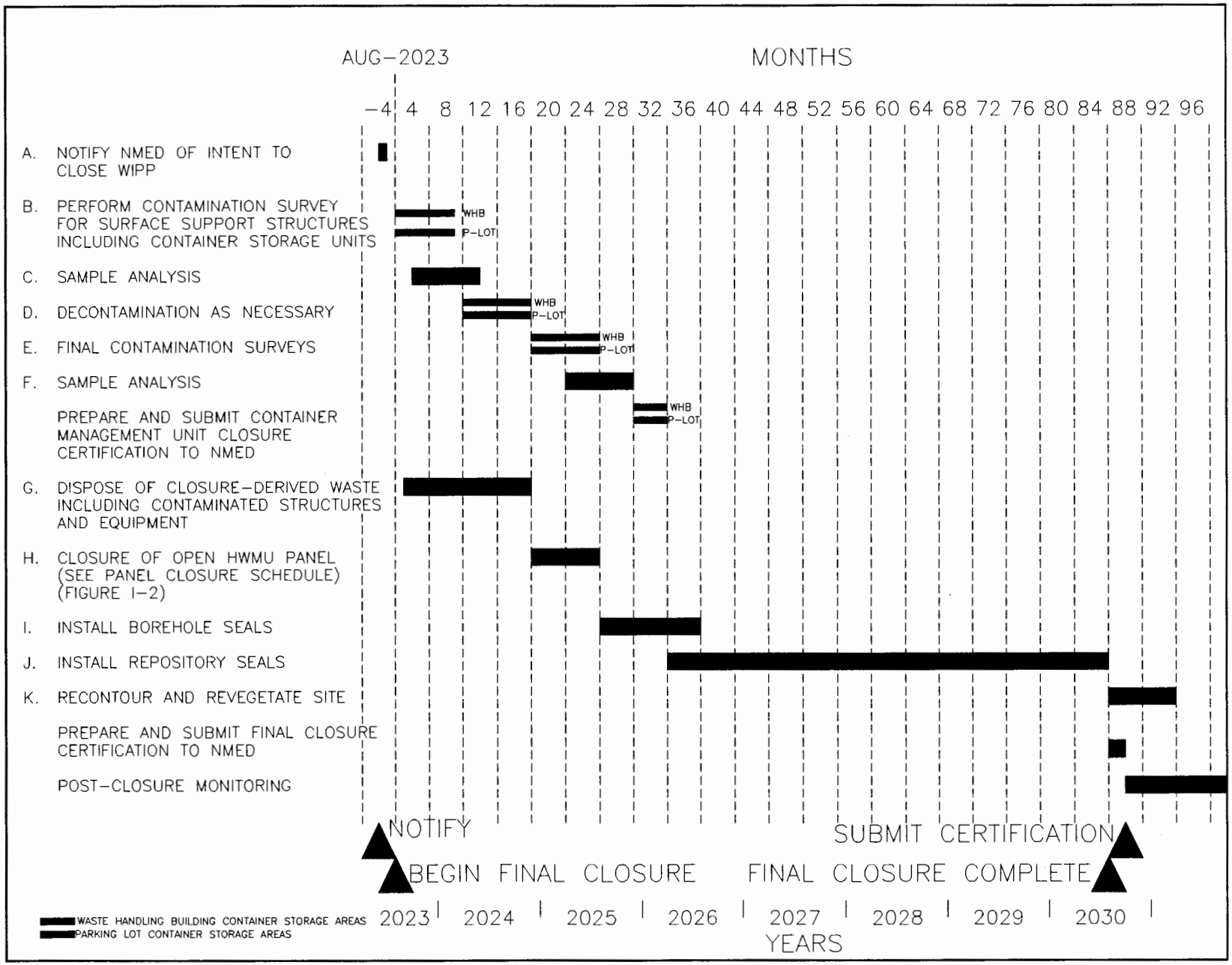

Figure I-3
WIPP Facility Final Closure Schedule

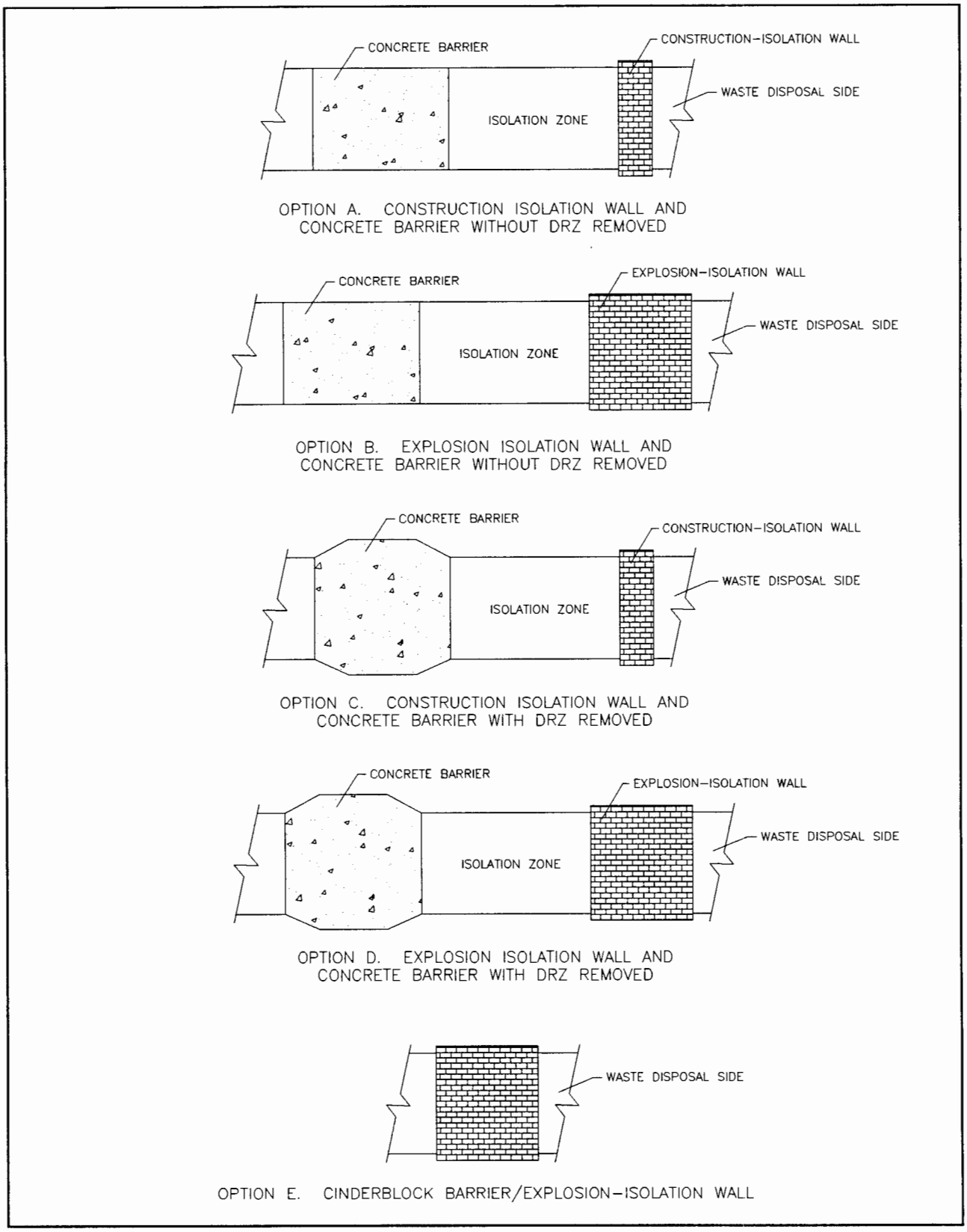

Figure I-4
Design of a Panel Closure System

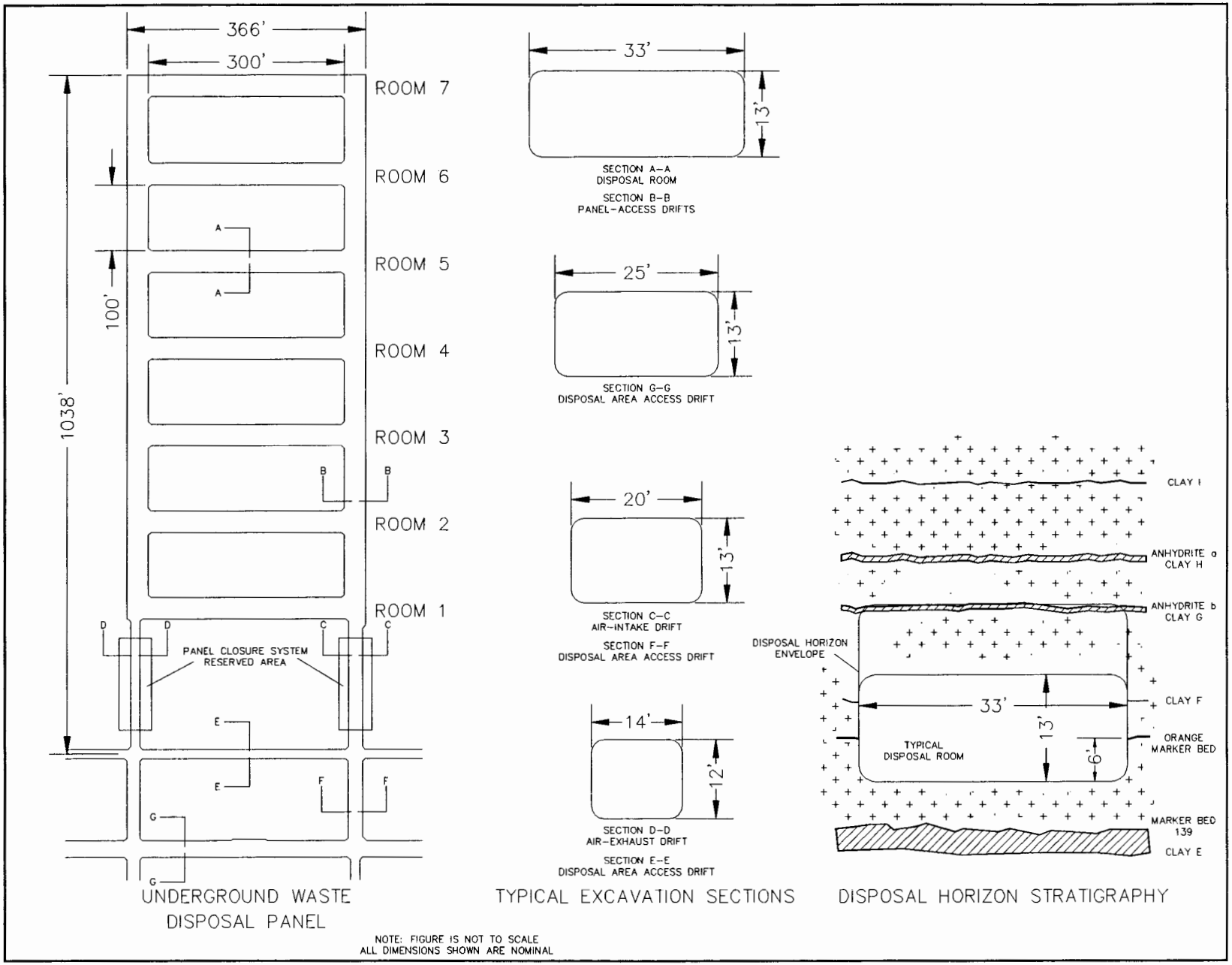

Figure I-5
Typical Disposal Panel

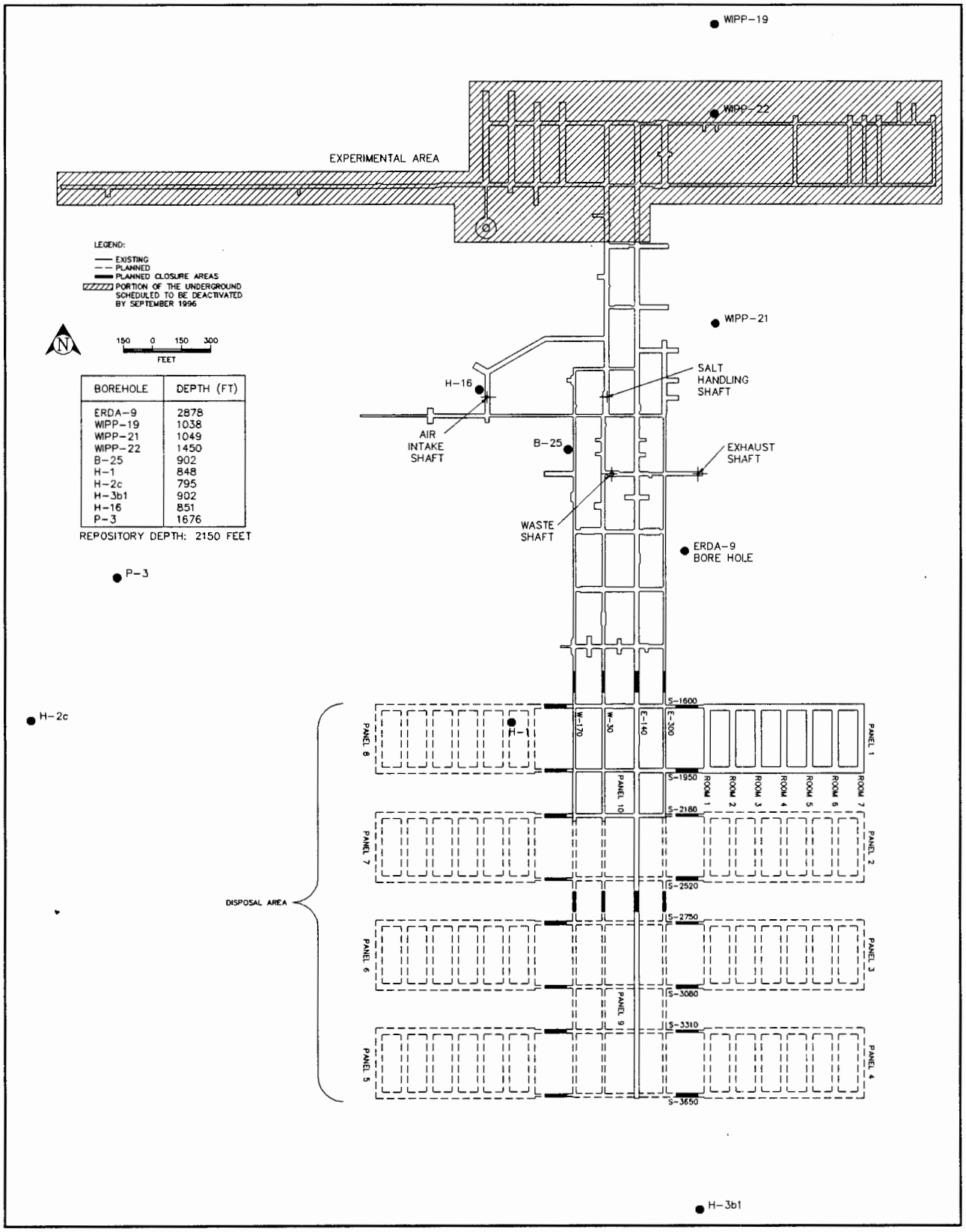

Figure I-6
Approximate Locations of Boreholes in Relation to the WIPP Underground

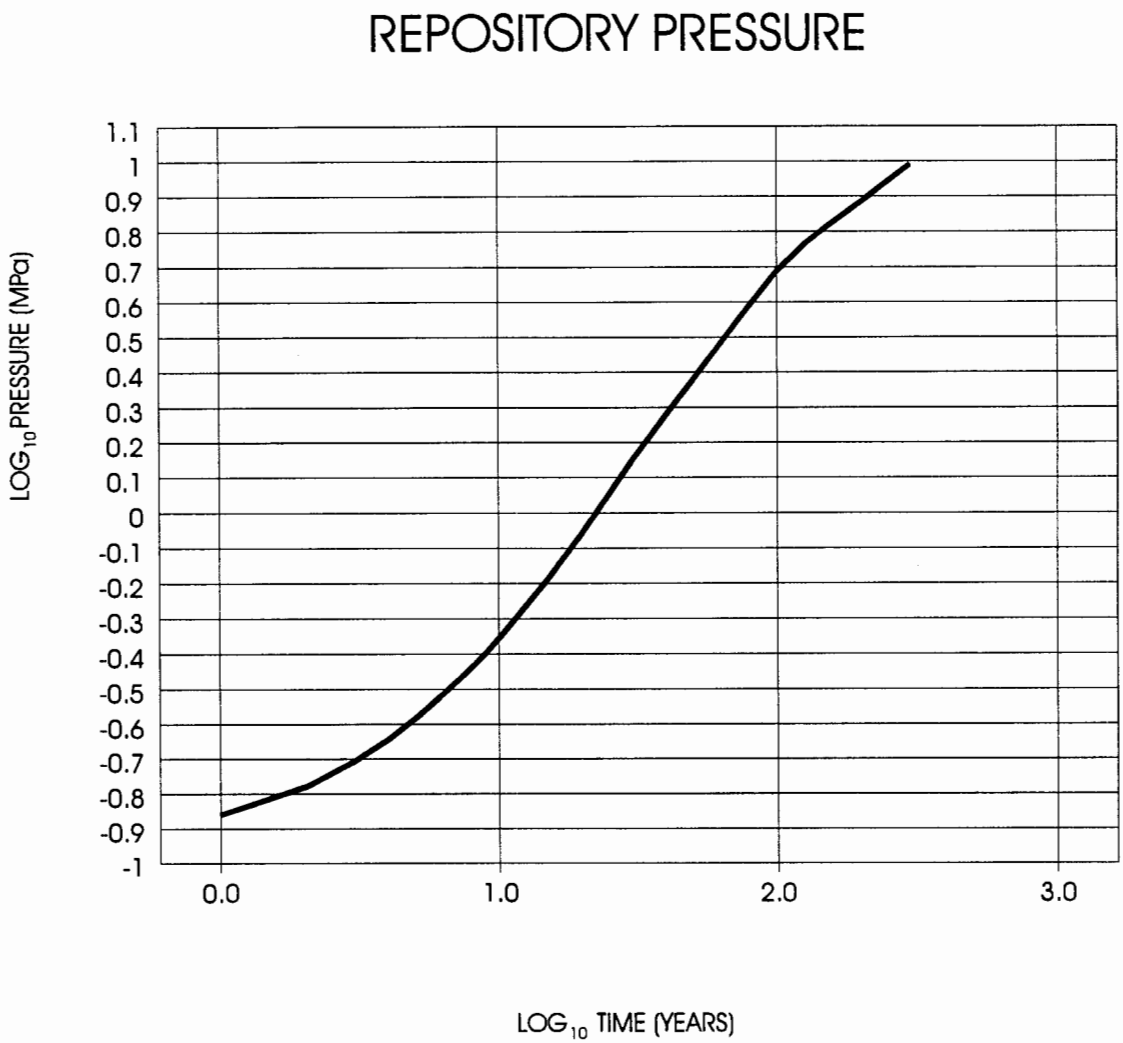

Figure I-7

Predicted Change in Disposal Region Pressure Following Shaft Sealing

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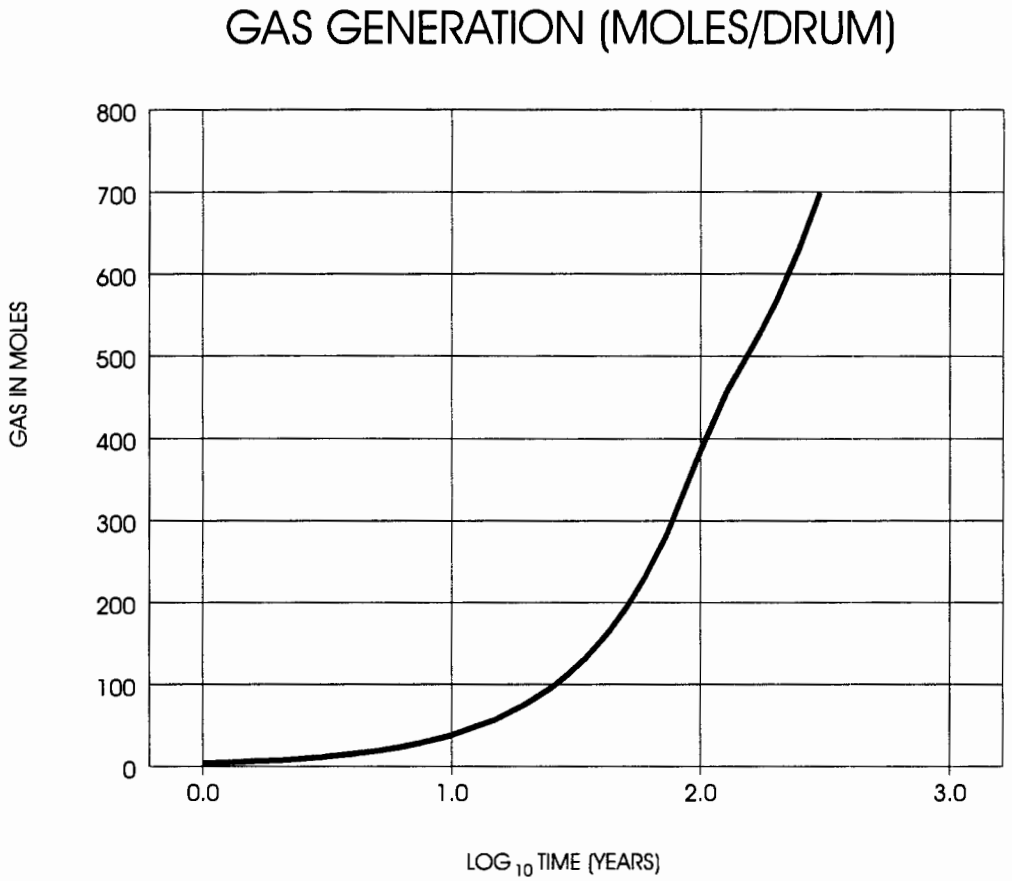

Figure I-8

Predicted Cumulative Volume of Gas Generated Per Drum of Waste

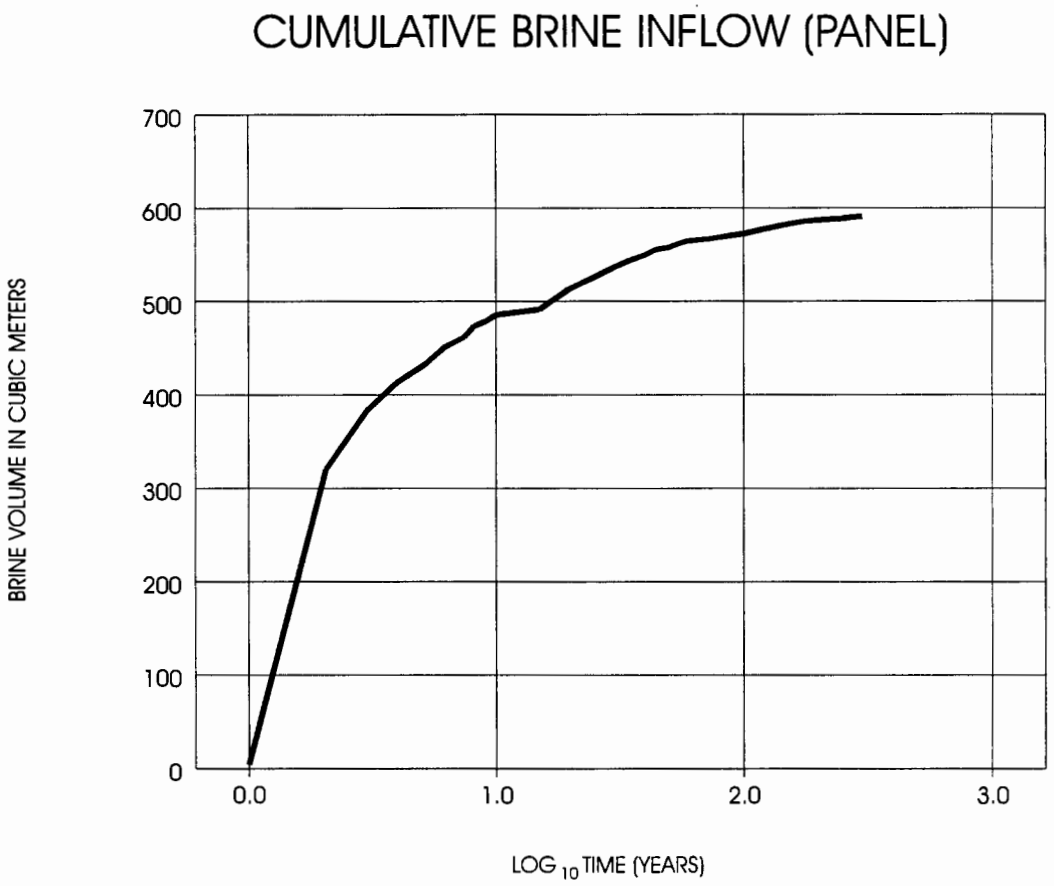

Figure I-9

Predicted Cumulative Brine Inflow into a Closed Waste Panel

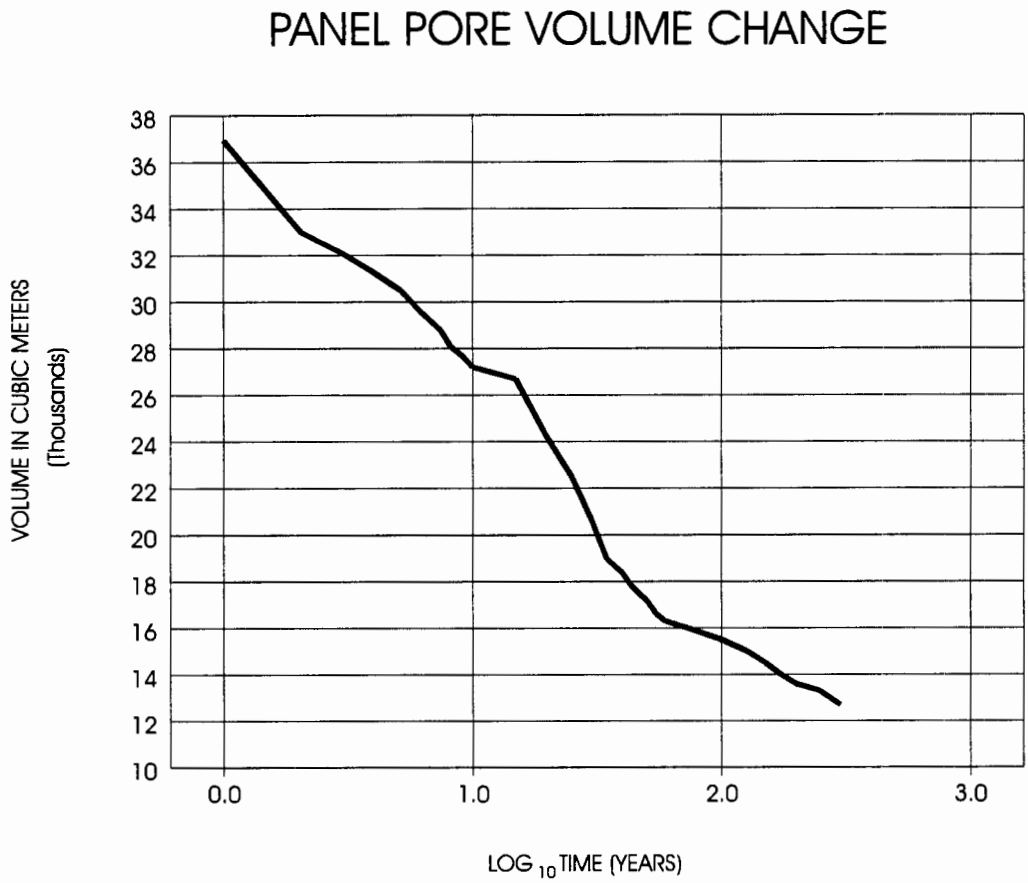

Figure I-10

Predicted Change in Panel Pore Volume Due to Creep Closure

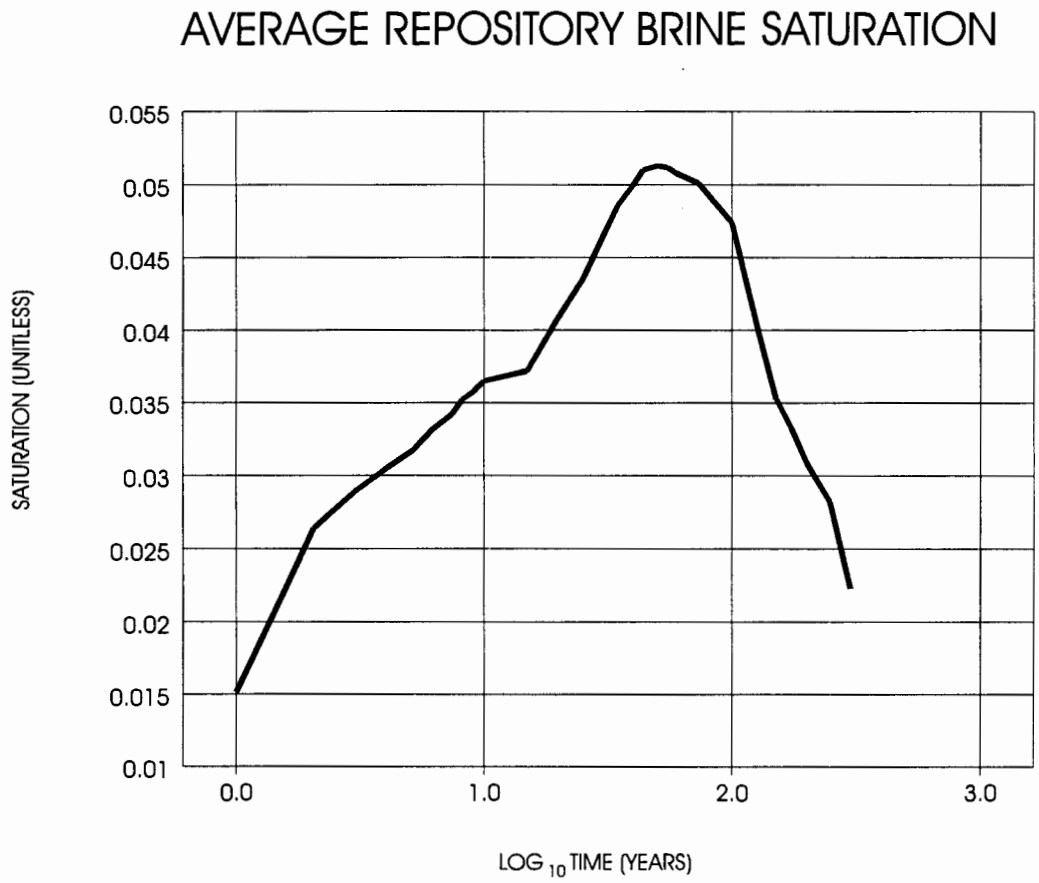

Figure I-11

Predicted Average Brine Saturation Within the Repository

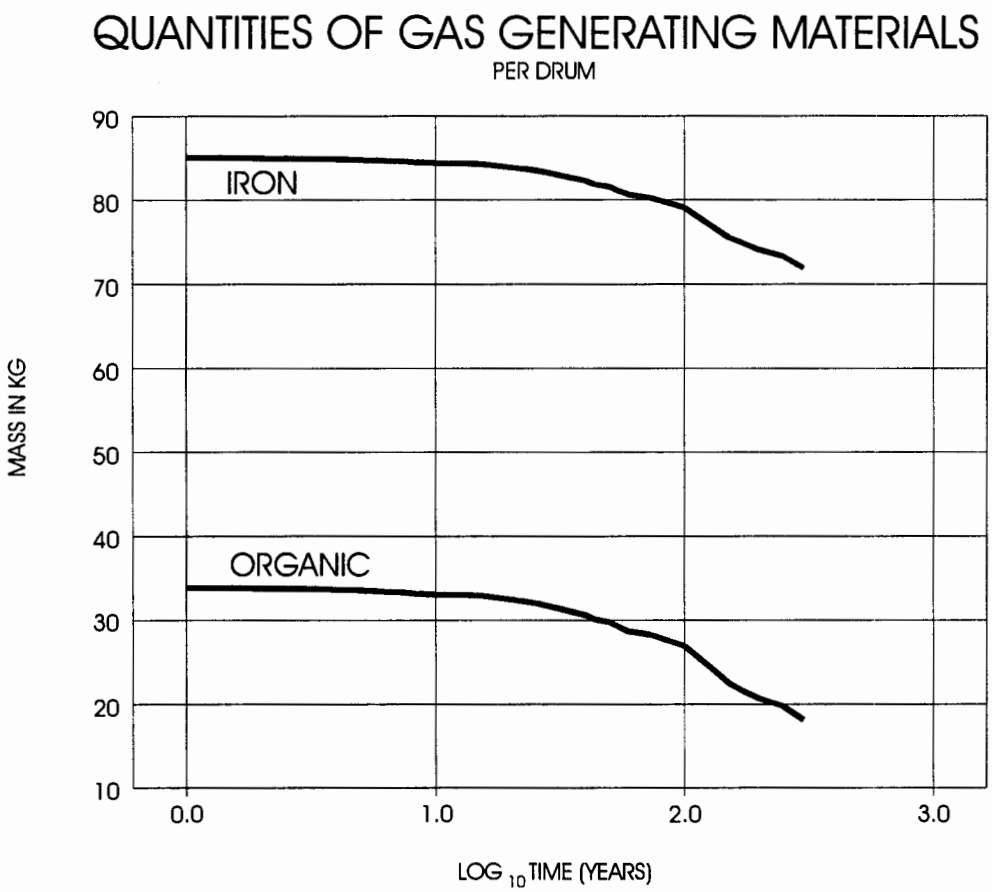

Figure I-12

Predicted Change in the Quantity of Gas Generating Material In Each Drum

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CHAPTER I
CLOSURE PLANS, POST-CLOSURE PLANS, AND FINANCIAL REQUIREMENTS

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CHAPTER I
CLOSURE PLANS, POST-CLOSURE PLANS, AND FINANCIAL REQUIREMENTS

Introduction

This chapter contains the Closure Plan that describes the activities necessary to close the Waste Isolation Pilot Plant (WIPP) facility after termination of the operating permit. Since the current plans for operations extend over several decades, the Department of Energy (DOE) will periodically reapply for an operating permit in accordance with Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart IX, §270.10(h). Consequently, this Closure Plan describes several types of closure. The first type is panel closure, which occurs as underground hazardous waste management units (HWMU) are filled. Secondly, final closure at the end of the Disposal Phase is described. Finally, in the event a new permit is not issued prior to expiration of an existing permit, a modification to this Closure Plan will be sought to perform contingency closure. Contingency closure defers the final closure of waste management facilities such as the Waste Handling Building (WHB), the conveyances, the shafts, and the haulage ways because these will be needed to continue operations with non-mixed Transuranic (TRU) waste.

The HWMUs addressed in this Closure Plan include the aboveground HWMU in the WHB, the parking area HWMU, and Panels 1 through 8, each consisting of seven rooms. In addition, the disposal area access drifts shown as E-300, E-140, W-30, and W-170 between S-1600 and S-3650 on Figure I-1 may, at some time in the future, be needed for waste disposal as discussed in Section D-9a(3)(f). These access drifts, if used for disposal, are also subject to the contents of this Closure Plan.

This plan is submitted to the New Mexico Environment Department (NMED) and the U.S. Environmental Protection Agency (EPA) in accordance with 20 NMAC 4.1, Subpart IX, §270.14(b)(13). Closure at the panel level will include the construction of barriers to limit the emission of hazardous waste constituents from the panel into the mine ventilation air stream below levels that meet environmental performance standards as described in Section D-9d(3)[1]

[1]As discussed in Section D-9d(3), the mechanism for air emissions prior to closure is different than the mechanism after closure. Prior to closure, volatile organic compounds (VOC) will diffuse through drum filters based on the concentration gradient between the disposal room and the drum headspace. These VOCs are swept away by the ventilation system, thereby maintaining a concentration gradient that is assumed to be constant. Hence, the VOCs in the ventilation stream are a function of the number of containers only. After closure, the panel air will reach an equilibrium concentration with the drum headspace and no more diffusion will occur. The only mechanism for release into the mine ventilation system is due to pressure that builds up in the closed panel. This pressure arises from the creep closure mechanism that is reducing the volume of the rooms and from the postulated generation of gas as the result of microbial degradation of organic matter in the waste. Consequently, the emissions after panel closure are a direct function of pressurization processes and rates within the panel. Details of these factors are found in Appendix I1 and in Section D-9b.

and to mitigate the impacts of methane buildup and deflagration that may be postulated for some closed panels. Closure also includes the implementation of institutional controls to limit access, the implementation of passive institutional controls, and the long-term monitoring to assess disposal system performance. Until final closure is complete and has been certified in accordance with 20 NMAC 4.1, Subpart V, §264.115, a copy of the approved plan and all approved revisions will be on file at the WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI Administrator upon request.

I-1 Closure Plan

This Closure Plan is prepared in accordance with the requirements of 20 NMAC 4.1, Subpart V, Closure and Post-Closure, Use and Management of Containers, and Miscellaneous Units. The WIPP underground HWMUs, including Panels 1 through 8 and the disposal area access drifts, designated as Panels 9 and 10 on Figure I-1, will be closed to meet the performance standards in 20 NMAC 4.1, Subpart V, §264.601. The WIPP surface facilities including Waste Handling Building Container Storage Unit and the Parking Area Container Storage Unit will be closed in accordance with 20 NMAC 4.1, Subpart V, §264.178. For final facility closure, this plan also includes closure and sealing of the facility shafts in accordance with 20 NMAC 4.1, Subpart V, §264.601.

Following completion of waste emplacement in each underground HWMU, the HWMU will be closed. The DOE will notify the NMED of the closure of each underground HWMU. For the purpose of this Closure Plan, panel closure is defined as the process of rendering HWMUs in the underground repository inactive and closed according to the facility Closure Plan. The Closure Plan addresses requirements for future monitoring that are deemed necessary for the post-closure period, including monitoring closed panels prior to final facility closure.

For the purposes of this Closure Plan, final facility closure is defined as closure that will occur when all waste disposal areas are filled or when the WIPP achieves its capacity of 6.2 million cubic feet (ft^3) (175,600 cubic meters (m^3)) of TRU waste. At final facility closure, the surface container storage areas will be closed, and equipment that can be decontaminated and used at other facilities will be cleaned and sent off site. Equipment that cannot be decontaminated plus any derived waste resulting from decontamination will be placed in the last open underground HWMU. Stockpiled salt may be placed in the underground; it may be used as the core material for the berm component of the permanent marker system; or it must be otherwise disposed of in accordance with Sections 2 and 3 of the Minerals Act of 1947 (30 U.S.C. §§602 and 603). In addition, shafts and boreholes which lie within the WIPP Site Boundary and penetrate the Salado will be plugged and sealed, and surface and subsurface facilities and equipment will be decontaminated and removed. Final facility closure will be completed to demonstrate compliance with the Closure Performance Standards contained in 20 NMAC 4.1, Subpart V §264.111, 178, and 601.

In the event the DOE fails to obtain an extension of the hazardous waste permit in accordance with 20 NMAC 4.1, Part IX, §270.51 or fails to obtain a new permit in accordance with 20 NMAC 4.1, Part IX, §270.10(h), the DOE will modify this Closure Plan to accommodate a contingency closure. Under contingency closure, storage units will undergo clean closure in accordance with

20 NMAC 4.1, Part V, §264.178 waste handling equipment, shafts, and haulage ways will be inspected for hazardous waste residues (using, among other techniques, the principle of co-detection in Appendix I3) and decontaminated as necessary, and underground HWMUs that contain radioactive mixed waste will be closed in accordance with the panel closure design described in this Closure Plan. Final facility closure, however, will be redefined and a request for a time extension for final closure will be requested. A copy of this Closure Plan will be maintained at the WIPP facility and at the DOE Carlsbad Area Office. The primary contact person at the WIPP facility is:

Manager, Carlsbad Area Office
U.S. Department of Energy
Waste Isolation Pilot Plant
P. O. Box 3090
Carlsbad, New Mexico 88221-3090
(505) 234-7300

I-1a Closure Performance Standard (20 NMAC 4.1, Subpart V, §264.111)

The closure performance standard specified in 20 NMAC 4.1, Subpart V, §264.111, states that the closure must be performed in a manner that minimizes the need for further maintenance; that minimizes, controls, or eliminates the escape of hazardous waste; and that conforms to the closure requirements of §264.178 and §264.601. These standards are discussed in the following paragraphs.

I-1a(1) Container Storage Units

Closure of the container storage units on the surface will be accomplished by removing all waste and waste residues. Identification of waste contamination will be based, among other techniques, on the principle of co-detection as described in Appendix I3. Co-detection uses very sensitive radiation detection equipment to determine if there has been a release of TRU waste, including hazardous waste components, from a container. This allows the DOE to detect releases that are not detectable from visible evidence such as stains or discoloration. Visual inspection and operating records will also be used to identify areas where decontamination is necessary. Contaminated surfaces will be decontaminated until radioactivity is below free release limits. Once surfaces are determined to be free of radioactive waste constituents, they will be tested for hazardous waste contamination. These surface decontamination activities will ensure the removal of waste residues to levels determined to be protective of human health and the environment. The facility is expected to require no decontamination at closure because any waste spilled or released during operations will be contained and removed immediately. Solid waste management units associated with the repository described in Chapter J of the permit application will be subject to closure. In the event portions of these units cannot be decontaminated, they will be remediated and the resultant wastes will be managed as derived waste.

Once the container storage units are decontaminated and certified to be clean, no further maintenance is required. The facilities and equipment in these units will be reused for other purposes as needed.

I-1a(2) Miscellaneous Unit

Post-closure migration of hazardous waste or hazardous waste constituents to ground or surface waters or to the atmosphere, above levels that will harm human health or the environment will not occur due to facility engineering and the geological isolation of the unit. The engineering aspects of closure are centered on the use of panel closures on each of the HWMUs in the underground and final facility seals placed in the shafts. The design of the panel closure system is based on the criteria that the closure system for closed HWMU panels will prevent migration of hazardous waste constituents in concentrations above health-based levels beyond the WIPP land withdrawal boundary during the 35-year operational and facility closure period and to withstand any flammable gas deflagration that may occur prior to final facility closure. The DOE has developed a design which is flexible in that components may be added or deleted to accommodate the conditions and waste characteristics encountered at the time of panel closure.

Consistent with the definitions in 20 NMAC 4.1, Subpart I, §260.10, the process of panel closure is considered partial closure because it is a process of rendering a part of the repository inactive and closed according to the approved HWMU partial closure plan. Panel closure will be considered complete when the panel closure system is emplaced and operational, when that HWMU and related equipment and structures have been decontaminated (if necessary), and when the NMED has been notified of the closure.

Shaft seals are designed to provide effective barriers to the inward migration of ground water and the outward migration of gas and contaminated brine over two discrete time periods. Several components become effective immediately and are expected to function for 100 years. Other components become effective more slowly, but provide permanent isolation of the waste. The conceptual shaft seal design is discussed in Appendix I2. Final seal designs are now undergoing final review and will be provided to the NMED by October 1, 1996. Preliminary copies of the final seal design drawings are attached to this application in Appendix I2 for NMED's review. The final seal design package, which will include final design drawings, will be certified by a professional engineer prior to submittal to the NMED.

The facility will be finally closed (i.e., decontaminated and decommissioned) to minimize the need for continued maintenance. Protection of human health and the environment includes, but is not limited to:

- Prevention of any releases that may have adverse effects on human health or the environment due to the migration of waste constituents in the groundwater or in the subsurface environment.

- Prevention of any releases that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, in wetlands, or on the soil surface.

- Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air.

As part of final facility closure, surface recontouring and reclamation will establish a stable vegetative cover, and further surface maintenance will not be necessary to protect human health and the environment. Prior to cessation of active controls, monuments will be emplaced to serve as long-term site markers to discourage activities that would penetrate the facility or impair the ability of the salt formation to isolate the waste from the surface environment for at least 10,000 years. The federal government will maintain administrative responsibility for the repository site in perpetuity and will limit future use of the area.

If, during panel or final facility closure activities, unexpected events require modification of this Closure Plan to demonstrate compliance with closure performance standards, a Closure Plan amendment will be submitted (see Section I-1d[5]).

I-1a(3) Post-Closure Care

The post-closure care period will begin after completion of the first panel closure and will continue for 30 years after final facility closure. The post-closure care period may be shortened or lengthened at the discretion of the regulatory agency based on evidence that human health and the environment are being protected or that they are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards in 20 NMAC 4.1, Part V, §264.601. Post-closure activities are described in Section I-2.

I-1b Requirements

The DOE proposes a sequential process for the closure of individual HWMUs at the WIPP. Each underground HWMU will undergo panel closure when waste emplacement in that panel is complete. Following waste emplacement in each underground HWMU, construction-side ventilation will be terminated and waste-disposal-side ventilation will be established in the next underground HWMU to be used, and the underground HWMU containing the waste will be closed. The DOE will notify the NMED of the closure of each of the underground HWMUs as they are sequentially filled on a HWMU-by-HWMU basis. The HWMUs in the WHB and in the parking area will be closed as part of final facility closure of the WIPP facility.

The DOE will notify the Secretary of the NMED in writing at least 60 days prior to the date on which closure activities are scheduled to begin.

I-1c Maximum Waste Inventory

The WIPP will receive no more than 6.2 million ft^3 (175,600 m^3) of TRU mixed waste. Excavations are mined as needed during operations to maintain a reserve of disposal areas. The amount of waste placed in each room is limited by structural and physical considerations of equipment and design. Waste volumes include waste received from off-site generator locations as well as derived waste from disposal and decontamination operations. Maximum waste volumes in the disposal panels are calculated as follows: for 100 percent 55-gallon drums--11,502 7-packs consisting of 80,514 drums and 591,800 ft^3 (16,760 m^3) of waste; for 100 percent standard waste boxes (SWB)--11,580 SWBs and 767,750 ft^3 (21,740 m^3) of waste; for remote handled (RH)--730 canisters containing 22,940 ft^3 (650 m^3) of waste. Since the waste

can arrive in any combination of 7-packs and SWBs, a fixed volume is not set for each panel. Furthermore, the placement of backfill materials to modify chemical nature of brines over the long-term will likely result in fewer containers per panel as described in Section D-9a. For planning purposes, a maximum achievable volume is used. This equates to 662,400 ft^3 (18,750 m^3) of contact handled (CH) TRU and 22,900 ft^3 (649 m^3) of RH TRU per panel. A number of 81,000 containers is used in design calculations since for air dispersion modeling, it is important to maximize the number of container vents through which volatile organic compounds (VOC) may be released. In reality, using the 40 percent-60 percent mix, there would be only 51,000 containers in a panel, containing 56,000 vents (2 vents per SWB). The areas designated as Panels 9 and 10 in Figure I-1 will not be used for RH waste.

The maximum extent of operations during the term of this permit is expected to be Panels 1 through 4 and Panels 9 and 10 as shown on Figure I-1, the WHB container storage unit, and the parking area container storage unit. Note that panels 4, 9, and 10 are scheduled for excavation only under this permit. If other waste management units are permitted during the Disposal Phase, this Closure Plan will be revised to include the additional waste management units. At any given time during disposal operations, it is anticipated that two rooms may be receiving waste for disposal at the same time. The overlap is necessary because RH TRU mixed waste emplacement in a room will precede CH TRU mixed waste emplacement in that room. Consequently, CH TRU mixed waste may be emplaced in one room of a panel while RH TRU mixed waste is emplaced in another room of the same panel. HWMU panels in which disposal has been completed (i.e., in which RH and CH TRU mixed waste emplacement activities have ceased) will undergo panel closure.

I-1d Schedule for Closure

For the purpose of establishing a schedule for closure, an operating and closure period of no more than 35 years (25 years for disposal operations and 10 years for closure) is assumed. This operating period may be extended or shortened depending on a number of factors, including the rate of waste approved for shipment to the WIPP facility and the schedules of TRU mixed waste generator sites, and future decommissioning activities.

I-1d(1) Schedule for Panel Closure

The anticipated schedule for the closure of each of the underground HWMUs known as Panels 1 through 8, is shown in Figure I-2. This schedule assumes there will be little contamination within the exhaust drift of the panel. The following assumptions are made in estimating the time that closure will be initiated at each HWMU: RH emplacement precedes CH emplacement and does not impede CH throughput; waste operations are assumed to begin in July 1998 for planning purposes; throughput for CH waste is 784 drums per week (7 pallets per day, 4 days per week, 28 drums per pallet); and the capacity of a panel is 81,000 drums. Under these assumptions, a minimum of 104 weeks is needed to emplace the waste. Allowing a 25 percent contingency for maintenance delays and time to transition from one room to another, it is estimated that a panel will be filled 2.5 years after emplacement is initiated. This means that

underground HWMUs will be ready for closure according to the schedule in Table I-1. These dates are estimates for planning and permitting purposes. Actual dates may vary depending on the availability of waste from the generator sites. Waste availability at maximum throughput is not anticipated immediately as assumed here.

In the schedule in Figure I-2, notification of intent to close occurs 30 days before placing the final waste in a panel. Once a panel is full, the DOE will initially block ventilation through the panel as described in Section D-10a(3)(b) and then will assess the closure area for ground conditions and contamination so that a definitive schedule and closure design can be determined. If as the result of this assessment the DOE determines that a panel closure cannot be emplaced in accordance with the schedule in this Closure Plan, a modification will be submitted requesting an extension to the time for closure.

I-1d(2) Schedule for Final Facility Closure

The Disposal Phase for the WIPP facility is expected to require a period of 25 years beginning with the first receipt of TRU waste at the WIPP facility and followed by a period ranging from seven to ten years for decontamination, decommissioning, and final closure. Assuming the first waste receipt occurs in July 1998, the Disposal Phase may extend until 2023, and so the latest expected year of final closure of the WIPP facility (i.e., date of final closure certification) would be 2033. If, as is currently projected, the WIPP facility is dismantled at closure, all surface and subsurface facilities (except the hot cell portion of the WHB, which will remain as an artifact of the Permanent Marker System [PMS]) will be disassembled and either salvaged or disposed in accordance with applicable standards. In addition, asphalt and crushed caliche that was used for paving will be removed, and the area will be recontoured and revegetated in accordance with a land management plan. A detailed closure schedule will be submitted in writing to the Secretary of the NMED, along with the notification of closure. Throughout the closure period, all necessary steps will be taken to prevent threats to human health and the environment in compliance with all applicable Resource Conservation and Recovery Act (RCRA) permit requirements. Figure I-3 presents the best estimate of a final facility closure schedule.

The schedule for final facility closure is considered to be a best estimate because closure of the facility is driven by policies and practices established for the decontamination, if necessary, and decommissioning of radioactively contaminated facilities. These required activities include extensive radiological contamination surveys and hazardous constituent surveys using, among other techniques, the principle of co-detection. Surveys will be performed at all areas of the WIPP site where hazardous waste were managed. These surveys, along with historical radiological survey records, will provide the basis for release of structures, equipment, and components for disposal or decontamination for release off site. Specifications will be developed for each structure to be removed. A cost benefit analysis will be needed to evaluate decontamination options if extensive decontamination is necessary. Individual equipment surveys, structure surveys, and debris surveys will be required prior to disposition. Size-reduction techniques may be required to dispose of mixed or radioactive waste at the WIPP site. Current DOE policy, as reflected in the WIPP facility Safety Analysis Report (SAR), requires the

preparation of a final decommissioning and decontamination (D&D) plan immediately prior to final facility closure. In this way, the specific conditions of the facility at the time D&D is initiated will be addressed. Section I-1e(2) provides a more detailed discussion of final facility closure activities.

Figure I-3 shows the schedule for the final facility closure consisting of decontamination, as needed, of the TRU waste-handling equipment, and of the aboveground equipment and facilities, including closure of surface HWMUs; decontamination of the shaft and haulage ways; disposal of decontamination derived wastes in the last open underground HWMU; and subsequent closure of this underground HWMU. Subsequent activities will include installation of repository shaft seals.

An overall schedule for final facility closure, showing currently scheduled dates for the start and end of final facility closure activities is shown in Table I-2. The dates assume a start up date of June 1998 and hazardous waste permit effective dates of September 1996, September 2006, and September 2016. Details for panel closures are shown on Table I-1.

I-1d(3) Extension for Closure Time

As indicated by the closure schedule represented in Figure I-3, the activities necessary to perform facility closure of the WIPP facility will require more than 180 days to complete because of additional stringent requirements for managing radioactive materials. Therefore, the DOE is requesting an extension of the 180-day final closure requirement in accordance with 20 NMAC 4.1, Subpart V, §264.113. During the extended closure period, the DOE will continue to demonstrate compliance with applicable permit requirements and will take all steps necessary to prevent threats to human health and the environment as a result of TRU mixed waste management at the WIPP facility including all of the applicable measures in Chapter F of this application.

In addition, according to the schedules in Figure I-3, the final derived wastes that are generated as the result of decontamination activities will not be disposed of for 16 months after the initiation of final facility closure. In accordance with 20 NMAC 4.1, Subpart V, §264.113(a), the DOE requests an extension of the 90-day limit to dispose of final derived waste resulting from the closure process. This request is necessitated by the fact that the radioactive nature of the derived waste makes placement in the WIPP the best disposition, and the removal of these wastes will, by necessity, take longer than 90 days in accordance with the closure schedules. During this extended period of time, the DOE will take all steps to prevent threats to human health and the environment, including compliance with all applicable permit requirements. These steps include all of the applicable preparedness and prevention measures in Chapter F of this permit application, including Section F-4g, Flammable Gas Control.

Finally, in the event the hazardous waste permit is not renewed as assumed in the schedule, the DOE will submit a modification to the Closure Plan to implement a contingency closure that will allow the DOE to continue to operate for the disposal of non-mixed TRU waste. This modification will include a request for an extension of the time for final facility closure. This modified Closure Plan will be submitted to the NMED for approval.

I-1d(4) Amendment of the Closure Plan

If it becomes necessary to amend the Closure Plan for the WIPP facility, the DOE will submit, in accordance with 20 NMAC 4.1, Subpart IX, §270.42, a written notification of or request for a permit modification describing any change in operation or facility design that affects the Closure Plan. The written notification or request will include a copy of the amended Closure Plan for approval by the NMED. The DOE will submit a written notification of or request for a permit modification to authorize a change in the approved plan, if:

- There are changes in operating plans or in the waste management unit facility design that affect the Closure Plan
- There is a change in the expected year of closure
- Unexpected events occur during panel or final facility closure that require modification of the approved Closure Plan
- Changes in state or federal laws affect the Closure Plan
- DOE fails to obtain permits for continued operations as discussed above

The DOE will submit a written request for a permit modification with a copy of the amended Closure Plan at least 60 days prior to the proposed change in facility design or operation or within 60 days of the occurrence of an unexpected event that affects the Closure Plan. If the unexpected event occurs during final closure, the permit modification will be requested within 30 days of the occurrence. If the Secretary of the NMED requests a modification of the Closure Plan, a plan modified in accordance with the request will be submitted within 60 days of notification or within 30 days, if the change in facility condition occurs during final closure.

I-1e Closure Activities

Closure activities include those instituted for panel closure (i.e., closure of filled underground HWMUs), contingency closure (i.e., closure of surface HWMUs and decontamination of other waste handling areas), and final facility closure (i.e., closure of surface HWMUs, D&D of surface facilities and the areas surrounding the WHB, and placement of repository shaft seals). Panel closure systems will be emplaced to separate areas of the facility and to isolate panels. Appendices I1 and I2 provide panel closure system and shaft seal designs. All closure activities will meet the applicable quality assurance (QA)/quality control (QC) program standards in place at the WIPP facility. Facility monitoring procedures in place during operations will remain in place through final closure, as applicable.

I-1e(1) Panel Closure

Following completion of waste emplacement in each underground HWMU, disposal-side ventilation will be established in the next panel to be used, and the panel containing the waste will be closed. A panel closure system will be emplaced in the panel access drifts, in accordance

with the design in Appendix I1 and the schedule in Figure I-2 and Table I-1. The panel closure system is designed to meet the following requirements that were established by the DOE for the design:

- the panel closure system shall limit the migration of VOCs to the compliance point so that compliance is achieved by at least one order of magnitude
- the panel closure system shall consider potential flow of VOCs through the disturbed rock zone (DRZ) in addition to flow through closure components
- the panel closure system shall perform its intended functions under loads generated by creep closure of the tunnels
- the panel closure system shall perform its intended function under the conditions of a postulated methane explosion
- the nominal operational life of the closure system is 35 years
- the panel closure system for each individual panel shall not require routine maintenance during its operational life
- the panel closure system shall address the most severe ground conditions expected in the waste disposal area
- the design class of the panel closure system shall be IIIb (which means that it is to be built to generally accepted national design and construction standards)
- the design and construction shall follow conventional mining practices
- structural analysis shall use data acquired from the WIPP underground
- materials shall be compatible with their emplacement environment and function
- treatment of surfaces in the closure areas shall be considered in the design
- thermal cracking of concrete shall be addressed
- during construction, a QA/QC program shall be established to verify material properties and construction practices
- construction of the panel closure system shall consider shaft and underground access and services for materials handling

The performance standard for air emissions from the WIPP facility is established in Section D-9d(3) and Table D-6. These are reiterated in the detailed design report, Appendix I1, Table A-1, as the closed panel release limits. Releases must be below these limits for the facility to remain in compliance with standards to protect human health and the environment. The

following panel closure design has been shown, through analysis, to meet these standards, if emplaced in accordance with the specifications in Appendix I1.

The final panel closure design in Appendix I1 was prepared with the assumption that there would be no backfill in the disposal rooms. With the inclusion of backfill, the design has been re-examined and it has been determined that the changes are insignificant for several reasons. First, the backfill has no effect on the gas generation rate so that the values used in the design for gas generation and methane buildup remain the same. Second, the quantity of backfill is sufficient to fill one-tenth of the void volume in the room. This results in more rapid pressurization of the room, however, the effect is small and will only be important after the facility is sealed. Third, the reduced volume will result in a faster accumulation of methane. This would not result in a revision of the design. Instead, it would change the criteria for installing explosion walls. The DOE believes the 20-year criterion is still appropriate, since the design report (Figure 2-14 in Appendix I1) shows that it takes 25-years to reach explosive limits. A ten percent reduction in this time is still beyond 20 years. Furthermore, the chances that methane will be generated initially are minimized by the fact that the closed panels will be initially oxic and may remain so for a long time after facility closure.

The design for the panel closure system calls for a composite panel barrier system consisting of a rigid concrete plug with or without removal of the DRZ, and either an explosion-isolation wall or a construction-isolation wall. The design basis for this closure is such that the migration of hazardous waste constituents from closed panels during the operational and closure period would result in concentrations well below health-based standards. The source term used as the design basis included the average concentrations of VOCs from CH waste containers as measured in headspace gases through January 1995. Appendix C2 discusses the methodology for calculating average concentrations. The VOCs are assumed to have been released by diffusion through the container vents and are assumed to be in equilibrium with the air in the panel. Emissions from the closed panel occur at a rate determined by gas generation within the waste and creep closure of the panel. The derivation of the emission rate is discussed in Appendix D9. Due to the relatively small amount of RH waste (approximately 5 percent of the total waste volume), VOC emissions from RH waste are assumed to contribute insignificantly to total VOC emissions. Analysis in Appendix D9 shows that emissions result in VOC concentrations at the site boundary below health-based limits; therefore, an adequate margin of safety also exists for potential RH waste VOC emissions. This design meets the environmental performance standard.

Figures I-4 and I-5 show a diagram of the panel closure design and installation envelopes. Appendix I1 provides the detailed design and the design analysis for the panel closure system. The panel closure design is such that components can be added or removed or their shapes adjusted depending on the particular ground conditions at the time of installation. For example, in Figure I-4, Option A represents the likely closure of panels less than 20 years old at the time of final facility closure and whose entries are sufficiently intact such that DRZ removal is not needed. These would likely include Panels 6 through 8. Option B represents the preferred option for panels that will be closed for more than 20 years prior to final facility closure and whose entries are reasonably intact at time of closure. These will likely be Panels 2 through 5. Option C may be desirable for panels whose entries require DRZ removal and whose closure precedes final facility closure by less than 20 years. This is the likely configuration of the closure

for Panels 9 and 10. Finally, Option D may be appropriate for panels whose entries require significant removal of the DRZ and whose closure will precede final facility closure by more than 20 years. Panel 1 is the most likely candidate for this type of closure.

The 20-year limit in the design selection process is based on what the DOE believes to be conservative analytical results that indicate methane, being generated by waste degradation at the rate of 0.1 mole per drum per year, will not reach flammable concentrations for at least 20 years. As part of the decision making process on design selection, an investigation of the DRZ would precede the selection of the concrete component and the specification of the amount of excavation that is needed. These investigations could be done using geophysical methods (such as ground penetrating radar) or drill holes. Drill holes can be investigated using video cameras or "scratchers".

The DOE believes that design Options A through D will function adequately as panel closures given the current state of knowledge about gas generation, the understanding of the DRZ, the expected characteristics of the waste, and the inability of monitoring techniques to accurately detect extremely small concentrations of VOCs. However, in the event sufficient information is collected that allows the DOE to make less conservative assumptions regarding these items, the designs A through D may prove to be significantly more protection than is actually needed. Consequently, the DOE has retained as a design concept, Option E, which is simply the explosion wall portion of Options B and D. Option E represents a significantly simpler panel closure system that the DOE would use if either of the following criteria are met as indicated:

- Gas generation rates are smaller. Current (unreported) work being performed by Sandia National Laboratories indicates that microbial gas generation rates under humid conditions are close to zero, and/or

- Average headspace concentrations are less than the averages used in the calculations. As new wastes are generated, the use of organic solvents is expected to be reduced drastically. Some compounds, such as carbon tetrachloride, have already been banned from use at some generator sites.

As stated previously, the DOE will evaluate these criteria at the time a panel closure is needed and will select the proper closure design. If a design different from those listed above is identified, the appropriate permit modification will be sought.

I-1e(2) <u>Decontamination and Decommissioning</u>

Decontamination is defined as those activities which are performed to remove contamination from surfaces and equipment that are not intended to be disposed of. The policy at the WIPP will be to decontaminate as many areas as possible, consistent with radiation protection policy. Decontamination is part of all closure activities and is a necessary activity in the clean closure of the surface container management units. Decontamination is performed using, among other techniques, the principles of co-detection as described in Appendix I3.

Decommissioning is the process of removing equipment, facilities, or surface areas from further use and rendering a facility to a final condition. Decommissioning is part of final facility closure

only and will involve the removal of equipment, buildings, closure of the shafts, and establishing active and passive institutional controls for the facility.

The objective of D&D activities at the WIPP facility is to return the surface to as close to the preconstruction condition as reasonably possible, while protecting the health and safety of the public and the environment. D&D activities are discussed in the "Conceptual Decontamination and Decommissioning Plan for the Waste Isolation Pilot Plant" (DOE, 1995a). Major activities planned to accomplish this objective include, but are not limited to the following:

1. Review of operational records for historical information on releases
2. Visual examination of surface structures for evidence of spills or releases
3. Performance of site contamination surveys
4. Decontamination, if necessary, of usable equipment, materials, and structures including surface facilities and areas surrounding the WHB.
5. Disposal of equipment/materials that cannot be decontaminated but that meet waste acceptance criteria in an HWMU
6. Dismantling of surface facilities
7. Dismantling of underground facilities at the time the panels are closed
8. Emplacement of final panel closure system
9. Emplacement of fill material in the underground, if required[2]
10. Emplacement of shaft seals[3]
11. Regrading the surface to approximately original contours
12. Initiation of active controls which includes monitoring and installation of the PMS

These activities, in addition to common techniques such as visual inspection and records, will be performed using the best technology available at the time of closure, and will be conducted in a manner that maintains personnel exposure to radiation levels as low as reasonably achievable and exposure to hazardous constituents to levels deemed acceptable by the DOE as discussed in Section D-9d(3). This Closure Plan will be amended prior to the initiation of closure activities to specify the D&D methods to be used, if appropriate.

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[2]Recent studies have shown that fill outside the waste emplacement region has negligible benefits for minimizing subsidence. Consequently, this function has been deleted from the WIPP base design. Such fills may, however, have long-term benefits and may prove to be desirable in the future. If need be, they will be included in future revisions of the Closure Plan.

[3]For the purposes of planning, the conclusion of shaft sealing is used by the DOE as the end of closure activities and the beginning of the Post-Closure Care Period.

Health and Safety

Before final closure activities begin, health physics personnel will conduct a hazards survey of the unit(s) being closed. A release of radionuclides could also indicate a release of hazardous constituents, in accordance with co-detection principles. If radionuclides are not detected, sampling for hazardous constituents may still be performed if there is evidence that a spill or release has occurred. The purpose of the hazards survey will be to identify potential contamination concerns that may present hazards to workers during the closure activities and to specify any control measures necessary to reduce worker risk. This survey will provide the information necessary for the health physics personnel to identify worker qualifications, personal protective equipment (PPE), safety awareness, work permits, exposure control programs, and emergency coordination that will be required to perform closure related activities.

I-1e(2)(a) Determine the Extent of Contamination

The first activities performed as part of decontamination include those needed to determine the extent of any contamination that needs to be removed prior to decommissioning a facility. This includes activities 1 to 3 above and, as can be seen by the schedules in Figures I-3 and I-4 (Items B and C), these surveys are anticipated to take ten months to perform, including obtaining the results of any sample analyses. The process of identifying areas that require decontamination include three sources of information. First, operating records will be reviewed to determine where contamination has previously been found as the result of historical releases and spills. Even though releases and spills will have been cleaned up at the time of occurrence, newer equipment and technology may allow further cleaning. Second, surfaces of facilities and structures will be examined visually for evidence of spills or releases. Finally, extensive detailed contamination surveys will be performed to document the level of cleanliness for all surface structures and equipment. If equipment or areas are identified as contaminated, a plan and procedure(s) will be developed and implemented to address decontamination-related questions, including:

- Should the component be decontaminated or disposed of as waste?
- What is the most cost-effective method of decontaminating the component?
- Will the decontamination procedures adequately contain the contamination?

The principle of co-detection will be used in determining the presence of hazardous waste and hazardous waste residues in areas where spills or releases have occurred. Co-detection is described in Appendix I3 and simply means that if radioactive contamination is found, it will be assumed that hazardous constituent contamination also occurs. Once cleanup of the radioactivity has been completed, the surface will be sampled for hazardous constituents to determine that they, too, have been cleaned up. Sampling will be in accordance with written procedures in the WIPP Site Effluent Hazardous Material Sampling Plans (Westinghouse, 1994), which provides for sampling protocols including QA/QC, organizational responsibilities, sample plan development, sample control, and laboratory selection and use. Sampling is established consistent with EPA's document SW-846 (EPA, 1986).

I-1e(2)(b) Decontamination Activities

Once the extent of contamination is known, decontamination activities will be planned. Radiological control and the control of hazardous waste residues are the primary criteria used in the design of decontamination activities. Radiation control procedures require that careful planning and execution be used in decontamination activities to prevent the exposure of workers beyond reasonable occupational levels and to prevent the further spread of contamination. Careful control of entry, cleanup, and ventilation are vital components of radiation decontamination. The level of care mandated by DOE orders and occupational protection requirements is what results in closure activities that will exceed the 180-days allowed in 20 NMAC 4.1, Subpart V. Decontamination activities are included as item 4 above and is shown on the schedules for contingency closure and final facility closure (Figures I-3 and I-4) as activities D, E, and F. These activities are anticipated to have a duration of 20 months for both contingency closure and for final facility closure. The result of these activities is the clean closure of the surface container management units. Under contingency closure, the other areas that have been decontaminated will not be closed. Instead they will remain in use for continued waste management activities involving non-mixed waste. Under final facility closure, other areas that are decontaminated are eligible for closure.

The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will provide for minimum need for decontamination. However, the need for decontamination techniques may arise.

Decontamination activities will be coordinated with closure activities so that areas that have been decontaminated will not be recontaminated. All waste resulting from decontamination activities will be surveyed and analyzed for the presence of contaminants. The waste will be characterized as hazardous, mixed, or radioactive and will be packaged and handled appropriately. Mixed and radioactive waste will be classified as TRU mixed waste managed in accordance with the applicable DOE Order(s) in place at the time of closure. Derived mixed waste collected during decontamination activities that are generated before repository shafts have been sealed will be emplaced in the facility, if appropriate, or will be managed together with decontamination derived waste collected after the underground is closed. This waste will be classified and shipped off site to an appropriate, permitted facility for treatment, if necessary, and for disposal.

Removal of Hazardous Waste Residues

Because of the type of waste management activities that will occur at the WIPP facility, waste residues that may be encountered during the operation of the facility and at closure may include derived waste. Derived wastes result from the management of the waste containers or may be collected as part of the closure activities (such as those during which wipes were used to sample the containers and equipment for potential radioactive contamination or those involving solidified decontamination solutions, the handling of equipment designated for disposal, and the handling of residues collected as a result of spill cleanup). Derived wastes collected during the operation and closure of the WIPP facility will be identified and managed as TRU mixed wastes. These wastes will be disposed of in the open-disposal HWMU. D&D derived wastes and equipment designated for disposal will be placed in the last HWMU panel before closure of that unit.

Surface Container Storage Units

The procedures employed for waste receipt at the WIPP facility allow no opportunity for any waste spillage to occur outside the WHB. TRU mixed waste is shipped to the WIPP facility in approved shipping containers (e.g., TRUPACT-IIs or shielded road casks) that are not opened until they are inside the WHB. Therefore, no soil in the parking area or elsewhere in the vicinity of the WHB will become contaminated with TRU mixed waste constituents as a result of TRU mixed waste management activities, and an evaluation of the soils in the vicinity of the WHB is unnecessary.

The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will minimize the need for decontamination of the WHB during decommissioning and closure. Procedures for opening shipping containers in the WHB limit the opportunity for waste spillage.

Should the need for decontamination of the WHB arise, the following methods may be employed, as appropriate, for the hazardous constituent/contaminant type and extent:

- Chemical cleaning (e.g., water, mild detergent cleanser, and polyvinyl alcohol)
- Nonchemical cleaning (e.g., sandblasting, grinding, high-pressure water spray, scabbler pistons and needle scalers, ice-blast technology, dry-ice blasting)
- Removal of contaminated components such as pipe and ductwork

Waste generated as a result of WHB decontamination activities will be managed as derived waste in accordance with applicable permit requirements and will be emplaced in the last open HWMU for disposal.

Equipment and Underground Waste Handling Areas

The waste hoist conveyance and associated waste handling equipment, as well as waste handling areas outside the disposal areas in the underground, will be decontaminated as needed as part of both contingency and final facility closure. Procedures for detection and sampling will be as described above. Equipment cleanup will be as above using chemical or nonchemical techniques. Contaminated areas in the underground will be managed on a case-by-case basis and may either be removed or entombed.

Personnel Decontamination

PPE worn by personnel performing closure activities in areas determined to be contaminated will be disposed of appropriately. Disposable PPE used in such areas will be placed into containers and managed as TRU mixed waste. Non-disposable PPE will be decontaminated, if possible. Non-disposable PPE that cannot be decontaminated will be managed as TRU mixed waste.

In accordance with DOE policy, TRU mixed waste PPE will be considered to be contaminated with all of the hazardous waste constituents contained in the containers that have been managed within the unit being closed. Wastes collected as a result of closure activities and that may be

contaminated with radioactive and hazardous constituents will be considered TRU mixed wastes. These wastes will be managed as derived wastes, as described in Section D-10a(3)(a). Such waste, collected as the result of closure of the WIPP facility, will be disposed of in the final open HWMU.

Cleanup Criteria

Radiation decontamination will be less than or equal to the following levels, or to whatever lesser levels that may be established by DOE Order at the time of cleanup:

Contamination Type	Loose[4]	Fixed plus removable
alpha contamination (α)	20 dpm/100 cm^2	500 dpm/100 cm^2
beta-gamma contamination (β-γ)	200 dpm/100 cm^2	1000 dpm/100 cm^2

Hazardous waste decontamination will be conducted in accordance with standards in 40 CFR Part 264, Subpart S.

Final Contamination Sampling and Quality Assurance

Verification samples will be analyzed by an approved laboratory that has been qualified by the DOE according to a written program with strict criteria. The QA requirements of EPA/SW-846, "Test Methods for Evaluating Solid Waste," will be met for hazardous constituent sampling and analyses.

Quality Assurance/Quality Control

Because decisions about closure activities may be based, in part, on analyses of potentially contaminated surfaces and media, a program to ensure reliability of analytical data is essential. Data reliability will be ensured by following a QA/QC program that mandates adequate precision and accuracy of laboratory analyses. Field documentation will be used to document the conditions under which each sample is collected. The documented QA/QC program in place at the WIPP facility meets DOE QA requirements.

Field blanks and duplicate samples will be collected in the field to determine potential errors introduced in the data from sample collection and handling activities. To determine the potential for cross-contamination, rinsate blanks (consisting of rinsate from decontaminated sampling equipment) will be collected and analyzed. At least one rinsate blank will be collected for every 20 field samples. Duplicate samples will be collected at a frequency of one duplicate sample for every ten field samples. In no case will less than one rinsate blank or duplicate sample be collected for a field-sampling effort. These blank and duplicate samples will be identified and

[4]The unit "dpm" stands for "disintegration per minute" and is the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

treated as separate samples. Acceptance criteria for QA/QC hazardous constituent sample analyses will be compatible with the most recent version of EPA SW-846 or other applicable EPA guidance.

I-1e(2)(c) Dismantling

Final facility closure will include dismantling of structures on the surface and in the underground. These are items 6 and 7 above and are represented as Activity G in the final facility closure schedule in Figure I-4. During dismantling, priority will be given to contaminated structures and equipment that cannot be decontaminated to assure these are properly disposed of in the remaining open underground HWMU in a timely manner. All such facilities and equipment are expected to be removed and disposed of 16 months after the initiation of closure. Dismantling of the balance of the facility, including those structures and equipment that are not included in the application and are not used for TRU mixed waste management, is anticipated to take an additional 66 months. It should be noted that the placement of D&D waste into the final underground HWMU may, by necessity, involve the placement of uncontainerized bulk materials such as concrete components, building framing, structural members, disassembled or partially disassembled equipment, or containerized materials in non-standard waste boxes. Such placement will only occur if it can be shown that it is protective of human health and the environment and all items are described in an amendment to the Closure Plan. Identification of bulk items is not possible at this time since their size and quantity will depend on the extent of non-removable contamination.

I-1e(2)(d) Closure of Open Underground HWMU

The closure of the final underground HWMU is shown by Activity H in Figure I-3. This closure will be consistent with the description in Section I-1e(1) and the design in Appendix I1. Detailed closure schedules for underground HWMUs are given in Figure I-2 and Table I1.

I-1e(2)(e) Final Facility Closure

Final facility closure includes several activities designed to assure both the short-term isolation of the waste and the long-term integrity of the disposal system. These include the placement of plugs in boreholes that penetrate the salt and the placement of the repository sealing system. In addition, the surface will be returned to as near its original condition as practicable, and will be readied for the construction of markers and monuments that will provide permanent marking of the repository location and contents.

Figure I-6 identifies where ten existing boreholes overlie the proximate area of the repository footprint. Of these identified boreholes in Figure I-6, all but ERDA-9 are terminated hundreds of feet above the repository horizon. Only ERDA-9, which is accounted for in long-term performance modeling, is drilled through the repository horizon, near the WIPP excavations.

To mitigate the potential for migration beyond the repository horizon, the DOE has specified that borehole seals be designed to limit the volume of water that could be introduced to the repository from the overlying water-bearing zones and to limit the volume of contaminated brine released from the repository to the surface or water-bearing zones.

Borehole plugging activities have been underway since the 1970s, from the early days of the development of the WIPP facility. Early in the exploratory phase of the project, a number of boreholes were sunk in Lea and Eddy counties. After the WIPP site was situated in its current location, an evaluation of all vertical penetrations was made by Christensen and Peterson (1981).

As an initial criterion, any borehole that connects a fluid-producing zone with the repository horizon becomes a plugging candidate.

Grout plugging procedures are routinely performed in standard oil-field operations; however, quantitative measurements of plug performance are rarely obtained. The Bell Canyon Test reported by Christensen and Peterson (1981) was a field test demonstration of the use of cementitious plugging materials and modification of existing industrial emplacement techniques to suit repository plugging requirements. Cement emplacement technology was found to be "generally adequate to satisfy repository plugging requirements." Christensen and Peterson (1981) also report "that grouts can be effective in sealing boreholes, if proper care is exercised in matching physical properties of the local rock with grout mixtures. Further, the reduction in fluid flow provided by even limited length plugs is far in excess of that required by bounding safety assessments for the WIPP." The governing regulations for plugging and/or abandonment of boreholes are summarized in Table I-3.

The proposed repository sealing system design will prevent water from entering the repository and will prevent gases or brines from migrating out of the repository. The proposed design includes the following subsystems and associated principal functions:

- Near-surface: to prevent subsidence at and around the shafts
- Rustler Formation: to prevent subsidence at and around the shafts and to ensure compliance with federal and State of New Mexico groundwater protection requirements
- Salado Formation: to prevent transporting hazardous waste constituents from the WIPP repository beyond the unit boundary

The repository sealing system will consist of natural and engineered barriers within the WIPP repository that will withstand forces expected to be present because of rock creep, hydraulic pressure, and probable collapses in the repository and will meet the closure requirements of 20 NMAC 4.1, Subpart V. Appendix I2 presents the repository sealing system design basis and performance evaluations. The design in Appendix I2 is conceptual. The DOE is currently preparing a final seal design report. This report will be provided to the NMED by October 1, 1996. The design drawings that will be included in the final design report are included in Appendix I2. These drawings are stamped preliminary because the final peer review has not been conducted. These drawings, in their final form, will accompany the final design report.

Once shaft sealing is completed, the DOE will consider closure complete and will provide the NMED with a certification of such within 60 days.

I-1e(2)(f) Final Contouring and Revegetation

In the preparation of its Final Environmental Impact Statement (DOE, 1980), the DOE committed to restore the site to as near to its original condition as is practicable. This involves removal of access roads, unneeded utilities, fences, and any other structures built by the DOE to support WIPP operations. Provisions would be left for active post-closure controls of the site and for the installation of long-term markers and monuments for the purpose of permanently marking the location of the repository and waste. Section I-1e(3) discusses the active and long-term controls proposed for the WIPP. Installation of borehole seals are anticipated to take 12 months, shaft seals 52 months, and final surface contouring 8 months.

I-1e(2)(g) Closure, Monuments, and Records

A record of the WIPP Project shall be listed in the public domain in accordance with the requirements of 20 NMAC 4.1, Subpart V, §264.116. Active access controls will be employed for at least the first 100 years after final facility closure. In addition, a passive control system consisting of monuments or markers shall be erected at the site to inform future generations of the location of the WIPP repository (see "Permanent Marker Conceptual Design Report" [DOE, 1995b]).

Closure of the WIPP facility will contribute to the following:

- Prevention of the intrusion of fluids into the repository by sealing the shafts
- Prevention of human intrusion after closure
- Minimization of future physical and environmental surveillance

Detailed records shall be filed with local, state, and federal government agencies to ensure that the location of the WIPP facility is easily determined and that appropriate notifications and restrictions are given to anyone who applies to drill in the area. This information, together with land survey data, will be on record with the U.S. Geological Survey and other agencies. The federal government will maintain permanent administrative authority over those aspects of land management assigned by law. Details of post-closure activities are in Section I-2.

I-1e(3) Performance of the Closed Facility

20 NMAC 4.1, Subpart V, §264.601 requires that a miscellaneous unit be closed in a manner that protects human health and the environment. The following addresses the performance of the closed facility during the 30-year post closure period.

The principal barriers to the movement of hazardous constituents from the facility or the movement of waters into the facility are the halite of the Salado Formation (natural barrier) and the repository seals (engineered barrier). Data and calculations that support this discussion are presented. The majority of the calculations performed for the repository are focused on long-term performance and making predictions of performance over 10,000 years. In the short term, the repository is reaching a steady state configuration where the hypothetical brine inflow rate is

affected by the increasing pressure in the repository due to gas generation and creep closure. These three phenomena are related in the numerical modeling.

I-1e(3)(a) Gas Generation

Gas generation affects repository pressure, which in turn is an important parameter in other processes such as creep closure, interbed fracture, and two-phase flow. The computer simulation of this process[5] uses an average-stoichiometry model to estimate the potential for gas generation in the waste disposal region. Parameter values for the average-stoichiometry gas generation model are summarized in Table I-4 and detailed in Appendix D16, §D16-5.

Gas generation processes considered in the simulation include anoxic corrosion and microbial degradation. Radiolysis is not included in the model on the basis of laboratory experiments and model calculations that demonstrate the process to be an insignificant gas generation mechanism compared to corrosion and biodegradation. For the purpose of calculating repository pressure and fluid flow, the properties of the generated gas are assumed to be those of H_2.

Specific to the simulation, anoxic corrosion of ferrous metals and microbial degradation of cellulosics, plastics, and rubbers is assumed to occur and generate gas at rates limited only by the availability of brine and solid reactants. Assuming that all cellulosics, plastics, and rubbers are available to degrade and participate in the gas generation process is a conservative assumption. This is because there are no reasonable mechanisms to mix microbes, moisture, cellulosics and nutrients in order to sustain degradation. Biodegradation is considered to have a 50 percent chance of occurring, primarily due to uncertainties in the long-term survival of microbes (Brush, 1995, pp. B-19 to B-24). These assumptions serve to maximize gas generation rates.

Anoxic corrosion is represented by an equation that accounts for corrosion only of the steel content in the repository by the two reactions expected to dominate corrosion rates. Because the total quantity of aluminum and aluminum alloys is a small fraction of the quantity of iron-based metals, corrosion of aluminum is omitted for simplicity. As corrosion proceeds the steel content of the repository is depleted over time. Brine is also consumed as gas generation proceeds. Effects of wicking (the retention of brine in a capillary fringe) on the corrosion gas generation rates are incorporated in the analysis through the use of a wicking parameter, as explained in Appendix D16, §D16-5. The DOE assumes no passivation of steel by interaction with microbial degradation reactions, a process capable of preventing anoxic corrosion. Important parameters in the corrosion equation are assigned fixed values, as summarized in Table I-4.

Similar to modeling anoxic corrosion, microbial degradation is represented by an equation with the inventory of cellulosics, plastic, and rubber material also depleted with time. Biodegradable materials are depleted at a rate dependent on the amount of liquid present. It is assumed that

[5]The DOE uses the code BRAGFLO to simulate repository. This code was developed by the Sandia National Laboratories specifically for the WIPP and is being used for the DOE's demonstration of compliance to long-term repository performance standards.

the microbial degradation process neither produces nor consumes water. Depending on parameter values, gas generation by microbial degradation in the computer simulation can continue until all degradable materials or available brine are consumed. Important parameters used to model microbial degradation are summarized in Table I-4 and discussed further in Appendix D16, §D16-5.

I-1e(3)(b) Brine Inflow

For the computer simulation used in this analysis, the DOE conceptualized the Salado as a porous medium composed of several rock types arranged in layers, through which fluid flow occurs according to Darcy's Law. This model was chosen because it can be simulated using standard numerical techniques and because it is the most conservative of the three mechanisms in that it predicts the maximum rate and cumulative volume of brine inflow. Two rock types, impure halite and anhydrite, are used to represent the intact Salado. Near the repository, the DRZ has increased permeability compared to intact rock and offers little resistance to flow between anhydrite interbeds and the repository. Except for the DRZ and anhydrite interbeds, under certain circumstances, this simulation assumes spatially constant properties for Salado rock types based on observations of compositional and structural regularity in layers exposed by the repository. The inference is that there is little variation in large-scale averages of rock or flow properties across the disposal system. Assumptions about Salado flow in general are presented in Appendix D16, §D16-6. This model serves to maximize the potential brine inflow to the repository.

Table I-5 shows various parameter values used in modeling the impure halite. Supported by four hydraulic tests in the WIPP underground believed to represent far-field conditions and stratigraphic variation in the Salado, the median value for permeability calculated for this region is 3.4×10^{-22} square feet (3.16×10^{-23} square meters [m^2]). Additional information on parameter values is contained in Appendix D16, §D16-6, including the distinction between rock compressibility and pore compressibility used in the simulation.

Gas may not be able to flow through or into intact, halite-rich strata of the Salado under realistic conditions for the repository. As halite is modeled as 100 percent brine saturated, the capillary resistance of the rock must be overcome to displace brine from pores and drive gas into the rock. This condition represents the concept of threshold pressure. While the permeability of halite is known to be low, its threshold pressure has never been measured. An empirical relationship between threshold pressure and permeability in non-WIPP rocks (Davies, 1991, pp.17–19) suggests that threshold pressure will be sufficiently high and gas will not be able to flow into the halite-rich strata of the Salado under any conditions foreseeable for the WIPP. Values used by the DOE for impure halite threshold pressure are set to prevent the flow of gas into this material. This is a conservative assumption, because gas flow into impure or pure halite would decrease the pressure in the repository and the driving force available for flow.

Three distinct anhydrite interbeds are modeled in the computer simulation representing MB 138, anhydrite layers a and b, and MB 139. The three interbeds are assigned identical parameter values, and these values are initially spatially constant. The interbeds differ only in stratigraphic location and thickness. The three interbeds are included in the model simulation, because they exist in the disturbed region around the repository within which fluid is expected to be able to

flow with relative ease compared to the surrounding formation. MB 139 and anhydrite layers a and b are present within the DRZ that forms around excavations; MB 138 may be above the DRZ, and is of no consequence during the post-closure period.

In the computer simulation, brine flows from the Salado and into the repository in response to fluid potential gradients that form over time. Due to the low permeability of the impure halite and relatively small surface area of the excavation, direct brine flow between the impure halite and the repository is limited. The interbeds, however, can serve as conduits for brine flow between the impure halite and the repository. Conceptually, brine flows laterally along higher-permeability interbeds towards or away from the repository and vertically between the interbeds and the lower-permeability halite. Because the interbeds have a very large contact area with adjacent halite-rich rock, even very small flux from the halite into the interbeds (for brine inflow) or to the halite from the interbeds (for brine outflow) can accumulate into a significant quantity of brine. In this manner, halite serves as a source or sink for brine in the repository. It is expected that, due to density differences between gas and brine and their stratification within the repository, brine outflow will dominate in underlying MB 139, and gas outflow will occur in anhydrite a and b or overlying MB 138. Parameters associated with the interbeds are shown in Table I-6.

I-1e(3)(c) Rock Properties

Creep closure is the focus of the computer model that implements the repository processes associated with rock properties in the repository rooms and the shafts. The amount of waste consolidation resulting from creep closure, and the time it takes to consolidate the waste, are governed by properties of the waste (waste strength), properties of the surrounding rock, the dimensions and location of the room, and the quantities and pressure of fluids present in the room. Creep closure of waste disposal areas will cause their volume to decrease as the Salado deforms to consolidate and encapsulate the waste, changing waste porosity and permeability. Waste strength and fluid pressure may act to resist creep closure.

Fluids that could affect closure are brine that may enter the repository from the Salado, air present in the repository when it is sealed, and gas produced by reactions occurring during waste degradation. Closure and consolidation slowed by fluid pressure in the repository can be quantified according to the principle of effective stress:

$$\sigma_T = \sigma_e + p \qquad (1)$$

where σ_T is the stress caused by the weight of the overlying rock and brine (an essentially constant value), p is the pressure of the repository pore fluid, and σ_e is the stress that is applied to the waste skeleton or matrix. In this formulation, the waste is considered a skeleton structure immersed in pore fluids. As the pore pressure increases, an increasing amount of overburden stress is supported by pore fluid pressure, and less overburden stress is supported by the strength of the waste matrix. Due to waste strength, waste consolidation can cease even if pore fluid pressures do not reach lithostatic. If gas and brine quantities in the repository stabilize, creep closure will act to establish a constant pressure and void volume.

Two material-response models are required for closure analyses within the disposal room. The first describes how the halite in the formation surrounding the waste deforms (creeps) as a function of time and stress. The second model describes the state of consolidation of the waste as a function of applied stress.

Halite deformation is predicted using a multimechanism deformation (M-D) steady-state creep model with workhardening/recovery transient response (Model 1). At the WIPP, there are potentially three distinct creep mechanisms involved, which are governed by the temperature and shear stress at a given location in the surroundings at any given time. WIPP conditions are expected to be isothermal so temperature is treated as a constant value. All three mechanisms can be active at the same time because of the large range of stress states that occur around underground rooms and shafts.

The focus of the mechanistic part of the model is definition of steady-state creep strain, with transient creep strain described through a multiplier on the steady-state rate, thus accommodating both transient changes in stress loading and loading. More information is presented in Munson et al. (1995).

The volumetric plasticity part of the model is the mathematical model for room closure and waste consolidation. The experimental data used in this model are summarized and interpreted in Butcher et al. (1991, pp. 65-76) and Luker et al. (1991). The volumetric plasticity model and M-D model are numerically implemented.

As a boundary condition, the computer code requires estimates of the fluid pressure and, hence, the initial quantity of gas present in a disposal room. These estimates are obtained using the average-stoichiometry model of gas generation with different rates of gas generation that reflect different assumptions about the quantity of brine that might be available in a waste disposal room. The different rates of gas generation used in the analysis bound the possible conditions for gas content in the repository. With the volumetric plasticity model and the fluid pressure boundary condition, the code calculates the void volume of the disposal room through time.

In the computer simulation, the time-dependent effects of creep closure on volume are linked to the fluid flow via a look-up table, which relates porosity or void volume to: a) time after sealing, and b) gas pressure. At the beginning of a time step, the fluid flow code evaluates the pressure of a cell in the waste disposal region. The code then consults the look-up table to find the void volume of the cell appropriate for a given time and pressure. The void volume in the cell is iteratively adjusted during a time step solution for consistency with gas generation, fluid movement, and repository pressure. The look-up table method of incorporating the dynamic effect of creep closure in the simulation has been compared to more complex techniques that are computationally impractical. In these comparisons, the porosity surface method was found to be a reasonable representation of behavior observed in more complex models. Parameter values used in the computer simulation for repository and panel closure are given in Appendix D16, Section D16-7.

The four shafts connecting the repository to the surface are represented in the computer simulation with a single shaft. This single shaft has a cross section and volume equal to the total cross section and volume of the four actual shafts and is separated from the waste disposal

region in the model by the true north-south distance from the waste to the nearest shaft (the Waste Shaft).

Seal component materials and properties used in the simulation are given in Table I-7. From top to bottom, the seal system is represented in the simulation by the following materials (see Appendix I2):

- an earthen fill region above the Rustler Formation
- a clay region in the Rustler Formation (designated Rustler Compacted Clay in Table I-7)
- an asphalt region at the top of the Salado
- three concrete sections (upper, middle, lower) within the Salado
- a thick section of compacted crushed salt within the Salado
- an upper compacted clay region within the Salado (designated Upper Salado Compacted Clay in Table I-7)
- a lower compacted clay region within the Salado (designated Lower Salado Compacted Clay in Table I-7)
- a basal clay component below MB 138 (designated Bottom Clay in Table I-7)
- a lower concrete section at the repository horizon (shaft station concrete monolith)

Conceptually, the simulation considers the maturation of the DRZ surrounding the shaft with respect to variation in the rate of DRZ healing with depth, time, and the type of adjacent seal material. For example, the DRZ in the halite adjacent to concrete members is assumed to heal very rapidly because of the rigidity of the concrete and the high lithostatic stress. Against less rigid seal components and at higher elevations in the shaft, the DRZ is assumed to heal more slowly. Depending on shaft material properties and depth of emplacement, the simulation also considers potential time-dependent consolidation.

To reflect shaft material consolidation and DRZ maturation, effective permeabilities of selected shaft regions are adjusted with time in a stepwise fashion (Table I-7). In some halite shaft regions enhanced flow is expected through the surrounding DRZ, before healing occurs. In this case, the increased permeability is modeled by increasing the permeability of the adjacent shaft seal component. In some cases, this adjustment acts to counteract the expected decrease in permeability resulting from consolidation. The increase in permeability noted for concrete from 1.8×10^{-19} to 10^{-14} m^2 is conservative; the permeability of concrete within the Salado section of the shaft is not expected to degrade to the permeability of silty-sand, and, in fact, physical and hydraulic properties of concrete seals are expected to remain stable over the long-term. Note that Appendix D16, §D16-8 lists only the initial permeability for shaft materials within the Salado and not the effective permeabilities calculated for each time step presented in Table I-7.

I-1e(3)(d) Contaminant Transport Calculations

A computer simulation of disposal system performance has been completed for the DOE's demonstration of no-migration. This simulation, along with supporting documentation, is due to be submitted to the EPA in June 1996. Those portions of the simulation that are applicable to the closed panel and sealed shaft configurations, are summarized here as background for the subsequent discussions of pathways and environmental protection and to support the DOE's demonstration of compliance with the environmental performance standards in 20 NMAC 4.1, Subpart V, §264.601.

The computer simulation for the no-migration determination was conducted to predict disposal system performance over 10,000 years. Only the first 300 years are discussed here. This period goes sufficiently beyond the post-closure period to depict trends in the calculations.

Caution should to be exercised in using this simulation for interpreting repository performance prior to shaft sealing and during the first 100 years of the simulation. This is due to several reasons:

- The simulation assumes higher gas generation rates than anticipated in order to assure sufficient gas is present to evaluate the disposal system performance.
- The simulation assumes anoxic conditions exist from the outset and the gas generation rates are those observed for anoxic conditions. It is anticipated that oxic conditions will prevail during the initial closure period, during which time there will likely be no gas generation.
- The model does not account for any dewatering of the DRZ that may have occurred during operations when the excavated surfaces were exposed to the ventilation system.
- The model assumes the repository is filled instantaneously.

These limitations notwithstanding, the modeling process and the results, along with the raw and interpreted data, are useful in the discussion of repository performance during the period covered by the hazardous waste permits. A summary of the output for the first 300 years is shown in Table I-8.

The conceptual model used in this simulation includes creep closure of the waste-disposal panels, a process that will act to consolidate waste in the disposal areas. The altered stress field created by the excavation will also result in a system of fractures surrounding the excavation and the shaft, referred to as a DRZ. The conceptual model considers brine inflow to the waste-disposal panels in response to pressure gradients created by the excavation. Opposing brine inflow is the pressure increase expected in the repository resulting from creep closure and waste-generated gas. In general pressure increases due to closure and gas generation, may retard consolidation of the waste region and cause brine and gas to migrate away from the repository. The conceptual model includes two-phase flow from the repository and dilation or fracturing of interbeds, a process capable of accelerating the mass transport of contaminants.

The primary software code used in the simulation is BRAGFLO (BRine And Gas FLOw). BRAGFLO calculates the overall movement of gas and brine in the disposal unit formations and defines the flow fields for contaminant migration post-processing codes. BRAGFLO also contains the submodels for estimating gas generation in the repository, disposal room closure and consolidation, and interbed fracturing. Changes in void volume of the waste resulting from creep closure are coupled to BRAGFLO through SANTOS, a code that provides a look-up table used as a reference to track changes in room volume.

Actual quantities of hazardous constituents in waste containers can only be approximated from available waste characterization data. Furthermore, actual quantities available for transport are controlled by both the waste form and hazardous constituent mobility or immobility in the post-closure environment. Mobility is in turn controlled by long-term physical and chemical processes (e.g., availability of transport media and release mechanisms). Given these constraints, this simulation defines the source term, where appropriate, as the maximum concentration of hazardous constituents in a particular phase.

For the sealed shaft configuration, weighted average concentration for each VOC is used as the source term concentration in cases where waste characterization data are available. Weighted headspace concentrations are corrected for void volume conditions expected in the repository. In cases where no waste characterization data are available, saturated vapor concentrations are used to represent source term concentrations for VOCs. Because waste characterization data are also not available for semi-volatile compounds, saturated vapor concentrations are also assumed for this class of organic constituents. Releases of gas to the soil is modeled, therefore soil-based concentrations are calculated assuming gas-available porosity within shaft seals and within anhydrite marker beds at the subsurface disposal unit boundaries and then compared to health based limits for soil.

The DOE concludes that an organic liquid-phase source term is required only if compliance cannot be demonstrated for organic gas-phase compounds using bounding calculations. For these bounding calculations, the assumptions of no partitioning between the gas and the liquid phases ensures that maximum concentrations are used for the gas-phase source term. Because organic constituents must partition into the liquid phase from the gas phase according to Henry's Law, the concentrations in the brine phase must be less than that for the gas phase. If compliance can be demonstrated for the organic gas phase, liquid-phase compliance is also demonstrated.

The simulation results presented in Figures I-7 to I-12 and discussed below are based on a conservative assumption of higher than expected gas generation rates. Gas generation is purposely modeled in this manner to maximize the potential for migration of brine and gas away from the repository and into the anhydrite interbeds and sealed shaft. The modeling approach implemented is conservative, based on the assumption that the entire inventory of ferrous metals, cellulosics, plastics, and rubbers in the waste is available to generate gas. No credit is taken for the 50 percent probability that biodegradation may not occur and result in lower gas generation rates.

The simulation indicates that average pressure in the waste disposal region increases with time (Figure I-7). The pressure increase is primarily attributed to gas being generated more quickly

than pressure can be relieved by fluids flowing out of the anhydrite layers or up the sealed shaft. Smaller contributions to the pressure build-up occur through reduction of void volume by creep closure. For the high gas generation conditions assumed, pressure rises rapidly from atmospheric pressure to about 725 lb/in.^{2} (5 MPa) over the first 100 years after shaft seal placement. The total amount of gas generated by biodegradation and by anoxic corrosion during 300 years is shown in Figure I-8. Approximately 420 moles of gas per drum are generated during the first 100 years.

The simulation shows that brine flows into the repository from the DRZ and the far field (Figure I-9). At the same time, the pore volume (void space) present in the repository is being reduced by creep closure, as shown in Figure I-10. Eighty-nine percent of the brine inflow occurs during the first 50 years, (562 m^3 of brine per panel). Total void volume in a panel decreases from 37,099 to 16,709 m^3 during the first 50 years. The closure rate subsequently slows. (The minimum pore volume is achieved after 1060 years.)

The average brine saturation in the panel is depicted in Figure I-11. The initial increase in brine saturation during the first 50 years is due to brine inflow, to rapid creep closure, and a sharp reduction in pore volume in the waste. Once the repository ceases to close, brine consumption due to corrosion causes brine saturation to decrease. Figure I-11 shows this transition as a sharp increase in average brine saturation to just above five percent (at 50 years) followed by a steady decrease.

The simulation indicates the consumption of ferrous metals occurs by corrosion (Figure I-12). Figure I-12 shows similar behavior involving consumption of the inventory of biodegradable materials. In order for biodegradation and corrosion to take place sufficient brine must be present to inundate the waste. However, microbial degradation is assumed to proceed at inundated rates even in the absence of brine. The moisture originally present in the waste, together with the brine flowing into the repository, are consumed by the ongoing corrosion but is not consumed by biodegradation processes. Both processes eventually are limited by the lack of brine and proceed at much lower rates. As noted earlier, the reduction in brine inflow (and resulting brine availability) is a direct consequence of the pressure increase from gas generation and creep closure.

The simulation indicates no brine leaving the waste disposal region during the post-closure period. This conclusion results from two factors. First, the pressure never gets high enough to drive brine or gas from the disposal zone. Second, a comparison of calculated brine saturation in the waste region (see Appendix D16, §D16-7) with the estimated residual brine saturation (S_{br}) of the waste. As described in Appendix D16, §D16-7, S_{br} is the brine saturation required to permeate the waste matrix sufficiently to create an incipient network of interconnected pores. Wetting phase relative permeability begins at the residual brine saturation; below this point, brine existing in the waste matrix remains immobile.

Appendix D16, §D16-7 discusses the bases for the residual brine saturation of the post-closure waste region. Essentially, this demonstration takes advantage of literature-based data of residual brine saturations measured for unconsolidated analog materials. As an analog, the waste region is initially unconsolidated; the degree of consolidation increases rapidly with decreasing pore volume relatively early into the simulation, as indicated in Figure I-10.

I-2 Post-Closure Plan

The post-closure care period begins after completion of closure of the first HWMU unit and continues for 30 years after final facility closure. The DOE's post-closure care period may be shortened or lengthened at the discretion of the NMED, based on evidence that human health and the environment are being protected or are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards applicable to the facility. During this period, the DOE will employ active institutional controls as necessary.

This post-closure plan focuses on activities following final facility closure. However, some discussion of post-closure following panel closure is warranted since some panel closures will occur long before final facility closure. As discussed in Section I-1e(1), panel closures have been designed to require no post-closure maintenance. The DOE has defined a post-closure care program for closed panels that has three aspects. These are routine inspection of the openings in the vicinity of the closures, the sampling of ventilation air for harmful constituents, and a VOC Confirmatory Monitoring Program. The rules of the Mine Safety Health and Administration drive the implementation of the first two programs. These rules require that underground mines monitor air quality to assure good breathing air whenever personnel are underground and that mine operators provide safe ground conditions for personnel in areas that require access. Routine monitoring of the openings in the access ways to panels will be continued and these openings will be maintained for as long as access into them is needed. This includes continued reading of installed geomechanical instrumentation, sounding the areas, visual inspection and maintenance activities such as scaling, mining, or bolting as required and as described in Section D-10d(1). In addition, all areas in the underground that are occupied by personnel are checked prior to each day's work activities for accumulations of harmful gases, including methane. Action levels for increasing ventilation to areas that show high levels of harmful gases are specified as described in Section F-4g.

These monitoring programs will be carried out during the period between the closure of the first panel and the initiation of final facility closure for the underground facility. The DOE has prepared a VOC Confirmatory Monitoring Plan (VCMP) which will be implemented to confirm that the assumptions and predictions used to demonstrate compliance to the environmental performance standards are valid. Validity is shown when observed emissions are equal to or less than those predicted. The VCMP is provided in Appendix D20. The VCMP includes monitoring design, sampling and analysis procedures and quality assurance objectives. This plan is submitted in compliance with 20 NMAC 4.1, Subpart V, §264.602 and §270.23(a)(2).

In this application, the DOE demonstrates the theoretical compliance with the environmental performance standards of 20 NMAC 4.1, Subpart V, §264.601(c). This VCMP describes a sampling and analysis program to confirm the theoretical calculations. The monitoring program is capable of quantifying VOC concentrations in the ambient mine air at the WIPP. The VCMP addresses the following information requirements:

- Rationale for the design of the monitoring program, based on possible pathways, operations, engineered and natural barriers, and monitoring locations optimized for detection.

- Descriptions of the specific elements of the monitoring program including the type of monitoring, the location of stations, the frequency of sampling, the target analytes, the schedule for implementation, the equipment used, the sampling and analytical techniques, and the data recording and reporting procedures.

The DOE's intent is to collect air samples upstream and down stream of Panel 1 beginning just prior to waste emplacement and proceeding until at least six months following completion of panel closure. The DOE will continue monitoring until the criterion for terminating monitoring are met. These criterion are established in Appendix D20 for each target analyte.

The current VOC monitoring program uses EPA Compendium Method TO-14. The DOE has had success with TO-14 at the WIPP if care is taken in placing sampler to avoid high dust and if stringent cleaning requirements are imposed for the clean canisters. This is necessary because of the extremely low concentrations that are being monitored. The DOE is evaluating the use of the Fourier Transform Infra-Red (FTIR) technique for monitoring VOCs at WIPP. This method is being used successfully at other locations and has recently been approved by the EPA for measuring the concentration of VOCs in the headspace gases of drums of TRU waste. If FTIR becomes viable, the monitoring plan will be revised and the revisions will be submitted to the NMED for approval prior to implementation.

The VCMP will be run under a Quality Assurance Plan that conforms to the document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations". Quality Assurance criteria for the target analytes are presented in Table D-10. Definitions of these criteria are given in Appendix D20 along with a discussion of other aspects of the Quality Assurance Program including sample handling, calibration, analytical procedures, data reduction, validation and reporting, performance and system audits, preventive maintenance, and corrective actions.

I-2a Post-Closure Plan after Final Facility Closure

A number of regulations deal with the period of time that begins once the WIPP has undergone final facility closure and decommissioning. Under 40 CFR Part 191, the period consists of an active control period and a passive control period; only 100 years of the active control period can be used in performance assessment. Under the no-migration standard in 40 CFR §268.6, the EPA is interested in the measures the DOE will take in terms of long-term passive institutional controls "...such as land withdrawal, records, and markers--to ensure that the likelihood of human intrusion is appropriately reduced, even after active control of the facility has ceased and any permits at the site may have terminated." (EPA, 1990) The Land Withdrawal Act (LWA) of 1992 requires that the DOE prepare and submit a post-decommissioning land management plan. 20 NMAC 4.1, Subpart V, §264.117 requires post-closure care, including monitoring, security, and property use. Because of the numerous regulations, the DOE has prepared a single strategy for post-closure management of the WIPP. This strategy consists of three elements: 1) active controls, 2) monitoring, and 3) passive controls. Although only the first and second elements occur within the post-closure period covered by this permit, all three elements are described.

I-2a(1) Active Institutional Controls

Once a facility is decommissioned, positive actions (referred to as "active institutional controls") should be taken to assure proper maintenance and monitoring. The EPA, in 40 CFR Part 191, §191.14(a) has specified that active controls should be maintained for as long as practicable and that no more than 100 years of active institutional control can be assumed in predictions of long-term performance. This assumption assures that future protection and control does not rely on positive actions by future generations.

The DOE's active institutional control program has a primary objective of addressing all applicable requirements, including restoring the WIPP site as nearly as possible to its original condition, and thereby equalizing any preference over other areas for development by humans in the future. Restoration of the WIPP site includes any necessary remedial actions or cleanup of releases resulting from decommissioning. In addition, as part of the active institutional control program, the DOE will implement monitoring systems suitable for assessing disposal system performance if such monitoring is feasible.

The DOE currently plans to implement the active institutional control program in five steps, each of which are described in more detail below:

Step 1 - Identification of Active Institutional Control Measures

The first step in the process of implementing the active institutional control program is to identify measures needed to satisfy the active institutional control requirements. It is anticipated that certain characteristics of active institutional control measures, such as minimizing bias toward the site, warning of potential hazards, providing meaningful data, preserving knowledge, using state-of-the-art technology, implementing such measures for at least 100 years, addressing the standards, and deterring systematic development, will be identified and used to judge the usefulness of active institutional control programs.

A detailed explanation of the active institutional controls selected by the DOE as part of this first step is provided in Appendix I4, entitled WIPP Active Access Controls after Disposal, Design Concept Description. This is the DOE's reference design for active institutional controls. The reference design will be reviewed periodically and updated as appropriate during WIPP disposal operations. The ongoing review and evaluation ensure that the active institutional controls implemented are appropriate for the conditions that may exist at that time. The DOE will review the reference design prior to implementation and all affected regulatory agencies will be consulted as part of this review.

As part of the active institutional controls program, the DOE has developed a set of design criteria upon which the reference design is based. These design criteria provide a description of how the active institutional controls will be implemented. These are as follows:

- A fence line shall be established to control access to the repository's footprint area (the waste disposal area projected to the surface). A standard wire fence shall be erected along the perimeter of the repository surface footprint. The fence shall have gates placed approximately midway along each of the four sides.

- An unpaved roadway along the perimeter of the barbed wire fence shall be constructed to provide ready vehicle access to any point around the fenced perimeter, to facilitate inspection and maintenance of the fence line, and to permit visual observation of the repository footprint to the extent permitted by the lay of the land. This roadway shall connect to the paved south access road.

- To ensure visual notification, the fence line shall be posted with signs having as a minimum, a legend reading "Danger—Unauthorized Personnel Keep Out" and a warning against entering the area without specific permission of the DOE (or other local authority such as the Eddy County Sheriff's Office).

- Contractual arrangements shall be developed to ensure that periodic inspection and necessary corrective maintenance is conducted on the fence line, its associated warning signs, and the roadway. The DOE will maintain control over all contractual work and will maintain, in the operating record, the results of all inspections and maintenance activities.

- Through direct DOE staffing support and/or contractual arrangements, procedures shall be established to provide routine periodic patrols and surveillances of the protected area by personnel trained in security surveillance and investigation.

- Processes will be developed for monitoring and controlling the long-term testing requirements of the PMS.

- Processes will be developed for implementing the periodic monitoring requirements of the disposal system's monitoring program. Initially, the procedures currently in place in such documents as the Environmental Monitoring Plan (see Appendix D5) will be used.

- Recommendations will be developed for modifications to the active institutional controls appropriate for access control and surveillance upon installation of the PMS.

- Guidelines will be developed for recommending mitigating actions to be taken to address any abnormal conditions identified during periodic surveillance and inspections.

- Reports of activities associated with the post-disposal active access controls shall be prepared in accordance with regulatory requirements for submittal to the appropriate regulatory and legislative authority.

Details on meeting these criteria are found in Appendix I4.

Step 2 - Preparation of a Post-Decommissioning Land Management Plan

Section 13(b) of the LWA requires the DOE to prepare and submit by October 30, 1997, a plan for managing the land withdrawal area after decommissioning the WIPP facility. This plan will include a description of both the active and passive institutional controls that will be imposed

after decommissioning is complete. This plan will be prepared in consultation with the Department of Interior and the state of New Mexico.

Step 3 - Gathering of Data Necessary for Implementing Active Institutional Control Measures

It may be useful to gather additional data to support implementation of the referenced Active Institutional Control Design. This includes an ongoing assessment of conditions that could affect active institutional controls. Information regarding land use and population trends gathered during the Disposal Phase will be taken into account in implementing post-closure surveillance.

Step 4 - Preparation of the Active Institutional Control Plan

An active institutional control plan will be prepared as part of the overall site D&D strategy. This will be done in accordance with a written plan, which will be initiated prior to actual plant closure, and will contain all the information needed to implement the active and passive institutional controls for the WIPP facility. Active institutional control planning will be based on the reference design and will take into account the most current information regarding the facility and its vicinity and will make use of state-of-the-art materials and techniques. This plan will include acceptable decontamination levels, sampling and analysis plans, and QA/QC specifications.

Step 5 - Implementation of Active Institutional Control Measures

Most of the active institutional control measures, such as long-term site monitoring and site remedial actions, will be implemented simultaneously with decommissioning. However, it may be possible to implement some measures earlier. For example, salt disposal may begin prior to final plant closure. Reclamation and restoration of unused disturbed surface areas has already begun. Guarding and maintenance activities, which are already in place, could evolve into an appropriate type of post-closure activity.

I-2a(2) Monitoring

Because the WIPP is a mined geological repository that is designed to permanently isolate contaminants, no post-closure monitoring for the detection of releases is needed since the migration of contaminants is unlikely during the disposal and Post-Closure Care Periods. This is substantiated by the analysis of closure system performance as described in Section I-1e(6). However, the NMED has indicated that it is their policy to require the DOE to perform groundwater monitoring regardless of whether or not the WIPP is eligible for a groundwater monitoring waiver. Because of this, the DOE has prepared a post closure groundwater monitoring plan for implementation after the completion of final facility closure. Post-closure groundwater monitoring will involve a continuation of the monitoring plan in Appendix D18 as described in Section D-10d(1)(a). The frequency will be changed to biannually after final facility closure is complete. In addition, the final target analyte list shown in Table D-12 may be adjusted based on final volume of waste.

I-2a(3) Passive Institutional Controls

Passive institutional controls include markers that warn of the presence of buried nuclear waste and identify: 1) the boundary of the disposal area footprint, 2) external records about the WIPP repository, and 3) continued federal ownership.

Passive institutional controls, as opposed to active institutional controls, are controls that once established, can be expected to remain effective with minimal human surveillance and maintenance, or maintenance resulting from normal governmental activities. Passive controls may be instituted at the site, a remote location, or both.

With regards to passive controls, the DOE interprets the phrase "federal ownership and regulations regarding land or resource use" to mean that the DOE or some successor agency with nuclear waste management expertise will retain administrative control over the land. "Administrative control" means that the federal agency responsible for the land will institute regulations that impose appropriate restriction on land use and development. Regarding the WIPP facility, the DOE interprets the term "markers" to include any on-site structures engineered and constructed as a means of preserving knowledge of the location of the wastes and conveying associated hazards. The DOE interprets "records" to include any written information regarding the site and its contents, which are maintained to preserve knowledge of the site. The DOE intends to use passive institutional controls (ownership, markers, and records) throughout the entire controlled area.

In the proposed No-Migration Determination for the WIPP facility (EPA, 1990), the EPA discussed the use of passive controls as part of an overall strategy to protect a land disposal facility and to decrease the likelihood of human disruption. The EPA believes that, in the context of RCRA no-migration variance decisions, the question of human intrusion, either during operations or after closure, is best addressed through a consideration of the likelihood of intrusion, and the imposition of controls to make such intrusions unlikely events. The EPA emphasizes that this approach to human intrusion is consistent with its general approach under RCRA, both in permitting and variances. Under RCRA, the EPA typically relies on institutional controls (both active and passive) imposed through general regulatory standards and site-specific conditions (e.g., in RCRA permits) to ensure that access to a hazardous waste disposal site is appropriately restricted. The EPA believes that any permanent no-migration variance for the WIPP will have to impose long-term passive institutional controls, such as land withdrawal, records, and markers—to ensure that the likelihood of human intrusion is appropriately reduced, even after active control of the facility has ceased and any permits at the site may have terminated.

The DOE is committed to retaining control over the WIPP site for as long as possible. Accordingly, an extensive system of explanatory markers and records will be instituted to warn future generations about the location and dangers of these wastes. The agency assumed that society in general will retain knowledge about these wastes and that future societies should be able to deter systematic or persistent exploitation of a disposal site.

The objective of the DOE's passive institutional control program for the WIPP is to accomplish the following:

- Ensure a record of the disposal site and its contents are preserved
- Warn those who attempt to enter the disposal site vicinity of the hazards associated with activities that would disturb the subsurface

The DOE believes that passive institutional controls will render human intrusion sufficiently unlikely so that the possibility need not be included in the long-term performance calculations.

A substantial amount of work has been completed in the area of passive institutional controls at the WIPP facility.

- *DOE Ownership.* The DOE has been successful in gaining control of the entire surface of the 16-section WIPP site and the entire subsurface, except for Section 31 where DOE control extends over the surface and the first 6,000 feet (ft) (1,829 meters [m]) of the subsurface, including the acquisition of oil, gas, and potash leases. The area now under the control of the DOE includes the following sections in Township 22 South, Range 31 East: 15, 16, 17, 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32, 33, and 34.
- *Land Use Controls.* Land use controls have been implemented addressing allowable uses of the withdrawal area.

Beyond land ownership and implementation of use controls, which are the key preclosure passive controls, there are six steps that have been identified for the WIPP passive institutional control program.

Step 1 - Definition of Passive Institutional Controls Appropriate for the WIPP

The process of defining the passive institutional controls for the WIPP disposal site is based on the controls identified in 40 CFR Part 191, §191.12. This includes items such as records, markers, monuments, legal documentation, federal control, land use restrictions, and other methods of preserving knowledge.

The current conceptual design for post-closure passive institutional controls is described in the Permanent Marker Design Report (DOE, 1995b). The design includes:

- Large surface monuments and earthen structures to mark the repository footprint
- One or more on-site buried rooms for the long-term storage of messages describing the nature of the repository
- Small subsurface markers
- Off-site archival storage of information pertaining to the WIPP, including its potential hazards

Shaft-Location Markers

The controlled area will be identified by these passive institutional controls. Markers showing the locations of shafts will consist of permanent surveyor markings engraved with the site elevation and coordinates. The markers will be firmly anchored to the shaft plug and will also contain site description, date of closure, land survey data, and other information required by applicable regulations. A uniform system of coordinates will be adopted. The definitions of these coordinates will be included in the permanent records.

Permanent Marker System

A PMS designed to minimize the possibility of inadvertent human intrusion into the repository over the long-term, following the cessation of active controls, will be implemented at the WIPP facility. The PMS will be comprised of messages, surface monument markers, small subsurface warning markers, on-site rooms for long-term storage of messages, archival storage of WIPP information off-site, and large earthen structures marking the WIPP repository footprint on the surface. The PMS is still in the conceptual design process and will evolve prior to closure, based on activities to test marker effectiveness during disposal, decommissioning, and active access controls periods. Actual construction of the PMS will be completed 100 years following closure of the WIPP facility, in accordance with WIPP Active Access Controls After Disposal Design Concept Description (March 1995b).

The PMS will provide a durable record of the repository's existence, and its design will provide reasonable assurance that it will endure for at least 10,000 years. The system will be clearly visible from any portion of the repository's surface footprint. The current PMS design basis, proposed for detailed design, consists of a large earthen berm enclosing the perimeter of the repository's surface footprint. The design basis for the berm is for a minimum width of 100 ft (30 m) and a height of 31 ft (10 m), with a 1.3 horizontal to 1.0 vertical slope. The berm would be designed to provide a dielectric or magnetic anomaly when compared to the local surface characteristics. Large monoliths would be arranged just inside the berm. The number of monoliths would be sufficient to allow future generations to reconstruct monolith orientation with several monoliths missing. An information center would be placed at the center of the monoliths, and two storage rooms would be buried about 20 ft (6 m) below the footprint. The PMS components will be designed and constructed to resist erosional and depositional effects. Construction materials will be selected for durability under the local climatic conditions and the predicted changes to those conditions in the long term.

Monuments will be engraved with the most critical warning information in a concise format, inscribed to a minimum depth of 0.5 inches (1.3 centimeters). More detailed information regarding the repository content, caution against intrusion, and the time of emplacement will be provided in protected vaults buried underground and in a surface information center. The information will be provided in multi-language translation and will include an assortment of symbols, pictographs, and diagrams to convey danger of intrusion. Universal symbols will enhance the likelihood of understanding by people of different backgrounds. To minimize the likelihood of future salvaging, the marking system will use materials with as little intrinsic value as is reasonable.

Subsurface markers would be less than 2 ft (0.6 m) in the longest dimension, made of inert material, and spaced so that they are likely to be discovered by drilling crews and professional archaeologists. The warning message would be engraved so that slight erosion or fracture of the marker would not render it completely unintelligible. In addition, the markers would be buried at a greater depth than that used for plowing/tilling operations or for amateur archaeological excavation, so that such activities would be unlikely to disturb them. Further details on the subsurface markers may be obtained from the WIPP Active Access Controls After Disposal Design Concept Description (March 1995b).

Written Records

Written documentation of the WIPP will be placed in local, state, and federal agencies. Documentation will also be provided to international entities and commercial organizations that act as resource information centers for the petroleum and gas industries. Records will use the most stable and durable media available at the time that the record deposits are made. These records will describe the location of the repository; the nature and hazard of the waste; the geologic, geochemical, and hydrologic data pertinent to waste containment; and environmental monitoring data from preoperational baseline and summaries of data collected during D&D activities. Overall record selection for storage at the agencies selected will be in accordance with federal, state, and local regulations.

Specific documents which will be included in the archived information portfolio include:

- Detailed maps describing the exact location of the repository
- The SAR and the addenda which describes the disposal phase of the WIPP
- The Final Environmental Impact Statement for WIPP and the Supplement(s) to the Environmental Impact Statement
- The RCRA Permit
- The Certification of Compliance with 40 CFR Part 191 and associated application
- Environmental and ecological background data collected during the preoperational phase of WIPP and summaries of data collected during the disposal and decommissioning phases of WIPP
- Records of the waste containers' contents and disposal locations within the WIPP repository
- Drawings defining the construction and configuration of the repository and shafts

- Drawings, procedures, and the design report(s) describing how the waste was emplaced; how the repository was decommissioned, closed and sealed; and how the shafts were sealed

The organization identified as the record holder responsible for the permanent storage of this information is the National Archives. In addition, other locations for this information will include publicly funded organizations which may expend the resources necessary to preserve the documents in well-controlled environments. However, the most likely strategy for long-term protection of the information is through widespread distribution. The information will be submitted to the following facilities and organizations for archiving:

- Library of Congress

- Within the states of New Mexico and Texas

  - The state archives
  - The state library
  - The city libraries of population centers exceeding 15,000 within 150 miles of Carlsbad

- The state libraries of the remaining 48 states

- The local office of the Bureau of Land Management

- The local office of the Bureau of Mines

- The local office of the Bureau of Reclamation

- The national library and national archives of the nations worldwide which possess nuclear weapons and/or operate nuclear power generating plants

- The archive of the United Nations

- The national archive and libraries of the signatory nations to the nuclear non-proliferation treaty

- The U.S. Nuclear Regulatory Commission

- The 53 federal regional depository libraries

- The American Nuclear Society

This list of receiving organizations will be reviewed and expanded, as appropriate, as the time of the actual transfer of the information approaches.

Location and hazards information will be submitted to various federal and state of New Mexico mapping agencies to ensure that the WIPP location and drilling or mining restrictions are

identified on widely distributed maps used by almost all public and private organizations. These agencies include:

- Bureau of Land Management
- U.S. Geological Survey
- Library of Congress
- National Archives and Records Service
- Defense Mapping Agency
- International Boundary Commission
- Federal Highway Administration
- New Mexico State Highway Department Planning and Research Division, Cartography Section

To ensure widespread of location information on the WIPP site and the hazards associated with the emplaced waste, detailed maps and descriptions of the hazardous material will be sent to national and international professional societies of cartographers and geographers. Weitzberg (1982) suggests the following organizations and societies receive this location and hazards information:

- The American Congress on Surveying and Mapping
- The American Society of Cartographers
- The Commission for the Geological Map of the World
- The International Cartographic Association
- The American Geographical Society
- The Association of American Geographers
- The International Geographical Union
- The Society of Women Geographers
- The American Geological Institute
- The American Geophysical Union
- The American Society of Professional Geographers

- The National Geographic Society
- The Federal Aviation Administration

Step 2 - Development of a Passive Institutional Control Implementation Plan

Once the appropriate passive institutional controls have been defined, a strategy will be prepared that includes final design, construction, and implementation. The strategy will identify site-specific information needs and approaches to obtaining needed technical and non-technical information.

There are some passive institutional control activities that can be implemented prior to the end of operations. For example, once wastes are permanently placed in the repository, appropriate notations can be made in land records.

Step 3 - Design and Implementation of Pre-decommissioning Passive Controls

Pre-decommissioning passive controls, such as land records, will be implemented and evaluated to the extent possible. For example, the effectiveness of DOE's land management plans will be assessed periodically to assure only acceptable land use is in effect. Closure records and plots for panel closures will be filed with Eddy County, New Mexico.

Step 4 - Implementation of Programs to Collect Needed Information

Programs may be necessary to support implementation of passive institutional control activities with site-specific information.

Planned Evaluations. Upon closure of the WIPP at the conclusion of the Disposal Phase, active controls will be implemented to control access to the site. In addition, monitoring systems will be managed to detect significant deviations in repository performance. With active control provided over the site, the schedule for construction of the PMS is a management option which could be extended for decades. In that the design of the PMS has a 10,000-year lifetime goal, it is prudent that the DOE conduct some testing of the construction materials planned for use as permanent marker material.

Berms. One aspect of the testing is the construction of a section of the berm. The overall size (height and width) of the test section of the berm will match the design of the permanent marker berm. However, the test berm length will be shorter than the full-sized berm. A section approximately 164 to 328 ft (50 to 100 m) long will be sufficient to test a number of different configurations. Included within the test section will be varying thicknesses of the salt core, the caliche layer, and the top layer of riprap and soil material. The DOE will construct a section of the berm for the purpose of evaluating materials and construction techniques. Actual construction and testing will be initiated during the Disposal Phase to provide sufficient time for testing.

Monuments. Another aspect of passive institutional controls to be evaluated during testing is monuments. The major considerations that will be evaluated include the following:

- Procuring, shipping, erecting test monuments, and evaluating long-term environmental effects of wind, rain, and shifting sand for various types of dimensional stone
- Evaluating the magnetic signature provided by sample permanent magnets buried within the berm to determine optimum locations and spacing
- Evaluating the affects of various soils used as protective backfill for dimensional stone
- Evaluating the effects of chemical interaction with the backfill material
- Evaluating the environmental effects on the berm caused by wind, rain, and shifting sand
- Evaluating the effects of plant root intrusion into the berm and potential for salt dissolution and berm slumping
- Evaluating the effectiveness of sample radar reflectors buried within the berm at various distances

Messages. Messages will also need to be evaluated during the testing program. The primary aspects of the messages program to be evaluated include the following:

- Evaluation of message text by presenting it to groups indigenous to the countries whose language is represented in the message
- Evaluation of message text by presenting it to linguists to assess the likelihood that the messages will continue to be understood through time

Step 5 - Design of Post-Decommissioning Passive Institutional Controls

This activity will use results derived from information gathering programs to make final decisions on passive institutional control measures. Passive institutional control implementation plans will be included as a portion of the WIPP long-term protection strategy and will include maintaining federal ownership, markers and monuments, surface modifications and controls, permanent written records, legal records, and land use identification and restriction.

Step 6 - Implementation of Post-Decommissioning Passive Institutional Controls

The final step involves constructing and installing the post-decommissioning passive institutional control measures. Additionally, a system for reviewing and approving the markers and other passive measures would be established.

I-3 Notices Required for Disposal Facilities

I-3a Certification of Closure

Within 60 days after completion of closure activities for an HWMU, the DOE will submit to the Secretary of the NMED, via certified mail, a certification that the unit (or, at final closure, the

facility) has been closed in accordance with the specifications of this Closure Plan. The certification will be signed by the cognizant DOE Manager and by an independent registered professional engineer. Documentation supporting the independent registered engineer's certification will be furnished to the Secretary of the NMED with the certification.

I-3b Survey Plat

Within 60 days of closure activities for an HWMU or within 60 days of final facility closure, the DOE will submit to the Secretary of the NMED, via certified mail, a survey plat indicating the location and dimensions of hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat will be prepared and certified by a professional land surveyor and will contain a prominently displayed note that states the DOE's obligation to restrict disturbance of the hazardous waste disposal unit. In addition, the land records in the Eddy County Courthouse, Carlsbad, New Mexico, will be updated through filing of the final survey plats.

I-3c Post-Closure Certification

Within 60 days of completion of the post-closure care period for each hazardous waste disposal unit and for final facility closure, the DOE will submit to the Secretary of the NMED, via certified mail, documentation that post-closure care was performed in accordance with the specifications of the approved post-closure plan. The certification will be signed by the cognizant DOE Manager and by an independent registered professional engineer. Documentation supporting the independent registered engineer's certification and a copy of the certification will be furnished to the Secretary of the NMED.

I-3d Post-Closure Notices

Within 60 days after certification of closure of each hazardous waste disposal unit or final facility closure, the DOE will submit to the Secretary of the NMED, and other applicable local and federal government agencies, a record of the type, location, and quantity of hazardous wastes disposed of in the disposal unit of the facility. Plans exist for extensive archiving of records beyond those required in 20 NMAC 4.1, Subpart V, §264.119. These are discussed in I-2a(3).

I-4 Closure Cost Estimates

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide cost estimates for closure actions.

I-5 Financial Assurance Mechanism for Closure

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide financial assurance mechanisms for closure actions.

I-6 Post-Closure Cost Estimate

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide cost estimates for post-closure actions.

I-7 Financial Assurance Mechanism for Post-Closure Care

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide financial assurance mechanisms for post-closure actions.

I-8 Liability Requirement

In accordance with 20 NMAC 4.1, Subpart V, §264.140(c), the WIPP facility, as a federal facility, is exempt from the requirement to provide liability insurance.

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TABLES

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TABLE I-1
ANTICIPATED EARLIEST CLOSURE DATES FOR THE UNDERGROUND HWMUS

HWMU	OPERATIONS START	OPERATIONS END	CLOSURE START	CLOSURE END
PANEL 1	7/98	1/01	2/01	6/01
PANEL 2	1/01	7/03	8/03	12/04
PANEL 3	7/03	1/06	2/06	6/06
PANEL 4	1/06	7/08	8/08	12/09
PANEL 5	7/08	1/11	2/11	6/11
PANEL 6	1/11	7/13	8/13	12/14
PANEL 7	7/13	1/16	2/16	6/16
PANEL 8	1/16	7/18	8/18	12/19
PANEL 9	7/18	1/21	2/21	SEE NOTE 4
PANEL 10	1/21	7/23	8/23	SEE NOTE 4

NOTE 1: Only Panels 1 to 3 will be closed under the permit covered by this application. Closure schedules for Panels 4 through 10 are projected assuming new permits will be issued in 2005 and 2015.

NOTE 2: The point of closure start is defined as 60-days following notification to the NMED of closure.

NOTE 3: The point of closure end is defined as 180-days following placement of final waste in the panel.

NOTE 4: The time to close these areas may be extended depending on the nature and extent of the disturbed rock zone. The excavations that constitute these panels will have been opened for as many as 40 years so that the preparation for closure may take longer than the time allotted in Figure I-2. If this extension is needed, it will be requested as an amendment to the Closure Plan.

TABLE I-2
ANTICIPATED OVERALL SCHEDULE FOR CLOSURE ACTIVITIES

ACTIVITY	FINAL FACILITY CLOSURE	
	START	STOP
Notify NMED of Intent to Close WIPP (or to Implement Contingency Closure)	August 2023	N/A
Perform Contamination Surveys in both Surface Storage Areas	August 2023	February 2024
Sample Analysis	October 2023	May 2024
Decontamination as Necessary of both Surface Storage Areas	April 2024	November 2024
Final Contamination Surveys of both Surface Storage Areas	December 2024	July 2025
Sample Analysis	April 2025	November 2025
Prepare and Submit Container Management Unit Closure Certification	December 2025	March 2026
Dispose of Closure-Derived Waste	September 2023	November 2024
Closure of Open HWMU Panel	December 2024*	July 2025
Install Borehole Seals	August 2025	July 2026
Install Repository Seals	April 2026	July 2030
Recontour and Revegetate	August 2030	March 2031
Prepare and Submit Final (Contingency) Closure Certification	August 2030	March 2031
Post-closure Monitoring	May 2031	N/A

N/A--Not Applicable
Refer to Figures I-3 and I-4 for precise activity titles.

*This assumes the final waste is placed in this unit in November 2024 and notification of closure for this HWMU is submitted to the NMED in October 2024.

TABLE I-3
GOVERNING REGULATIONS FOR BOREHOLE ABANDONMENT

Federal or State Land	Type of Well or Borehole	Governing Regulation	Summary of Requirements
Both	Groundwater Surveillance	State and federal regulation in effect at time of abandonment	Monitor wells no longer in use shall be plugged in such a manner as to preclude migration of surface runoff or groundwater along the length of the well. Where possible, this shall be accomplished by removing the well casing and pumping expanding cement from the bottom to the top of the well. If the casing cannot be removed, the casing shall be ripped or perforated along its entire length if possible, and grouted. Filling with bentonite pellets from the bottom to the top is an acceptable alternative to pressure grouting.
Federal	Oil and Gas Wells	40 CFR Part 3160, §§ 3162.3-4	The operator shall promptly plug and abandon, in accordance with a plan first approved in writing or prescribed by the authorized officer.
Federal	Potash	40 CFR Part 3590, § 3593.1	(b) Surface boreholes for development or holes for prospecting shall be abandoned to the satisfaction of the authorizing officer by cementing and/or casing or by other methods approved in advance by the authorized officer. The holes shall also be abandoned in a manner to protect the surface and not endanger any present or future underground operation, any deposit of oil, gas, or other mineral substances, or any aquifer.
State	Oil and Gas Well Outside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Rule 202 (eff. 3-1-91)	B. Plugging (1) Prior to abandonment, the well shall be plugged in a manner to permanently confine all oil, gas, and water in the separate strata where they were originally found. This can be accomplished by using mud-laden fluid, cement, and plugs singly or in combination as approved by the Division on the notice of intention to plug. (2) The exact location of plugged and abandoned wells shall be marked by the operator with a steel marker not less than four inches (4") in diameter, set in cement, and extending at least four feet (4') above mean ground level. The metal of the marker shall be permanently engraved, welded, or stamped with the operator name, lease name, and well number and location, including unit letter, section, township, and range.
State	Oil and Gas Wells Inside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Order No. R-111-P (eff. 4-21-88)	F. Plugging and Abandonment of Wells (1) All existing and future wells that are drilled within the potash area, shall be plugged in accordance with the general rules established by the Division. A solid cement plug shall be provided through the salt section and any water-bearing horizon to prevent liquids or gases from entering the hole above or below the salt selection. It shall have suitable proportions—but no greater than three (3) percent of calcium chloride by weight—of cement considered to be the desired mixture when possible.

TABLE I-4
AVERAGE-STOICHIOMETRY GAS GENERATION MODEL PARAMETER VALUES

Parameter (units)	Values Used in Calculation[a]
Inundated Corrosion Rate for Steel without CO_2 Present (m/s)	7.94×10^{-15}
Inundated Corrosion Rate for Steel with CO_2 Present (m/s)	1.03×10^{-13}
Humid Corrosion Rate for Steel	0
Gas Generation Rate for Microbial Degradation Under Humid Conditions (mol/kg * s)	6.34×10^{-10}
Gas Generation Rate for Microbial Degradation under Brine-Inundated Conditions (mol/kg * s)	4.92×10^{-9}
Factor β for Microbial Reaction Rates (unitless)	0.5
Anoxic Corrosion Stoichiometric Factor X (unitless)	1.0
Average Density of Cellulosics in CH Waste (kg/m^3)	54.0
Average Density of Cellulosics in RH Waste (kg/m^3)	17.0
Average Density of Iron-Based Materials in CH Waste (kg/m^3)	170.0
Average Density of Iron-Based Materials in RH Waste (kg/m^3)	100.0
Average Density of Plastics in CH Waste (kg/m^3)	34.0
Average Density of Plastics in RH Waste (kg/m^3)	15.0
Average Density of Rubber in CH Waste (kg/m^3)	10.0
Average Density of Rubber in RH Waste (kg/m^3)	3.3
Bulk Density of Iron Containers, CH Waste (kg/m^3)	139.0
Bulk Density of Iron Containers, RH Waste (kg/m^3)	2.59×10^3
Bulk Density of Plastic Liners, CH Waste (kg/m^3)	26.0
Bulk Density of Plastic Liners, RH Waste (kg/m^3)	3.1
BIR Total Volume of RH Waste (m^3)	7.08×10^3
BIR Total Volume of CH Waste (m^3)	1.69×10^5
Wicking Saturation (unitless)	0.5

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, §D16-5

TABLE I-5
SALADO FORMATION HALITE PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
Permeability (m^2)	3.16×10^{-23}
Effective Porosity (%)	1.0
Threshold Pressure, P_t (Pa)[b]	3.41×10^{7}
Residual Brine Saturation, S_{br} (unitless)[c]	0.3
Residual Gas Saturation, S_{gr} (unitless)[c]	0.2
Pore Distribution, λ (unitless)[c]	0.7
Maximum Capillary Pressure (Pa)	10^{8}
Rock Compressibility[d] (1/Pa)	9.75×10^{-11}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section D16-6.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model used in this simulation.

[d] Pore compressibility = Rock compressibility/effective porosity.

TABLE I-6
SALADO FORMATION ANHYDRITE INTERBEDS A AND B AND MARKER BEDS 138 AND 139 PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
Permeability (m^2)	1.29×10^{-19}
Effective Porosity (%)	1.1
Threshold Pressure, P_t (Pa)[b]	9.74×10^5
Residual Brine Saturation, S_{br} (unitless)[c]	0.084
Residual Gas Saturation, S_{gr} (unitless)[c]	0.077
Pore Distribution, λ (unitless)[c]	0.644
Maximum Capillary Pressure (Pa)	10^8
Rock Compressibility[d] (1/Pa)	8.26×10^{-11}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section D16-6.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model used in this simulation.

[d] Pore compressibility = Rock compressibility/effective porosity.

TABLE I-7
SHAFT MATERIALS PARAMETER VALUES

Parameter (units)	Value Used in Calculation[a]
All Shaft Materials	
Residual Brine Saturation, S_{br} (unitless)[c]	0.2
Residual Gas Saturation, S_{gr} (unitless)[c]	0.2
Pore Distribution, λ (unitless)[c]	0.94
Maximum Capillary Pressure (Pa)	10^8
Clay Shaft Materials	
Permeability (m^2) - Rustler Compacted Clay (T = 0 - 10,000 yrs.)	5.00×10^{-19}
Permeability (m^2) - Upper Salado Compacted Clay (T = 0 - 10 yrs.)	7.65×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 10 - 25 yrs.)	5.02×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 25 - 50 yrs.)	3.02×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T = 50 - 100 yrs.)	1.16×10^{-17}
Permeability (m^2) - Upper Salado Compacted Clay (T > 100 yrs.)	5.00×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 0 - 10 yrs.)	9.32×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 10 - 25 yrs.)	1.74×10^{-17}
Permeability (m^2) - Lower Salado Compacted Clay (T = 25 - 50 yrs.)	7.07×10^{-19}
Permeability (m^2) - Lower Salado Compacted Clay (T > 50 yrs.)	5.00×10^{-19}
Permeability (m^2) - Bottom Clay (T = 0 - 10,000 yrs.)	5.00×10^{-19}
Thickness (m) - Rustler Compacted Clay	94.3
Thickness (m) - Upper Salado Compacted Clay	104.85
Thickness (m) - Lower Salado Compacted Clay	23.9
Thickness (m) - Bottom Clay	9.24
Effective Porosity (%) - Rustler Compacted Clay	24.0
Effective Porosity (%) - Upper and Lower Salado Compacted Clays and Bottom Clay	24.0
Threshold Pressure P_t (Pa) - All Clays[b]	2.0×10^5 to 1.20×10^6
Pore-Volume Compressibility (1/Pa) - Rustler Compacted Clay	1.96×10^{-9}
Pore-Volume Compressibility (1/Pa) - Upper Salado Compacted Clay	1.81×10^{-9}
Pore-Volume Compressibility (1/Pa) - Lower Salado Compacted Clay and Bottom Clay	1.59×10^{-9}
Salt Shaft Material	
Permeability (m^2) - Salt (T = 0 - 10 yrs.)	1.74×10^{-15}
Permeability (m^2) - Salt (T = 10 - 25 yrs.)	1.66×10^{-15}
Permeability (m^2) - Salt (T = 25 - 50 yrs.)	1.65×10^{-15}
Permeability (m^2) - Salt (T = 50 - 100 yrs.)	6.83×10^{-18}
Permeability (m^2) - Salt (T = 100 - 200 yrs.)	5.27×10^{-20}
Permeability (m^2) - Salt (T > 200 yrs.)	5.35×10^{-21}
Thickness (m) - Salt	171.37
Effective Porosity (%) - Salt	5.0
Threshold Pressure P_t (Pa) - Salt (T = 0 - 10 yrs.)[b]	7.16×10^4

TABLE I-7
SHAFT MATERIALS PARAMETER VALUES
(Continued)

Parameter (units)	Value Used in Calculation[a]
Threshold Pressure P_t (Pa) - Salt (T = 10 - 25 yrs.)[b]	7.28×10^4
Threshold Pressure P_t (Pa) - Salt (T = 25 - 50 yrs.)[b]	7.29×10^4
Threshold Pressure P_t (Pa) - Salt (T = 50 - 100 yrs.)[b]	4.87×10^5
Threshold Pressure P_t (Pa) - Salt (T = 100 - 200 yrs.)[b]	2.62×10^6
Threshold Pressure P_t (Pa) - Salt (T > 200 yrs.)[b]	5.78×10^6
Pore-Volume Compressibility (1/Pa) - Salt	1.60×10^{-9}
Concrete Shaft Materials	
Permeability (m^2) - Concrete (T = 0 - 400 yrs.)	1.78×10^{-19}
Permeability (m^2) - Concrete (T > 400 yrs.) and Concrete Monolith (T = 0 - 10,000 yrs.)	10^{-14}
Thickness (m) - Concrete	45.72
Thickness (m) - Concrete Monolith	9.08
Effective Porosity (%)	5.00
Threshold Pressure P_t (Pa) - Concrete (T = 0 - 400 yrs.) [b]	1.72×10^6
Threshold Pressure P_t (Pa) - Concrete (T > 400 yrs.)[b] and Concrete Monolith (T = 0 - 10,000 yrs.)	3.91×10^4
Pore-Volume Compressibility (1/Pa) - Concrete and Concrete Monolith	2.64×10^{-9}
Asphalt Shaft Material	
Permeability (m^2) - (T = 0 - 10,000 yrs.)	1×10^{-20}
Thickness (m)	37.28
Effective Porosity (%)	1.00
Threshold Pressure P_t (Pa)[b]	0.00
Pore-Volume Compressibility (1/Pa)	2.97×10^{-8}
Earthen Fill Material Above Rustler	
Permeability (m^2) (T = 0 - 10,000 yrs.)	10^{-14}
Thickness (m)	165.06
Effective Porosity (%)	32.0
Threshold Pressure P_t (Pa)[b]	3.91×10^4
Maximum Capillary Pressure (Pa)	10^3
Pore-Volume Compressibility (1/Pa)	3.1×10^{-8}

[a] Median values were used based on the data and parameter distributions contained in Appendix D16, Section 16-8.

[b] Threshold pressure (P_t) determined from the relationship: $P_t = PCT_A \cdot k^{PCT_EXP}$ where PCT_A and PCT_EXP are constants and k is the permeability.

[c] Two-phase flow: Brooks-Corey model is used in this simulation.

TABLE I-8

OUTPUT VALUES FOR FIRST 300 YEARS OF MODELED REPOSITORY PERFORMANCE

Time (Years After Closure)	Repository Pressure (MPa)	Gas Generated (Moles Per Drum)	Pore Volume (m^3 Per Panel)	Cumulative Brine (m^3 Per Panel)	Repository Saturation (Unitless)	Quantity of Ferrous Materials (kg Per Drum)	Quantity of Cellulosic Material (kg Per Drum)
0	0.101	0.037	36900	0	0.0153	85.09	33.92
1	0.138	3.69	33000	320.3	0.0264	85.01	33.83
2	0.167	7.62	32100	383.1	0.0289	84.93	33.74
3	0.196	11.23	31300	413.0	0.0304	84.86	33.65
4	0.226	14.85	30500	432.8	0.0317	84.78	33.56
5	0.266	19.29	29600	450.5	0.0331	84.69	33.45
6	0.301	23.15	28800	462.2	0.0342	84.60	33.35
7	0.345	27.96	28100	473.6	0.0352	84.50	33.23
8	0.371	30.77	27700	479.2	0.0358	84.44	33.16
9	0.405	34.22	27200	485.6	0.0365	84.37	33.08
10	0.441	37.77	26700	491.3	0.0372	84.30	32.99
15	0.646	56.54	24300	512.9	0.0407	83.90	32.52
20	0.863	74.52	22500	525.8	0.0435	83.52	32.08
25	1.134	95.40	20700	536.3	0.0463	83.08	31.56
30	1.397	114.41	19300	543.9	0.0486	82.68	31.09
35	1.634	132.59	18400	549.5	0.0500	82.29	30.64
40	1.906	153.59	17600	554.7	0.0510	81.85	30.12
45	2.09	168.05	17200	557.7	0.0513	81.54	29.77
50	2.403	192.59	16600	562.0	0.0512	81.02	29.16
55	2.652	211.70	16300	564.9	0.0508	80.62	28.69
60	2.888	229.90	16000	567.3	0.0501	80.23	28.24
75	3.585	283.34	15500	572.7	0.0474	79.10	26.92

Revision 6.3
July 18, 1997
Supersedes all prior versions.

TABLE I-8

OUTPUT VALUES FOR FIRST 300 YEARS OF MODELED REPOSITORY PERFORMANCE (CONTINUED)

Time (Years After Closure)	Repository Pressure (MPa)	Gas Generated (Moles Per Drum)	Pore Volume (m^3 Per Panel)	Cumulative Brine (m^3 Per Panel)	Repository Saturation (Unitless)	Quantity of Ferrous Materials (kg Per Drum)	Quantity of Cellulosic Material (kg Per Drum)
100	4.881	385.30	15000	578.9	0.0400	75.95	24.39
125	5.873	457.32	14500	583.0	0.0353	75.54	22.53
150	6.508	496.44	14000	585.4	0.0332	74.80	21.50
175	7.062	529.48	13600	587.4	0.0309	74.10	20.69
200	7.654	565.23	13300	589.0	0.0282	73.35	19.80
250	8.737	631.64	12700	591.4	0.0223	71.94	18.16
300	9.816	699.19	12300	593.1	0.0156	70.52	16.49

FIGURES

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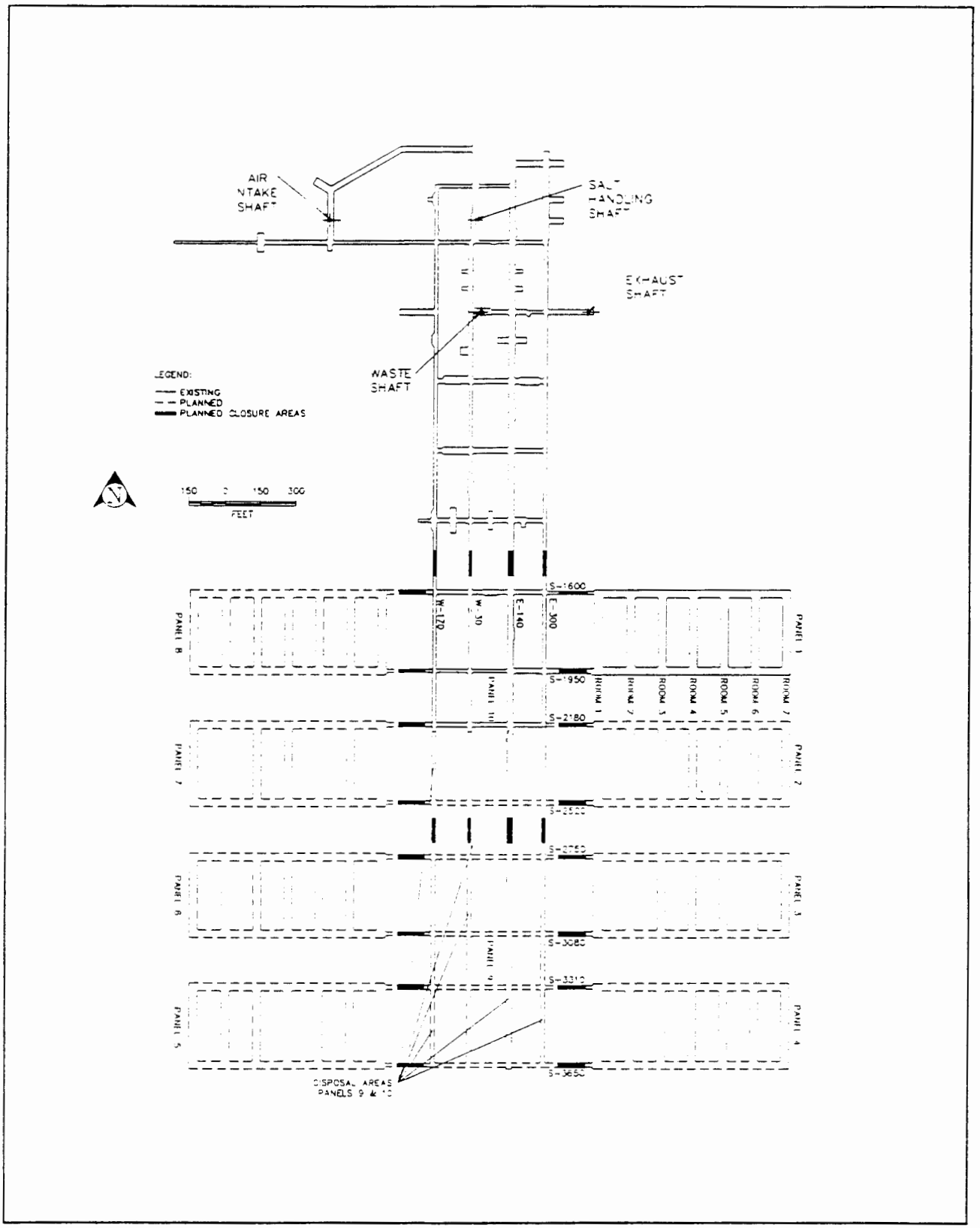

Figure I-1
Location of Underground HWMUs and Anticipated Closure Locations

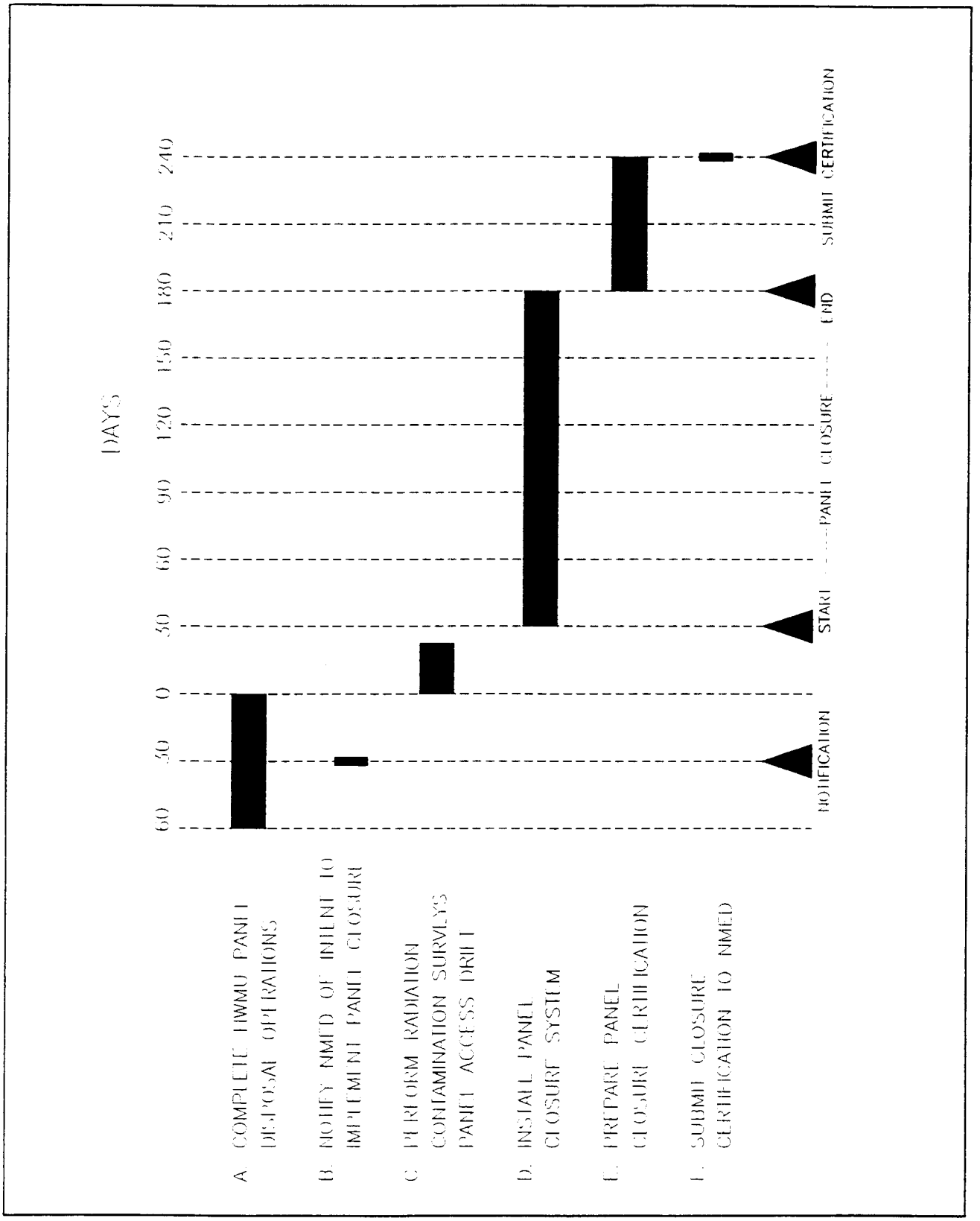

Figure I-2
WIPP Panel Closure Schedule

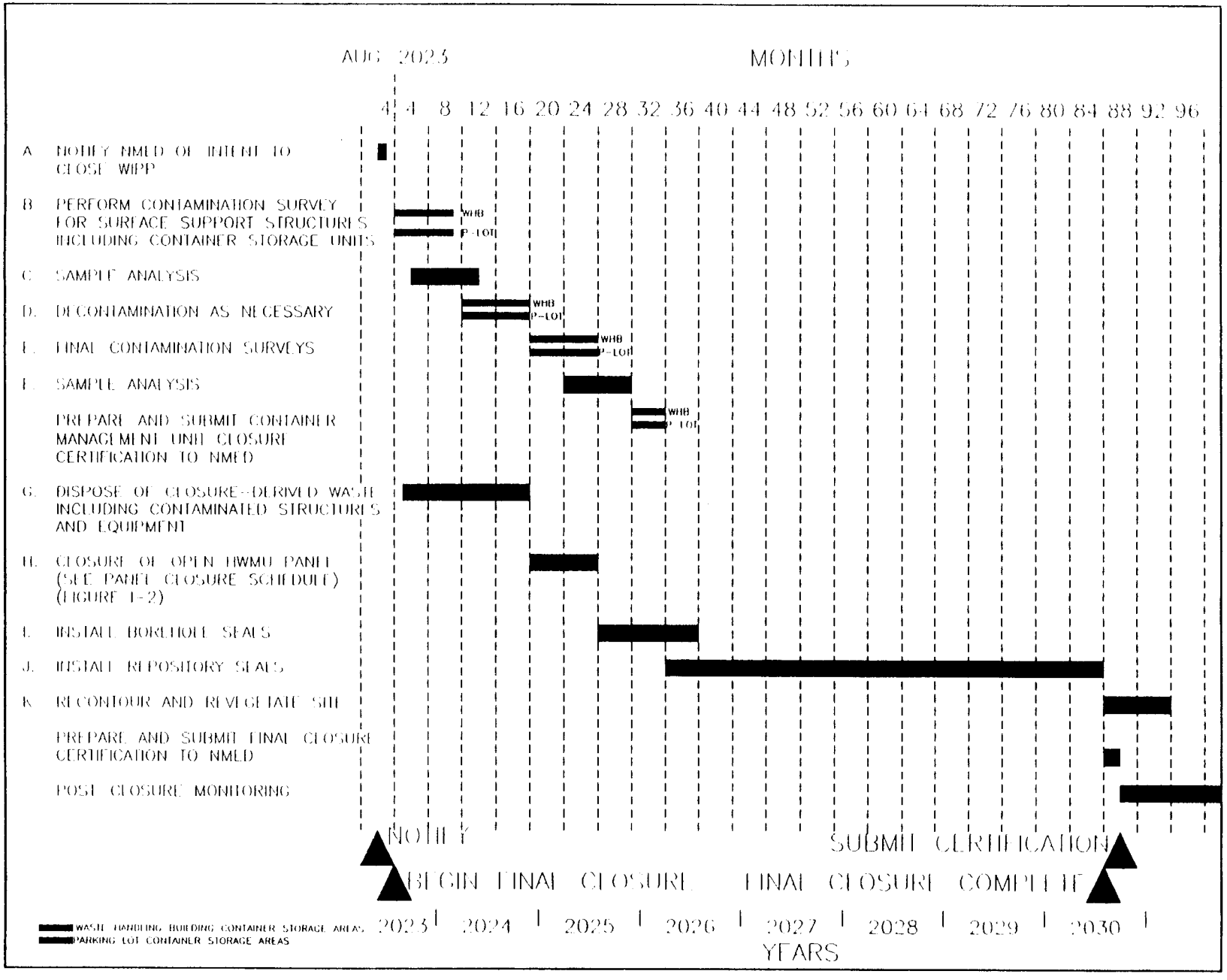

Figure I-3
WIPP Facility Final Closure Schedule

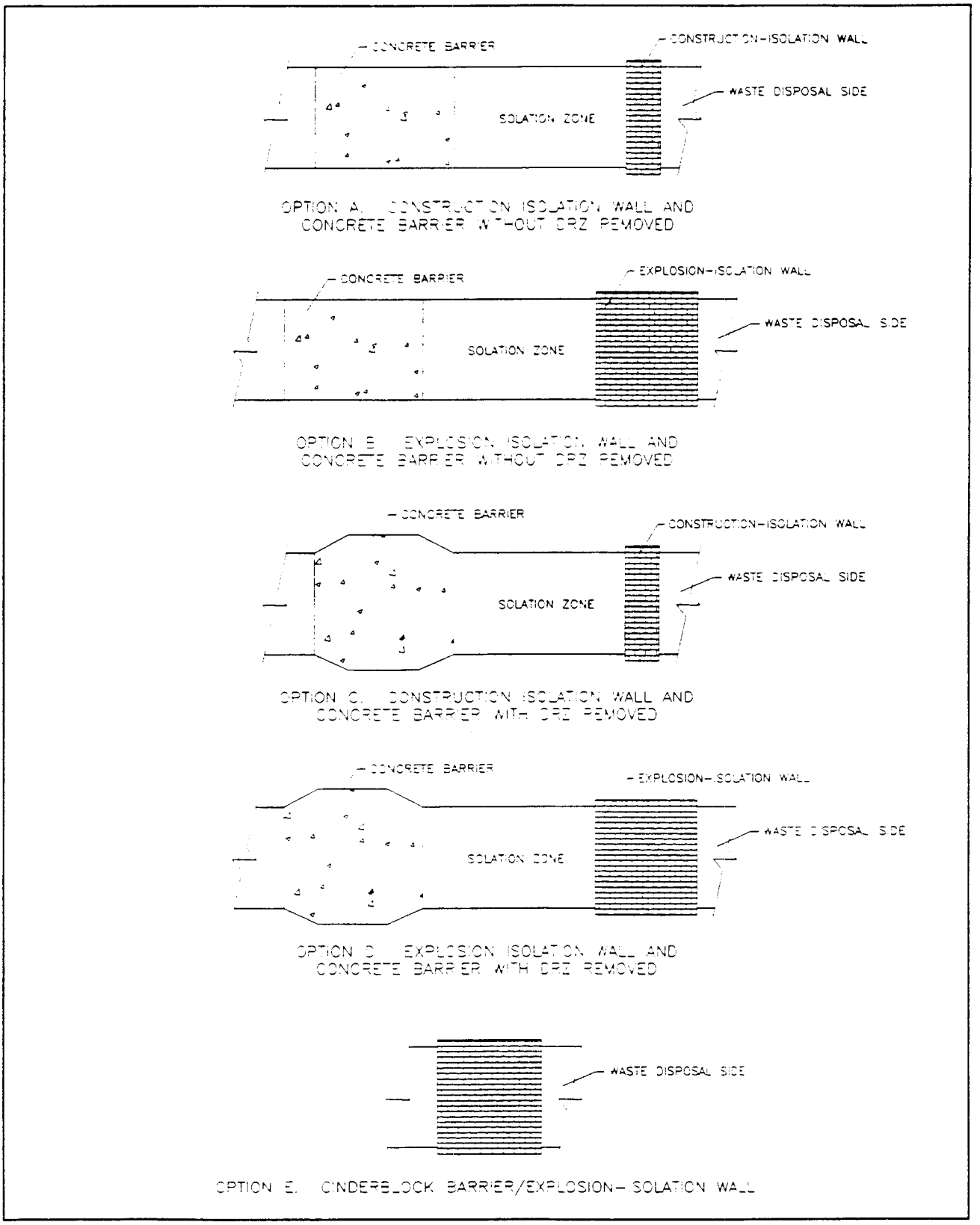

Figure I-4
Design of a Panel Closure System

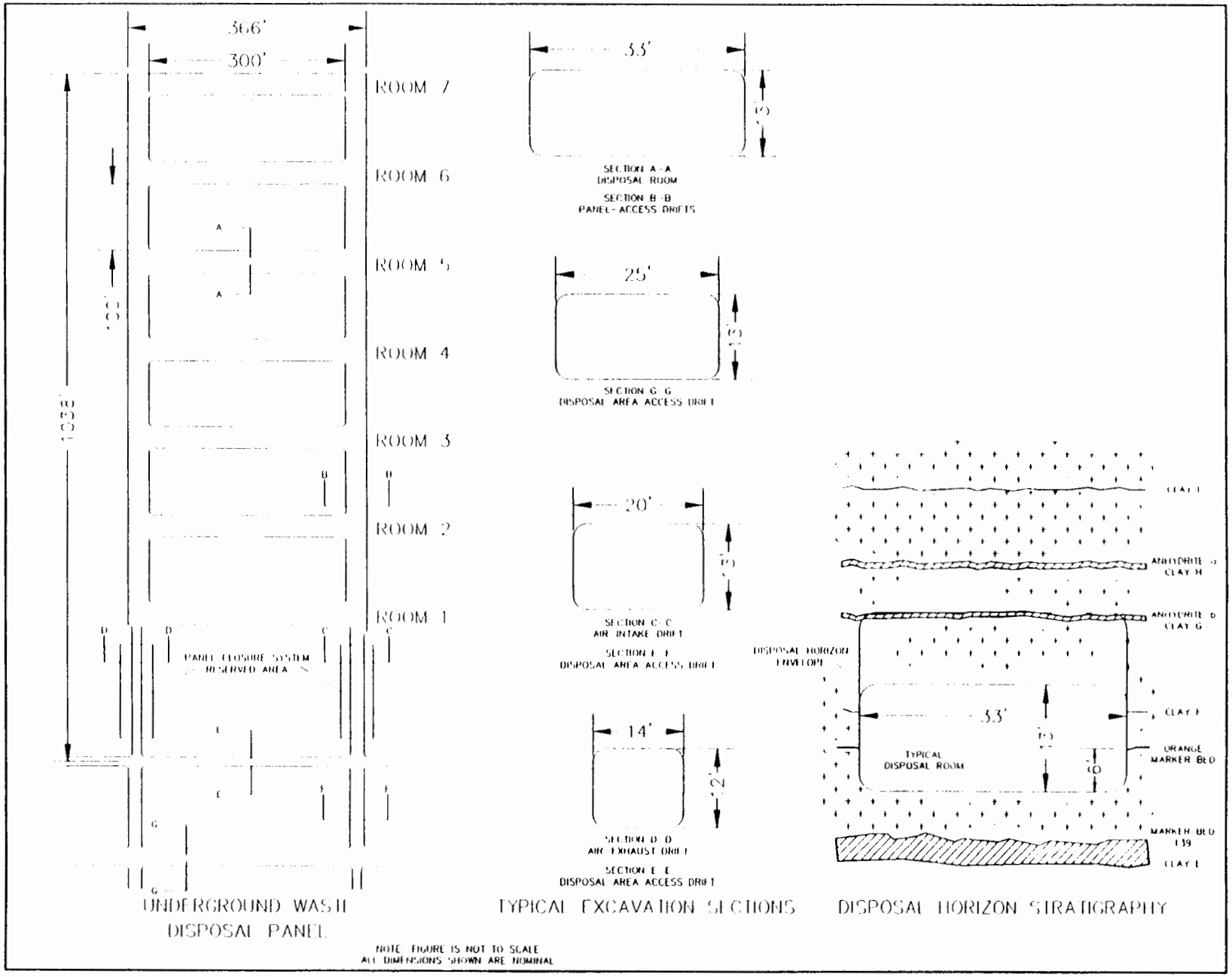

Figure I-5
Typical Disposal Panel

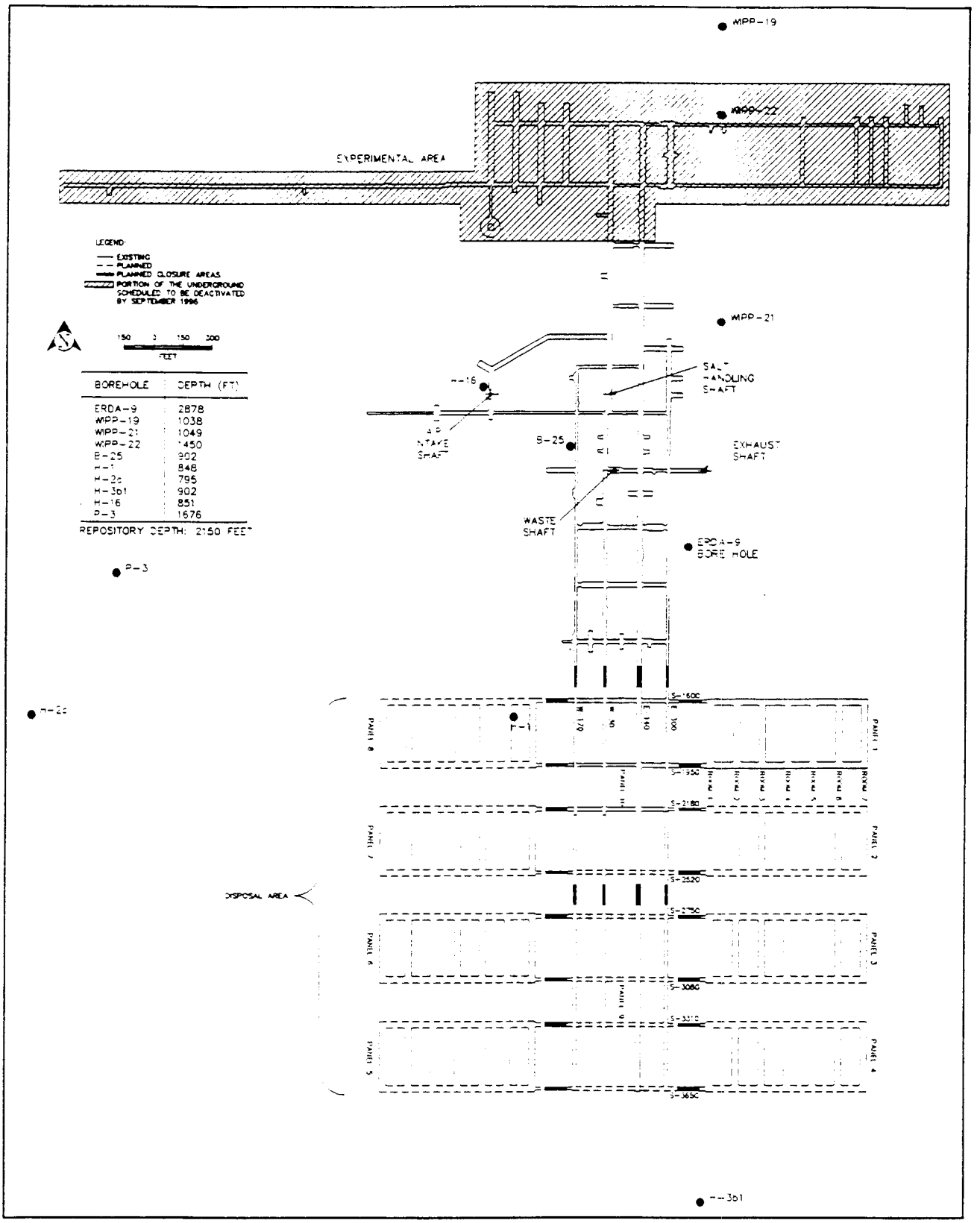

Figure I-6

Approximate Locations of Boreholes in Relation to the WIPP Underground

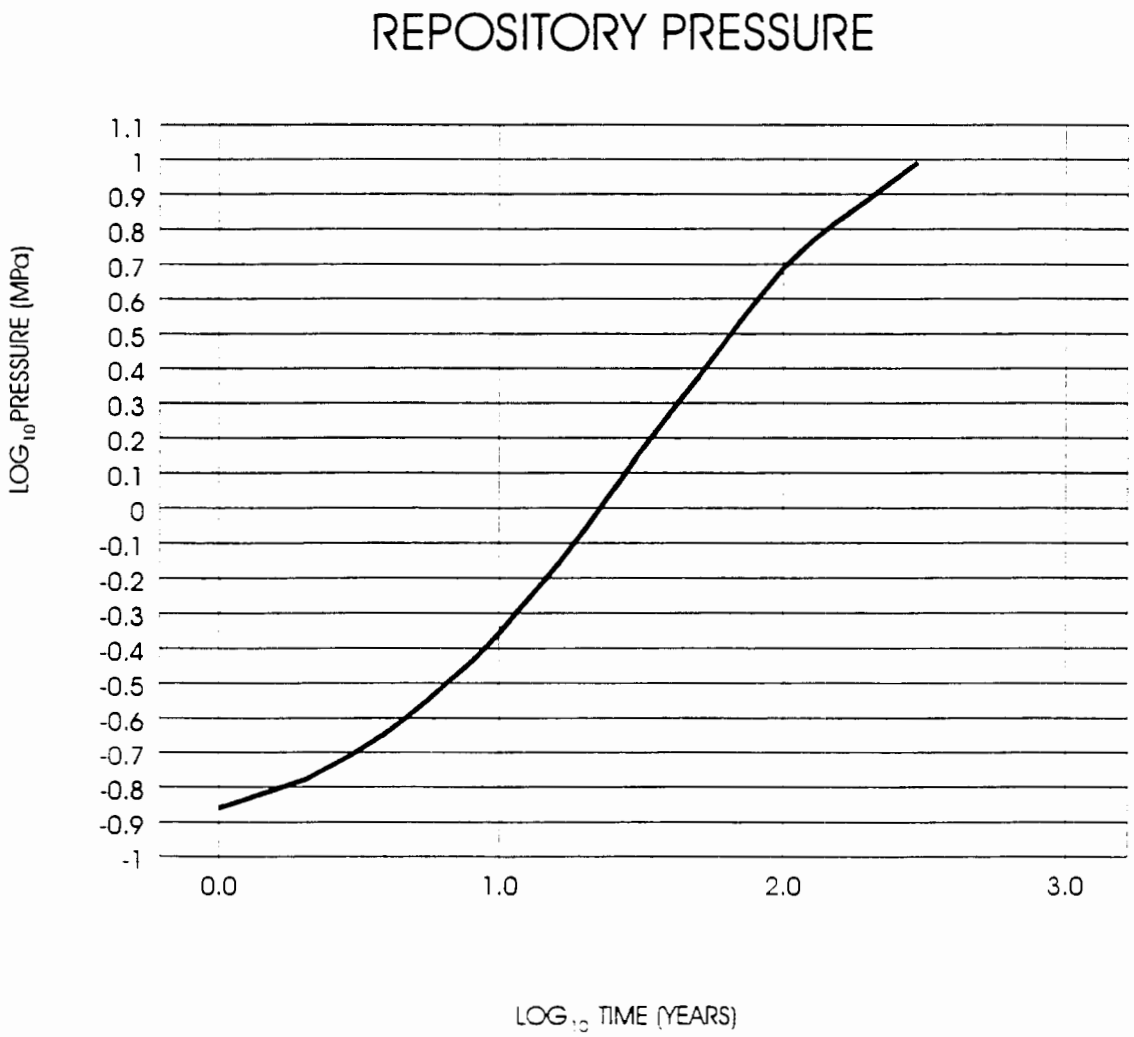

Figure I-7

Predicted Change in Disposal Region Pressure Following Shaft Sealing

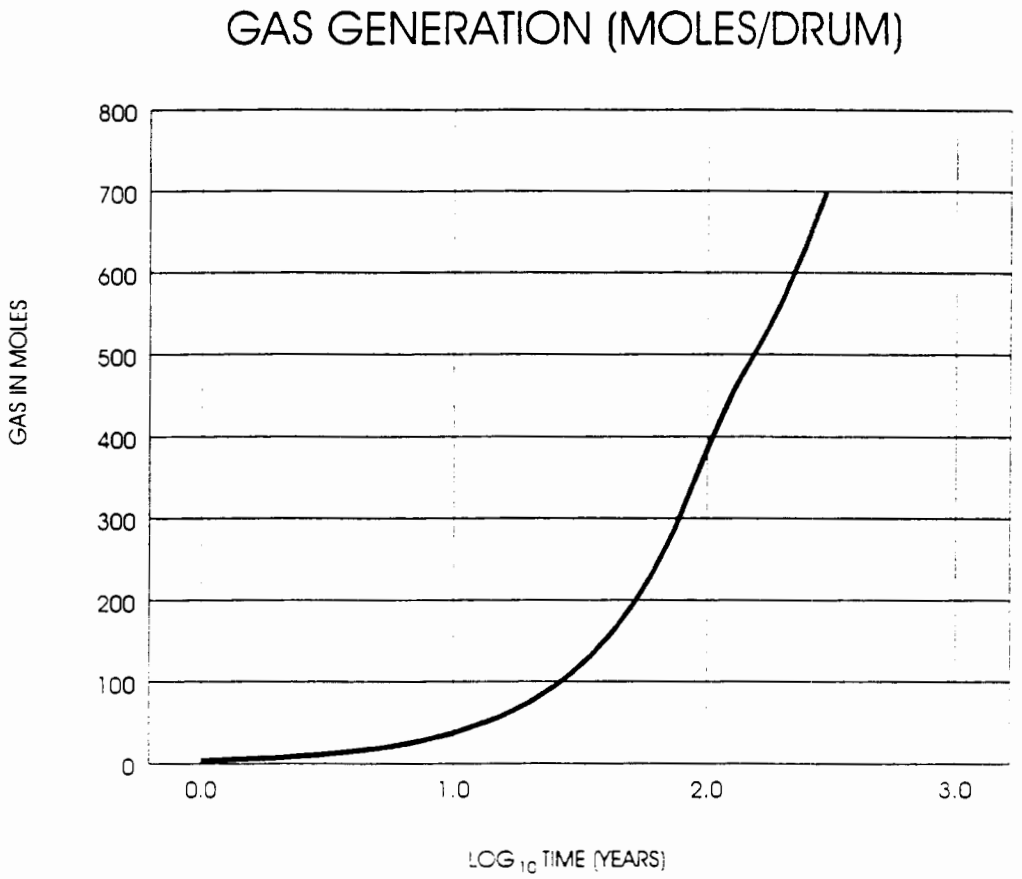

Figure I-8

Predicted Cumulative Volume of Gas Generated Per Drum of Waste

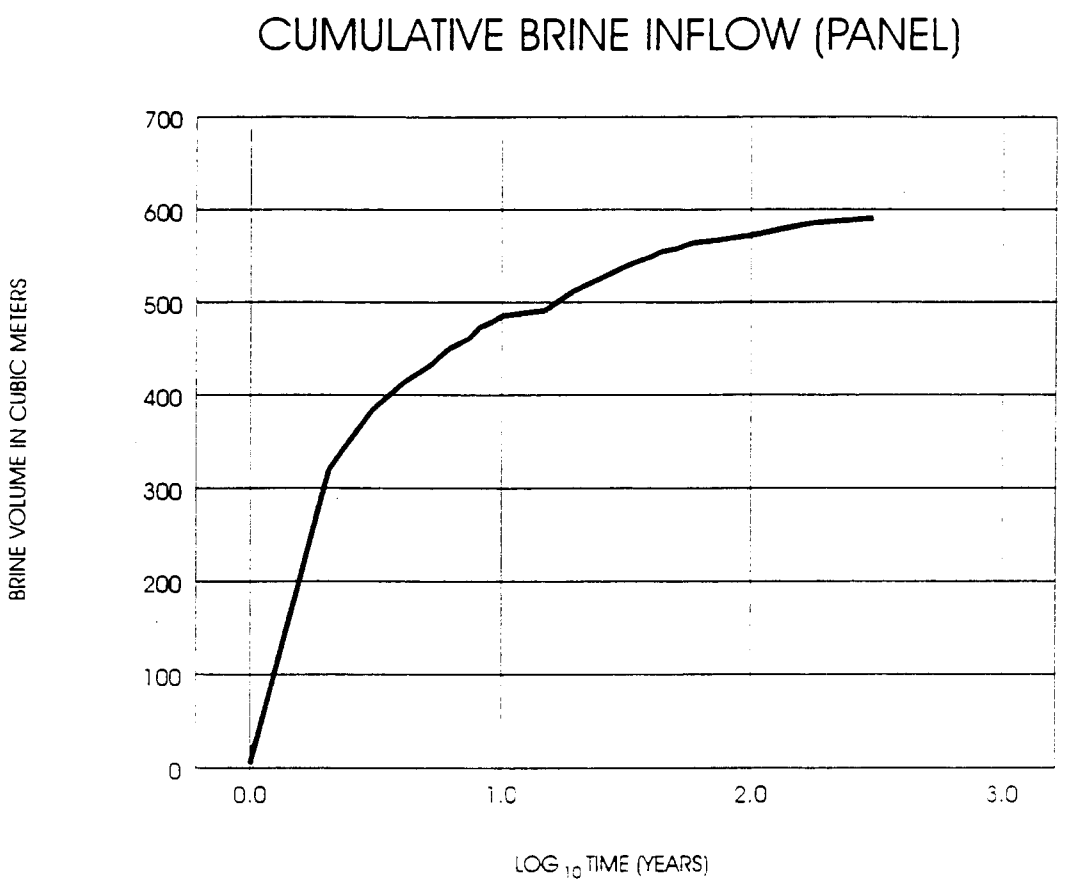

Figure I-9

Predicted Cumulative Brine Inflow into a Closed Waste Panel

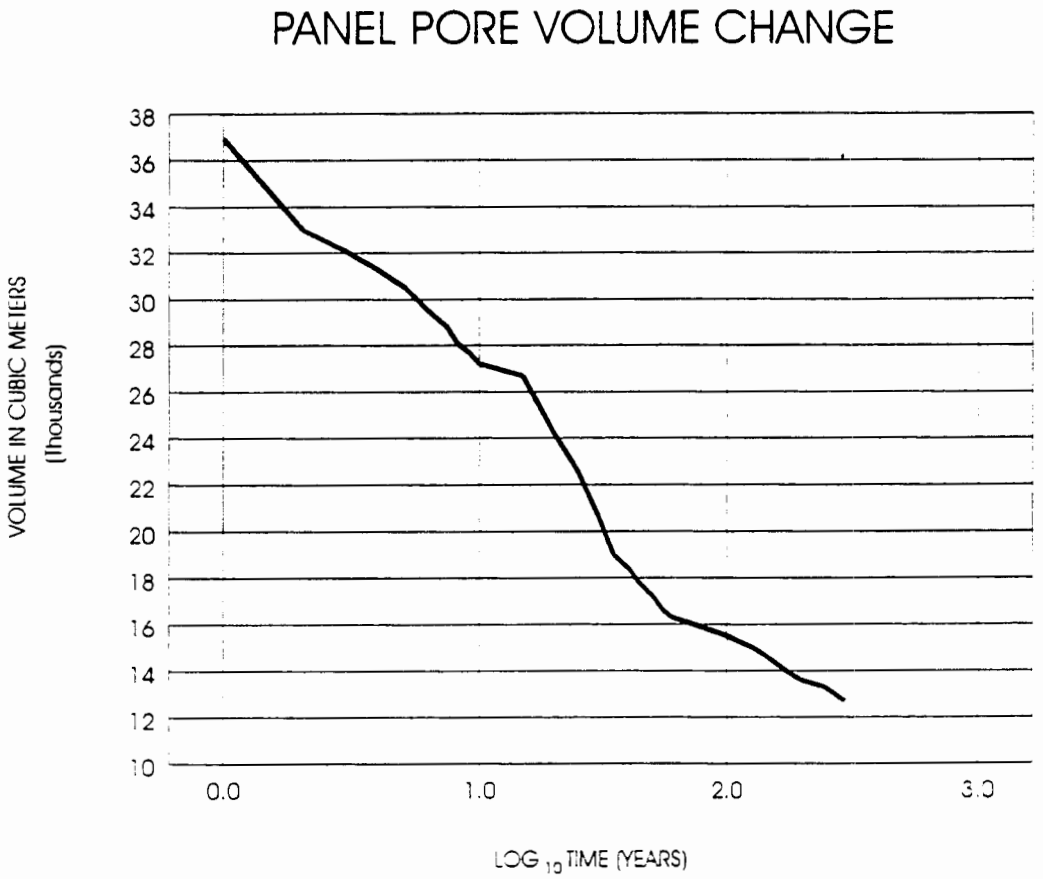

Figure I-10

Predicted Change in Panel Pore Volume Due to Creep Closure

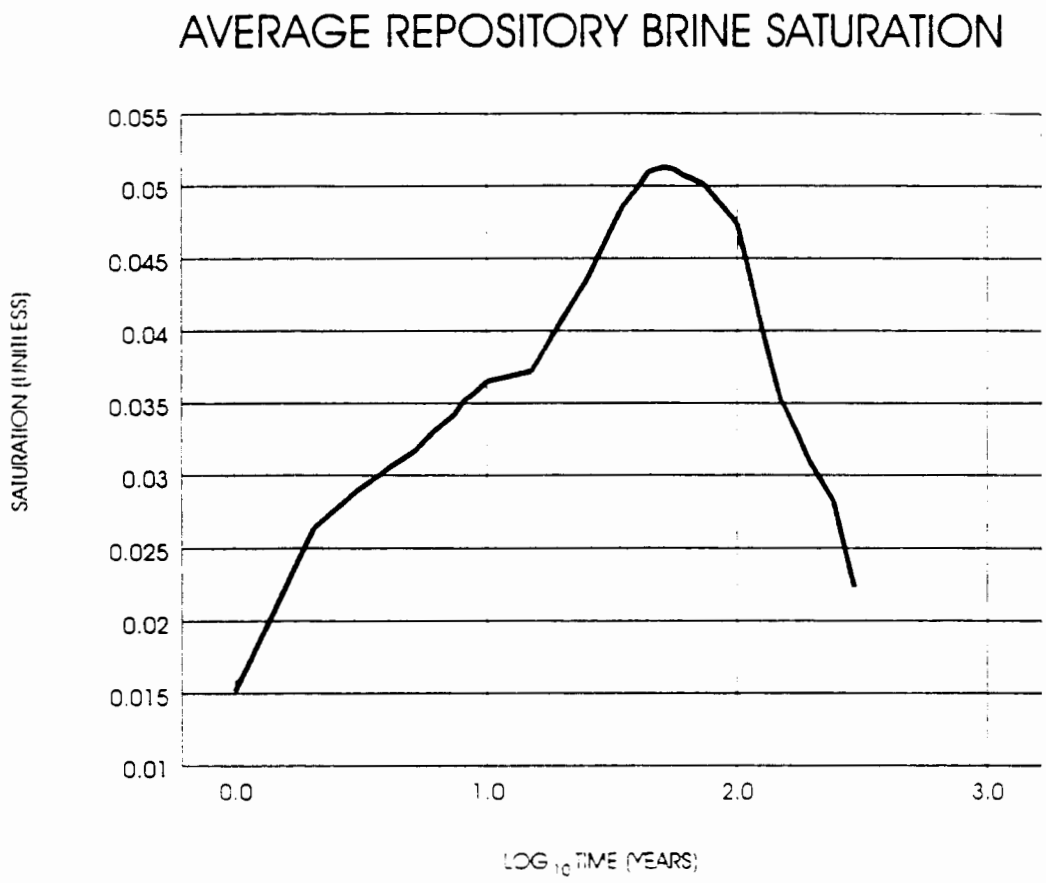

Figure I-11

Predicted Average Brine Saturation Within the Repository

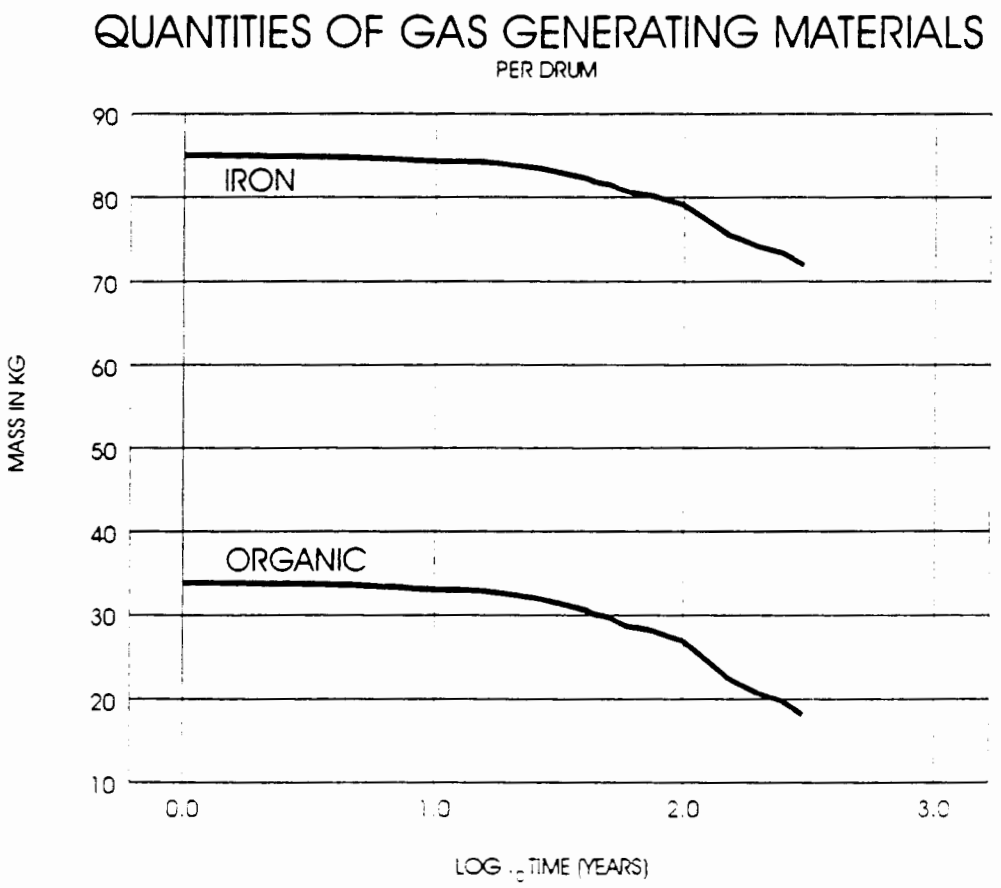

Figure I-12

Predicted Change in the Quantity of Gas Generating Material In Each Drum

CHAPTER J

CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS

CHAPTER J
CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS
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CHAPTER J
CORRECTIVE ACTION FOR
SOLID WASTE MANAGEMENT UNITS

Introduction

This chapter describes the solid waste management units (SWMU) within the 16-square-mile (mi) (41.4 square-kilometer [km]) Waste Isolation Pilot Plant (WIPP) facility boundary (Title 20 of the New Mexico Administrative Code Chapter 4, Part 1 [20 NMAC 4.1], Subpart V §264.101[a]) which have been identified by U.S. Environmental Protection Agency (EPA) Region 6 as requiring further investigation. SWMU characterization sheets are presented in Appendix J1 in response to regulatory requirements in 20 NMAC 4.1, Subpart IX, §270.14(d).

Corrective actions are only required for SWMUs from which releases of Resource Conservation and Recovery Act (RCRA) hazardous wastes or hazardous constituents have occurred. Hazardous waste is defined in 20 NMAC 4.1, Subpart II, §261.3. Hazardous constituents are listed in 20 NMAC 4.1, Subpart II, Appendix VIII. Based on the RCRA Facility Assessment (RFA) conducted by the New Mexico Environment Department (NMED) for the EPA, 16 SWMUs have been identified as requiring further action (NMED, 1994). These SWMUs are listed in Table J-1. Since the preparation of the RFA, the U.S. Department of Energy (DOE) has created seven additional SWMUs and is closing SWMU 009-f, the Underground Wash Rack, in accordance with written site procedures.

The definition of a SWMU has not yet been finalized by the EPA. The most recent definition, presented in the proposed Subpart S to RCRA regulations in Title 40 of the Code of Federal Regulations (CFR), Part 264, has been used to define SWMUs at the WIPP facility. This definition states that SWMUs are "any discernible unit at which solid wastes have been placed at any time irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units also include any area at or around a facility at which solid wastes have been routinely and systematically released."

J-1 Solid Waste Management Units

According to 20 NMAC 4.1, Subpart §264.90(d), the SWMU requirements of 20 NMAC 4.1, Subpart V, Releases from Solid Waste Management Units, "may apply to miscellaneous units when necessary to comply with §§264.601 through 264.603." The DOE believes compliance with the aforementioned sections is demonstrated in this permit application. Section D-9d(1), Chapter E, and Appendix E1 of this permit application address the requirements of 20 NMAC 4.1, Subpart V, §264.601(a). Section D-9d(2) and D-9d(3) of this permit application address the requirements of 20 NMAC 4.1, Subpart V, §§264.601(b) and (c), respectively. Chapter I of this permit application addresses the requirements of 20 NMAC 4.1, Subpart V, §264.603.

In addition, the DOE will institute corrective actions that are necessary to protect human health and the environment for any releases of hazardous waste or hazardous constituents from SWMUs at the WIPP site. Corrective actions will be performed in compliance with 20 NMAC 4.1, Subpart V, §264.101. Any releases from a SWMU deemed an immediate threat to human health or the environment will be responded to in accordance with the WIPP facility Contingency Plan (Chapter G) of this permit application.

The requirements of 20 NMAC 4.1, Subpart V, §§264.601 through 264.603, including corrective actions, are addressed in this permit application. Therefore, the requirements of 20 NMAC 4.1, Subpart V, Releases from Solid Waste Management Units, are not necessary to show compliance.

To eliminate repetition of information, units that are similar in physical characteristics use or waste type are grouped and described within a SWMU description for the particular type of discernible unit.

The following sections describe characterization of SWMUs identified in the RFA, assessment of potential releases, and corrective actions. Table J-1 provides a list of SWMUs.

J-1a Characterization of the SWMUs

SWMUs at the WIPP facility are identified by a unique number designation shown in the upper left-hand corner of the SWMU characterization sheets in Appendix J1. The individual units grouped within a SWMU are designated by a letter following the SWMU number. The locations of the SWMUs and individual units, if any, within SWMUs are shown in Figure J-1.

The SWMU characterization sheets in Appendix J1 include the name, type, and period of operation for each unit. The unit description includes all available information on the unit, including location, size, dates of operation for the individual units within a SWMU, materials of construction, and waste descriptions. Information on the extent and nature of known releases is also included. The figure showing the location of each individual unit within a SWMU is indicated on the SWMU characterization sheet.

J-2 Releases

Releases from the SWMUs identified in the RFA are described in this section.

J-2a Assessment of Potential Releases

The identified SWMUs were reviewed to assess potential releases. A summary of this assessment is presented in Appendix J1. The assessment includes a description of the material released and the nature of the release.

J-2b Corrective Actions

Based on sampling and analysis data, visual site inspections, and document/record reviews, the DOE believes that no releases of hazardous materials have occurred at any of the WIPP facility SWMUs. The DOE has initiated a voluntary Phase 1 RFI/Release Assessment process as described in the RCRA Corrective Action Plan (EPA 520-R-94-004) to define closure requirements for SWMUs. If corrective actions are required, they will be completed in compliance with applicable regulations.

Potential closure requirements for selected SWMUs will be defined through a voluntary Phase I RFI/Release Assessment process as described in the RCRA Corrective Action Plan (EPA 520-R-94-004). If corrective actions are required at selected SWMUs, all corrective actions will be completed in accordance with the requirements established by the regulator. Final closure of all other SWMUs described in the Resource Conservation and Recovery Act (RCRA) Operating permit will be completed to demonstrate compliance with the Closure Performance Standards contained in 20 NMAC 4.1, Subpart V, 264.111.

References

New Mexico Environment Department (NMED), 1994, "Assessment of Solid Waste Management Units at the Waste Isolation Pilot Plant," NMED/WIPP 93-001, New Mexico Environment Department, Santa Fe, New Mexico.

TABLES

1

TABLE J-1
SOLID WASTE MANAGEMENT UNIT (SWMU) DESCRIPTIONS

SWMU No.	Unit Type	Unit Description	Waste Description
001	Mud Pits	Thirteen decommissioned mud pits on drill pads are identified in the RCRA Facility Assessment (RFA). Additional mud pits associated with seven groundwater monitoring well sites have been created since the RFA. These were used for settling drill cuttings out of the drilling fluids being used in drilling holes to support hydrologic testing and monitoring, potash evaluation, and drilling for hydrocarbons.	Sodium- and potassium chloride-saturated brine; starch; bentonite gel; diesel fuel; drill cuttings; metal cuttings; grease; hydraulic fluid; motor oil.
002	Landfills	Two landfills used for disposal of construction debris are identified in the RFA.	Foundation excavation soils; concrete; scrap wood; and metal.
003	Storage Yards	One yard used for storage of construction and maintenance materials, wastewater, and used oils or materials that can be reclaimed or recycled has been identified in the RFA.	Water contaminated with motor oil, hydraulic oil, and diesel fuel; used hydraulic oil, motor oil, antifreeze, glycol-based oils, chemical grout; used lead acid batteries; scrap metal. Used hydrocarbons are collected in containers.

FIGURES

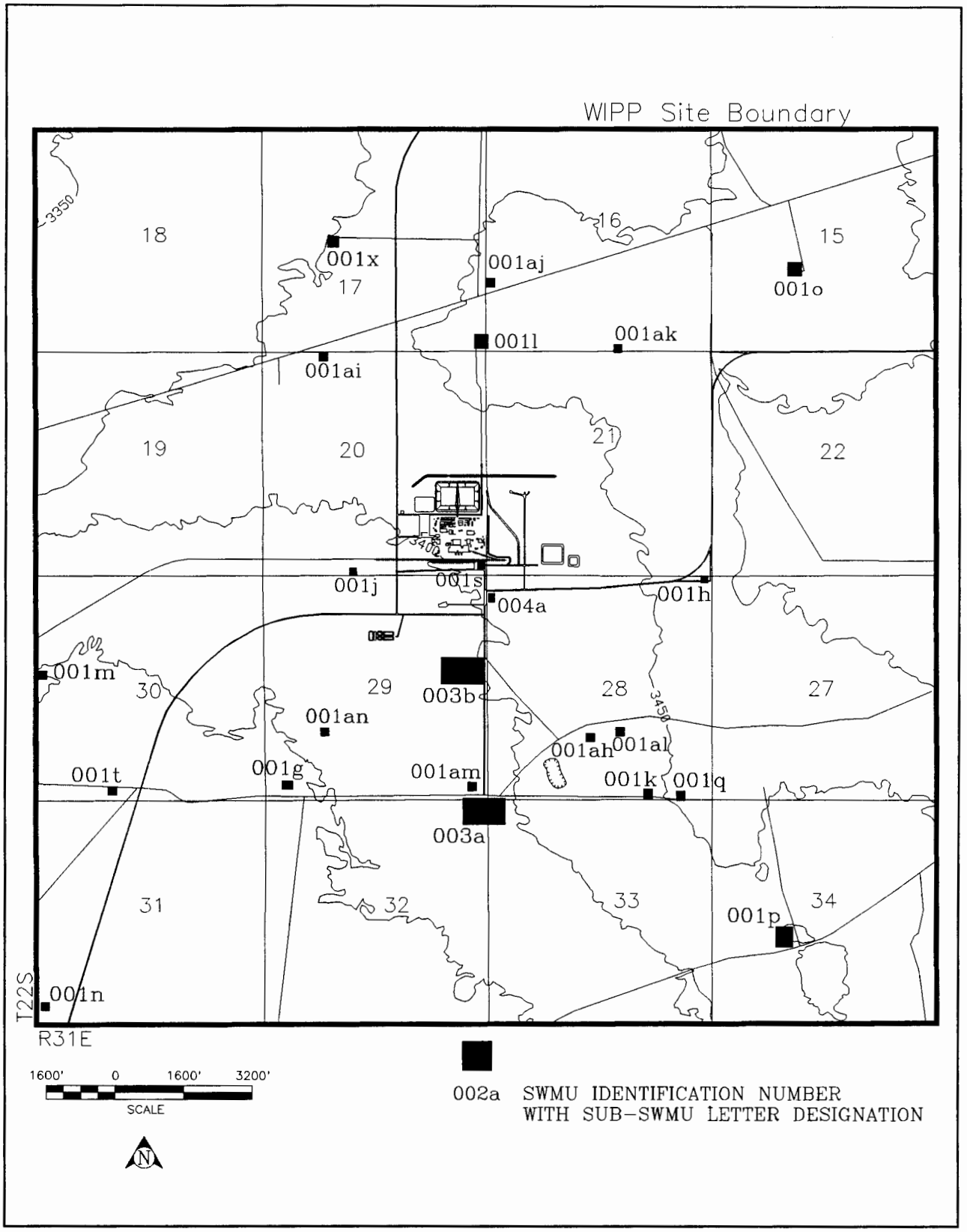

Figure J-1
Location of SWMUs within the WIPP Site Boundary

CHAPTER L
NO-MIGRATION VARIANCE PETITION

In March 1989, the U.S. Department of Energy (DOE) submitted to the U.S. Environmental Protection Agency (EPA) a no-migration variance petition (NMVP) under 40 CFR §268.6 for the Waste Isolation Pilot Plant (WIPP) facility. The document was subsequently expanded to include an addendum and was resubmitted to the EPA in March 1990. The addendum provided additional information specifically requested by the EPA. The petition demonstrated that site characteristics (i.e., the ability of the bedded salt to isolate emplaced wastes from groundwater); operational practices, which would prevent releases to air, soil, and surface water; and characteristics of the waste designated for disposal at the WIPP were sufficient to prevent migration of hazardous constituents beyond the unit boundary during the Test Phase.

On November 14, 1990, the EPA issued a Conditional No-Migration Determination (NMD) for the WIPP facility (55FR47700). The Federal Register notice provided information relevant to the NMD, described the EPA's responses to comments provided on the proposed NMD (55FR13068), and specified the conditions and limitations of the NMD.

The DOE abandoned plans for a Test Phase at the WIPP facility. Prior to initiating disposal operations, the DOE must seek another NMD from the EPA for disposal operations. The DOE will not receive transuranic mixed waste for disposal at the WIPP facility unless a disposal-phase NMD is granted by the EPA or this waste is otherwise exempted from the Land Disposal Restrictions (LDR) of 40 CFR Part 268. Currently, the DOE has no plans for treatment of the waste to meet the LDR, and in the event that a variance is not granted, the DOE would manage only non-mixed waste until appropriate treatment methods have been identified and that waste has been treated.

In May 1995, the DOE issued a draft NMVP for the disposal phase. This draft submittal focused on a demonstration of compliance with the no-migration standards during disposal operations and the closure period. The long-term demonstration of no migration will be presented in the final NMVP, which is scheduled to be submitted to the EPA in June 1996. Once an NMD has been issued by the EPA for the disposal phase, the DOE will comply with all associated terms and conditions.

In order to fulfill the requirement of Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1, Subpart IX, §270.14(b)(21), a copy of the Test Phase NMD is included as Appendix L1. However, as previously stated, the DOE has abandoned plans for a Test Phase and does not propose to conduct any activities relating to a Test Phase.

CHAPTER M
CERTIFICATION

Certification Statement

The U.S. Department of Energy (DOE), through its Carlsbad Area Office, has signed this application as "owner and operator," and Westinghouse Electric Corporation, acting through its Waste Isolation Division (WID), has signed this application for the permitted facility as "co-operator."

The DOE has determined that dual signatures best reflect the actual apportionment of Resource Conservation and Recovery Act (RCRA) responsibilities as follows:

> The DOE's RCRA responsibilities are for policy, programmatic directives, funding and scheduling decisions, Waste Isolation Pilot Plant (WIPP) requirements of DOE generator sites, auditing, and oversight of all other parties engaged in work at the WIPP, as well as general oversight.
>
> The WID's RCRA responsibilities are for certain day-to-day operations (in accordance with general directions given by the DOE and in the Management and Operating Contract as part of its general oversight responsibility), including, but not limited to, the following: certain waste handling, monitoring, record keeping, certain data collection, reporting, technical advice, and contingency planning.
>
> For purposes of the certification required by Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1, Subpart IX, §270.11(d), the DOE's and the WID's representatives certify, under penalty of law, that this document and all attachments were prepared under their direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on their inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of their knowledge and belief, true, accurate, and complete for their respective areas of responsibility. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner and Operator Signature: George E Dials
Title: Manager, Carlsbad Area Office
for: U.S. Department of Energy
Date: April 10, 1996

Co-Operator Signature: Joseph L. Epstein
Title: General Manager
for: Westinghouse Electric Corporation
Date: April 10, 1996

APPENDIX C4
WASTE CHARACTERIZATION SAMPLING METHODS

APPENDIX C4
WASTE CHARACTERIZATION SAMPLING METHODS

C4-1 Headspace-Gas Sampling

C4-1a Method Requirements

All sampling must be accomplished within a radiation containment area (e.g., glovebox or hot/warm cell). The configuration of the containment area and remote-handling equipment at each sampling facility are expected to differ. A description of the containment area and remote-handling equipment must be provided in the site quality assurance project plan (QAPjP). Headspace-gas samples will be analyzed for the analytes listed in Table C8-2 of Appendix C8.

Sites may collect samples in SUMMA® canisters using the headspace gas sampling methods described in the Methods Manual. As an alternative, sites may use on-line integrated sampling/analysis systems. In this case, samples are immediately directed to an analytical instrument instead of being collected in SUMMA® canisters. The same sampling manifold and sampling heads are used with on-line integrated sampling/analysis systems and all of the requirements associated with sampling manifolds and sampling heads must be met. However, when using an on-line integrated sampling/analysis system, the sampling batch and analytical batch quality control (QC) samples are combined as on-line batch QC samples as outlined in Section C4-1b.

Manifold

This headspace gas sampling protocol employs a multiport manifold capable of collecting multiple simultaneous headspace samples for analysis and QC purposes. The manifold can be used to collect samples in SUMMA® canisters or as part of an on-line integrated sampling/analysis system. The sampling equipment must be leak checked and cleaned prior to first use and as needed thereafter. The manifold and sample canisters must be evacuated to 0.0039 inches (in.) (0.10 millimeters [mm]) mercury (Hg) prior to sample collection. Cleaned and evacuated sample canisters must be attached to the evacuated manifold before the manifold inlet valve is opened. The manifold inlet valve must be attached to a changeable filter connected to different sampling head(s), capable of punching through the metal lid of the drum or penetrating a carbon-composite filter.

The manifold must also be equipped with a purge assembly that allows applicable QC samples to be collected through the entire manifold, from the needle tip through all of the same manifold components that the drum headspace gas passes through. Field blanks shall be samples of room air collected in the sampling area in the immediate vicinity of the waste container to be sampled. If using SUMMA® canisters, field blanks are collected directly into the canister, without the use of the manifold.

The manifold, the associated sampling heads, and the headspace-gas sample volume requirements must be designed to ensure that a representative sample is collected. The

manifold internal volume must be calculated and documented in the field logbook. The total volume of headspace gases collected during each sampling operation can be determined by adding the combined volume of the canisters attached to the manifold to the internal volume of the manifold. When an estimate of the available headspace gas volume can be made, less than 10 percent of that volume should be withdrawn.

As illustrated in Figure C4-1, the sampling manifold must consist of a sample side and a standard side. The dotted line indicates how the sample side shall be connected to the standard side for cleaning and collecting equipment blanks and field reference standards. The sample side must consist of the following major components:

- An applicable sampling head that forms a leak-tight connection with the headspace sampling manifold.

- A flexible hose that allows movement of the sampling head from the purge assembly (standard side) to the waste container.

- A pressure sensor(s) that must be pneumatically connected to the manifold. This manifold pressure sensor(s) must be able to measure absolute pressure in the range from 0.002 in. (0.05 mm) Hg to 39.3 in. (1,000 mm) Hg. Resolution must be ±0.0002 in. (0.005 mm) Hg at 0.0020 in. (0.05 mm) of Hg. The manifold pressure sensor(s) must have an operating range from approximately 59°F (15°C) to 104°F (40°C).

- Ports for attaching sample canisters. If using canister-based sampling methods, a sufficient number of ports must be available to allow simultaneous collection of headspace-gas samples and duplicates for volatile organic compounds (VOC) analyses. If using an on-line integrated sampling/analysis system, only one port is necessary for the collection of comparison samples. Ports not occupied with sample canisters during cleaning or headspace-gas sampling activities require a plug to prevent ambient air from entering the system. In place of using plugs, sites may choose to install valves that can be closed to prevent intrusion of ambient air into the manifold. Ports must have VCR® fittings for connection to the sample canister(s) to prevent degradation of the fittings on the canisters and manifold.

- Sample canisters, as illustrated in Figure C4-2, that are leak-free, welded stainless steel pressure vessels, with a chromium-nickel oxide (Cr-NiO) SUMMA®-passivated interior surface, bellows valve, and a pressure/vacuum gauge. All sample canisters must have VCR® fittings for connection to sampling and analytical equipment. The pressure/vacuum gauge must be mounted on each canister. It must be helium-leak tested to 1.5×10^{-7} standard cubic centimeters per second (cc/s), have all stainless steel construction, and be capable of tolerating temperatures to 125°C. The gauge range must be capable of indicating leaks and sample collection.

- A dry vacuum pump with the ability to reduce the pressure in the manifold to 0.05 mm Hg. A vacuum pump that requires oil may be used, but precautions must be taken to prevent diffusion of oil vapors back to the manifold. Precautions may include the use of a molecular sieve and a cryogenic trap in series between the headspace sampling ports and the pump.

- A minimum distance between the tip of the needle and the valve that isolates the pump from the manifold in order to minimize the dead volume in the manifold. The outer diameter of the system's tubing must be 1/8 in. (3.1750 mm).

- If real-time blanks are not available, the manifold must be equipped with an organic vapor analyzer (OVA) that is capable of detecting all analytes listed in Table C8-2 of Appendix C8. The OVA must be capable of measuring total VOC concentrations as low as 0.1 parts per million (ppm). Detection of 1,1,2-trichloro-1,2,2-trifluoroethane may not be possible if a photoionization detector is used. The OVA measurement must be confirmed by the collection of equipment blanks at the frequency specified in Section C4-1 to check for manifold cleanliness.

The standard side must consist of the following major elements:

- A cylinder of compressed zero air, helium, nitrogen or hydrocarbon and carbon dioxide (CO_2)-free air to clean the manifold between samples and to provide gas for the collection of equipment blanks or on-line blanks. These high-purity gases must be certified by the manufacturer to contain less than one ppm total VOCs. The gases must be metered into the standard side of the manifold by two-stage stainless steel regulators. Alternatively, a zero air generator may be used, provided a sample of the zero air is collected and demonstrated to contain less than one ppm total VOCs. Zero air from a generator must be humidified.

- Cylinders of field-reference standard gases or on-line control sample gases. These cylinders provide gases for evaluating the accuracy of the headspace-gas sampling process. Each cylinder of field-reference gas or on-line control sample gas must have a flow-regulating device. The field-reference standard gases or on-line control sample gas must be certified by the manufacturer to contain known analytes at known concentrations.

- If using an analytical method other than Fourier Transform Infrared System (FTIRS) a humidifier filled with American Society for Testing and Materials (ASTM) Type II water, connected, and opened to the standard side of the manifold between the compressed gas cylinders and the purge assembly. Dry gases flowing to the purge assembly will pick up moisture from the humidifier. Moisture is added to the dry gases to condition the equipment blanks and field-reference standards and to assist with system cleaning between headspace-gas sample collection. If using FTIRS for analysis, the sample and sampling system must be kept dry.

NOTE: Caution should be exercised to isolate the humidifier during the evacuation of the system to prevent flooding the manifold. In lieu of the humidifier, the compressed gas cylinders (e.g., zero air and field-reference standard gas) may contain water vapor in the concentration range of 1,000 to 10,000 parts per million by volume (ppmv).

- A purge assembly that allows the sampling head (sample side) to be connected to the standard side of the manifold. The ability to make this connection is required to transfer gases from the compressed gas cylinders to the canisters or on-line analytical instrument. This connection is also required for system cleaning.

- A flow-indicating device that is connected downstream of the purge assembly to monitor the flow rate of gases through the purge assembly. The flow rate through the purge assembly must be monitored to assure that excess flow exists during cleaning activities and during QC sample collection. Maintaining excess flow will prevent ambient air from contaminating the QC samples and allow samples of gas from the compressed gas cylinders to be collected near ambient pressure.

In addition to a manifold consisting of a sample side and a standard side, the area in which the manifold is operated must contain sensors for measuring ambient pressure and ambient temperature, as follows:

- The ambient-pressure sensor must have a sufficient measurement range for the ambient barometric pressures expected at the sampling location. It must be kept in the sampling area during sampling operations. Its resolution must be 1.0 mm Hg or less, and calibration must be based on National Institute of Standards and Technology (NIST), or equivalent, standards.

- The temperature sensor must have a sufficient measurement range for the ambient temperatures expected at the sampling location. The temperature sensor calibration must be traceable to NIST, or equivalent, standards.

<u>Direct Canister</u>

This headspace gas sampling protocol employs a canister-sampling system to collect headspace-gas samples for analysis and QC purposes without the use of the manifold described above. Rather than attaching sampling heads to a manifold, in this method the sampling heads are attached directly to an evacuated sample canister as shown in Figure C4-3.

Canisters must be evacuated to 0.0039 in. (0.10 mm) Hg prior to use and attached to a changeable filter connected to the appropriate sampling head. The sampling head(s) must be capable of punching through the metal lid of the drums and the rigid 90-mil poly liner or penetrating a carbon-composite filter to obtain the drum headspace samples. Field duplicates must be collected at the same time, in the same manner, and using the same type of sampling apparatus as used for headspace-gas sample collection. Field blanks must be samples of room air collected in the immediate vicinity of the waste-drum sampling area prior to removal of the

drum lid. Equipment blanks and field-reference standards must be collected using a purge assembly equivalent to the standard side of the manifold described above. These samples must be collected from the needle tip through the same components (e.g., needle and filter) that the headspace-gas samples pass through.

The sample canisters, associated sampling heads, and the headspace-sample volume requirements ensure that a representative sample is collected. When an estimate of the available headspace-gas volume can be made, less than 10 percent of that volume should be withdrawn. A determination of the sampling head internal volume must be made and documented. The total volume of headspace gases collected during each headspace gas sampling operation can be determined by adding the volume of the sample canister(s) attached to the sampling head to the internal volume of the sampling head. Every effort must be made to minimize the internal volume of sampling heads.

Each sample canister used with the direct canister method must have a pressure/vacuum gauge capable of indicating leaks and sample collection. Canister gauges are intended to be gross leak-detection devices not vacuum-certification devices. If a canister pressure/vacuum gauge indicates an unexpected pressure change, determine if the change is a result of ambient temperature and pressure differences or a canister leak. Prior to sampling, canisters must be evacuated to 0.0039 in. (0.10 mm) Hg. This gauge must be helium-leak tested to 1.5×10^{-7} standard cc/s, have all stainless steel construction, and be capable of tolerating temperatures to 125°C.

The SUMMA® sample canisters must be used when sampling each drum. Three different sampling heads for attachment to the sample canister are described below. These heads must form a leak-tight connection with the canister and allow sampling through the drum-lid carbon-composite filter, or through the drum lid itself. Figure C4-3 illustrates the direct canister-sampling equipment.

Sampling Heads

A sample of the headspace gas directly under the drum lid must be collected from within the drum. Two methods, sampling through the carbon filter and sampling through the drum lid, have been developed for collecting a representative sample.

Sampling Through the Carbon Filter

To sample the drum-headspace gas through the drum's carbon-composite filter, a side-port needle (i.e., a hollow needle sealed at the tip with a small opening on its side close to the tip) must be pressed through the filter and into the headspace beneath the drum lid. This permits the gas to be drawn into the manifold or directly into the canister(s). This procedure is described in detail in the Methods Manual and is specific to a type of carbon-composite filter that permits insertion of the needle. To assure that the sample collected is representative, all of the general method requirements, sampling apparatus requirements, and QC requirements described in this section must be met in addition to the following requirements that are pertinent to drum headspace-gas sampling through the carbon filter:

- The lid of the drum's 90-mil poly liner must contain a hole for venting to the drum. If headspace-gas samples are collected prior to venting the 90-mil poly liner, a nonconformance report must be prepared, submitted, and resolved. Nonconformance procedures are outlined in Appendix C8 (Section C8-13).

- For sample collection, the drum's carbon-composite filter must be sealed as specified in the Methods Manual, or equivalent, to prevent outside air from entering the drum and diluting and/or contaminating the sample.

The sampling head for collecting drum headspace by penetrating the carbon-composite filter must consist of a side-port needle, a filter to prevent particles from contaminating the gas sample, and an adapter to connect the two. To prevent cross contamination, the sampling head must be cleaned or replaced after sample collection, after field-reference standard collection, and after field-blank collection. The following requirements must also be met:

- The housing of the carbon-composite filter must allow insertion of the sampling needle through the filter element into the drum headspace.

- The side-port needle must be used to reduce the potential for plugging.

- The purge assembly must be modified for compatibility with the side-port needle.

Sampling Through the Drum Lid

Sampling through the drum lid must be performed when the drum's carbon-composite filter does not permit insertion of the side-port needle. To sample the drum headspace-gas through the drum lid, the lid must be breached using a sparkless punch. The punch must form an airtight seal between the drum lid and the manifold or direct canister. To assure that the sample collected is representative, all of the general method requirements, sampling apparatus requirements, and QC requirements specified in Methods Manual Procedures 110.1 through 110.4, as appropriate, must be met in addition to the following requirements:

- The seal between the drum lid and sampling head must be designed to minimize intrusion of ambient air [See Methods Manual Procedure 110.4, Section 8.0].

- All components of the drum-punch sampling system that come into contact with sample gases must be purged with humidified zero air, nitrogen, or helium prior to sample collection [See Methods Manual Procedure 110.4, Section 8.0].

- Equipment blanks and field reference standards must be collected through all the components of the punch that contact the headspace-gas sample.

- Pressure must be applied to the sparkless punch until the drum lid has been breached. Then the punch must be backed out to expose the headspace gas.

- Provisions must be made to relieve potential drum pressure increases during drum-punch operations; pressure increases may occur during sealing of the drum punch to the drum lid.

- The lid of the drum's 90-mil poly liner must contain a hole for venting to the drum. If headspace-gas samples are collected prior to venting the 90-mil poly liner, a nonconformance report must be prepared, submitted, and resolved.

- During sampling, the drum's carbon-composite filter, if present, must be sealed to prevent outside air from entering the drum.

Sampling through the drum lid must be accomplished using the drum punch described in the Methods Manual (Procedure 110.4), or an equivalent. The same type of sampling head as used for the 55-gallon (208-liter) poly bag sampling must be pneumatically connected to the drum punch to provide a seal between the drum lid and the manifold or direct canister. The following requirements must also be met:

- A flow-indicating device to verify excess flow of QC gases (for system purge) must be pneumatically connected downstream of the drum punch and operated in the same manner as the flow-indicating device described in the "Manifold" section. A flowrate of approximately one liter per minute for approximately three minutes is required.

- Equipment must be used adequately to secure the drum-punch sampling system to the drum lid.

- Provisions must be made to prevent the punch from rotating as it is pressed through the drum lid.

C4-1b Quality Control

For manifold and direct canister sampling systems, field QC samples must be collected on a per sampling batch basis. A sampling batch is a suite of samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding QC samples), all of which must be collected within 14 days of the first sample in the batch. For on-line integrated sampling/analysis systems, QC samples must be collected and analyzed on a per on-line batch basis. An on-line batch is the number of headspace gas samples collected and analyzed within a 12-hour period using the same on-line integrated analysis system. Table C4-2 provides a summary of field QC sample collection requirements. Table C4-3 provides a summary of QC sample acceptance criteria.

For on-line integrated sampling analysis systems, the on-line batch QC samples serve as combined sampling batch/analytical batch QC samples as follows:

- The on-line blank replaces the equipment blank and laboratory blank

- The on-line control sample replaces the field reference standard and laboratory control sample

- The on-line duplicate replaces the field duplicate and laboratory duplicate

The acceptance criteria for on-line batch QC samples are the same as for the sampling batch and analytical batch QC samples they replace. Acceptance criteria are shown in Table C4-3. A separate field blank must still be collected and analyzed for each on-line batch. However, if the results of a field blank collected through the sampling manifold meets the acceptance criterion, a separate on-line blank need not be collected and analyzed.

The site project Quality Assurance (QA) officer shall have the responsibility to monitor and document field QC sample results and fill out a nonconformance report if acceptance criteria are not met. The site project manager shall have the responsibility to ensure appropriate corrective action is taken if acceptance criteria are not met.

Field Blanks

Field blanks must be collected to evaluate background levels of program-required analytes. Field blanks must be collected prior to sample collection, and at a frequency of one per sampling batch. The site project manager shall use the field blank data to assess impacts of ambient contamination, if any, on the sample results. A nonconformance report (Section C8-13) must be initiated and resolved if the final reported QC sample results do not meet the acceptance criteria.

Equipment Blanks

Equipment blanks must be collected to assess cleanliness prior to first use of all sampling equipment. After the initial cleanliness check, equipment blanks collected through the manifold must be collected at a frequency of one per sampling batch for VOC analysis. If the direct canister method is used, field blanks may be used in lieu of equipment blanks. The site project manager shall use the equipment blank data to assess impacts of potentially contaminated sampling equipment on the sample results. Equipment blank results determined by gas chromatography/mass spectrometry and gas chromatography/flame ionization detection shall be acceptable if the concentration of each VOC analyte is less than three times the method detection limit (MDL) listed in Table C8-2 in Appendix C8. Equipment blank results determined by FTIRS shall be acceptable if the concentration of each VOC analyte is less than the program required quantitation limit and listed in Table C8-2.

Field Reference Standards

Field reference standards shall be used to assess the accuracy with which the sampling equipment collects VOC samples into SUMMA® canisters prior to first use of the sampling equipment. Field reference standards must contain a minimum of six of the analytes listed in Table C8-2 in Appendix C8 at concentrations within a range of 0 to 100 ppmv. Field reference standards must have a known valid relationship to a nationally recognized standard (e.g., NIST). If commercial gases are used, a Certificate of Analysis from the manufacturer documenting

traceability is required. Commercial stock gases must not be used beyond their manufacturer-specified shelf life. After the initial accuracy check, field reference standards collected through the manifold must be collected at a frequency of one per sampling batch and submitted blind to the analytical laboratory. For the direct canister method, field reference standard collection may be discontinued if the field reference standard results demonstrate the quality assurance objectives (QAO) for accuracy specified in Appendix C8. Field reference standard results shall be acceptable if the accuracy is 70 to 130 percent recovery.

Field Duplicates

Field duplicate samples must be collected simultaneously and in accordance with Table C4-1 to assess the precision with which the sampling procedure can collect samples into SUMMA® canisters. Field duplicate results shall be acceptable if the relative percent difference is less than or equal to 25.

C4-1c Equipment Testing, Inspection and Maintenance

All sampling equipment components that come into contact with headspace sample gases must be constructed of relatively inert materials such as stainless steel or Teflon®. A passivated interior surface on the stainless steel components is recommended.

To minimize the potential for cross contamination of samples, the headspace sampling manifold and sample canisters must be properly cleaned and leak-checked prior to headspace gas sampling. Procedures for cleaning and preparing the manifold and sample canisters are provided in the Methods Manual (Procedures 110.1 and 110.2). Cleaning requirements are presented below.

Headspace Gas Sample Canister Cleaning

SUMMA® canisters used in these methods must be subjected to a rigorous cleaning and certification procedure prior to use in the collection of any samples. Guidance for the development of this procedure has been derived from Method TO-14 (EPA 1988a) and can be found in the Methods Manual (Procedure 210.1). Specific details must be provided in laboratory standard operating procedures (SOPs) for the cleaning and certification of canisters.

Canisters must be cleaned and certified on an equipment cleaning batch basis. An equipment cleaning batch is any number of canisters cleaned together at one time using the same cleaning method. A cleaning system, capable of processing multiple canisters at a time, composed of an oven (optional) and a cryogenic trap vacuum manifold must be used to clean SUMMA® canisters. Prior to cleaning, a 24-hour leak test must be performed on all canisters. For a positive pressure check, a canister passes if the pressure does not change by more than ± 2 psig in 24 hours. Any canister that fails must be checked for leaks, repaired, and reprocessed. One canister per equipment cleaning batch must be filled with humid zero air or humid high purity nitrogen and analyzed for VOCs. The equipment cleaning batch of canisters shall be considered clean if there are no VOCs above three times the MDLs listed in Table C8-2 of Appendix C8. After the canisters have been certified for leak-tightness and free of background contamination, they must be evacuated to 0.0039 in. (0.10 mm) Hg or less for storage prior to shipment. The

laboratory responsible for canister cleaning and certification shall maintain canister certification documentation and initiate the canister tags as described in Section 6.0 of the Transuranic Waste Characterization Quality Assurance Program Plan (QAPP).

Sampling Equipment Initial Cleaning and Leak Check

The surfaces of all headspace gas sampling equipment components that will come into contact with headspace gas must be thoroughly inspected and cleaned prior to assembly, in accordance with Methods Manual Procedures 110.1 and 110.2, or equivalent. The manifold and associated sampling heads must be purged with humidified zero air, nitrogen, or helium, and leak checked after assembly. This cleaning must be repeated if the manifold and/or associated sampling heads are contaminated to the extent that the routine system cleaning is inadequate.

Sampling Equipment Routine Cleaning and Leak Check

The manifold and associated sampling heads which are reused must be cleaned and checked for leaks in accordance with the cleaning and leak check procedures described in Procedures 110.1 and 110.2 of the Methods Manual, or equivalent. The procedures must be conducted after headspace gas and field duplicate collection; after field blank collection, if the field blank is collected through the manifold; and after the additional cleaning required for field reference standard collection has been completed. The protocol for routine manifold cleaning and leak check requires that sample canisters be attached to the canister ports, or that the ports be capped or closed by valves, and requires that the sampling head be attached to the purge assembly. Humidified zero air, nitrogen, or helium, regulated through the purge assembly, must then be swept through the sample side of the sampling system.

VOCs must be removed from the internal surfaces of the headspace sampling manifold to levels that are less than three times the MDLs of the analytes listed in Table C8-2 of Appendix C8, as determined by analysis of an equipment blank or the OVA. This is achieved by sweeping the sample side of the sampling system. It is recommended that the headspace sampling manifold be heated and periodically evacuated and flushed with humidified zero air, nitrogen, or helium. When not in use, the manifold must be demonstrated clean before storage with a positive pressure of high purity gas (i.e., zero air, nitrogen, or helium) in both the standard and sample sides.

Sampling must be suspended and corrective actions must be taken when the analysis of an equipment blank indicates these limits have been exceeded. The site project manager must ensure that corrective action has been taken prior to resumption of sampling.

Manifold Cleaning After Field Reference Standard Collection

The sampling system must be specially cleaned after a field reference standard has been collected, because the field reference standard gases contaminate the standard side of the headspace sampling manifold when they are regulated through the purge assembly. This cleaning requires the installation of a gas-tight connector in place of the sampling head, between the flexible hose and the purge assembly. This configuration allows both the sample and standard sides of the sampling system to be flushed (evacuated and pressurized) with humidified

zero air, nitrogen, or helium which, combined with heating the pneumatic lines, should sweep and adequately clean the system's internal surfaces. After this protocol has been completed and prior to collecting another sample, the routine system cleaning and leak check (see previous section) must also be performed.

Sampling Head Cleaning

To prevent cross contamination, the needle, adapters, and filter of the sampling heads must be cleaned in accordance with the cleaning procedures described in Procedures 110.1 and 110.2 of the Methods Manual, or equivalent. After sample collection, a sampling head must be disposed of or cleaned in accordance with the Methods Manual procedures, or equivalent, prior to reuse. As a further QC measure, the needle and filter, after cleaning, should be purged with zero air, nitrogen, or helium and capped for storage to prevent sample contamination by VOCs potentially present in ambient air.

C4-1d Equipment Calibration and Frequency

The manifold pressure sensor must be certified prior to initial use, then annually, using NIST traceable, or equivalent, standards. If necessary, the pressure indicated by the pressure sensor(s) must be temperature compensated. The ambient air temperature sensor, if present, must be certified prior to initial use, then annually, to NIST traceable, or equivalent, temperature standards.

The OVA must be calibrated once per day, prior to first use, or as necessary according to the manufacturer's specifications. Calibration gases must be certified to contain known analytes at known concentrations. The balance of the OVA calibration gas must be consistent with the manifold purge gas when the OVA is used (i.e., zero air, nitrogen, or helium).

C4-2 Sampling of Homogenous Solids and Soil/Gravel

C4-2a Method Requirements

The methods used to collect samples of transuranic (TRU) waste, classified as homogenous solids and soil/gravel from waste containers, must be such that the samples are representative of the waste from which they were taken. To minimize the quantity of investigation-derived waste, laboratories conducting the analytical work may require no more sample than is required for the analysis, based on the analytical methods. Therefore, sampling must be conducted to collect samples in accordance with the QAO specifications as described below.

Core Collection

Coring tools must be used to collect cores of homogenous solids and soil/gravel from waste containers, when possible, in a manner that minimizes disturbance to the core. A rotational coring tool (i.e., a tool that is rotated longitudinally), similar to a drill bit, to cut, lift the waste cuttings, and collect a core from the bore hole, must be used to collect sample cores from containers of the waste. For homogenous solids and soil/gravel that are relatively soft, nonrotational coring tools may be used in lieu of a rotational coring tool.

To provide a basis for describing the requirements for core collection, diagrams of a rotational coring tool (i.e., a light weight auger) and a nonrotational coring tool (i.e., a thin-walled sampler) are provided in Figures C4-4 and C4-5, respectively. Each has been tested for its ability to collect a vertical core of simulated solidified waste contained in 55-gal (208-L) drums and 1-gal (3.8-L) poly bottles (EG&G 1994). The nonrotational coring tool has demonstrated core recoveries greater than 88 percent for soft simulated wastes. The rotational coring tool has demonstrated core recoveries greater than 75 percent for soft simulated wastes and greater than 94 percent for hard simulated wastes.

The following requirements apply to the use of coring tools:

- Each coring tool must contain a removable tube (liner) that is constructed of fairly rigid material unlikely to affect the composition and/or concentrations of target analytes in the sample core. Materials that are acceptable for use for coring device sleeves are polycarbonate, teflon, or glass for most samples, and stainless steel or brass if samples are not to be analyzed for metals (Methods Manual Procedure 120.1). Site QAPjPs must document that analytes of concern are not likely to be present in liner material. Sites must document that the materials are unlikely to affect sample results through the collection and analysis of equipment prior to first use as specified in the 'Equipment Blanks' section of this appendix. Liner outer diameter is recommended to be no more than 2 in. and no less than one in. Liner wall thickness is recommended to be no greater than 1/16 in. Before use, the liner must be cleaned in accordance the requirements in Section C4-2b. The liner must fit flush with the inner wall of the coring tool and must be of sufficient length to hold a core that is representative of the waste along the entire depth of the waste. The liner material must have sufficient transparency to allow visual examination of the core after sampling. If sub-sampling is not conducted immediately after core collection and liner extrusion, then end caps constructed of material unlikely to affect the composition and/or concentrations of target analytes in the core (e.g., Teflon®) must be placed over the ends of the liner. End caps must fit tightly to the ends of the liner.

- A spring retainer, similar to that illustrated in Figures C4-4 and C4-5, must be used with each coring tool when the physical properties of the waste are such that the waste may fall out of the coring tool's liner during sampling activities. The spring retainer must be constructed of relatively inert material (e.g., stainless steel or Teflon®) and its inner diameter must not be less than the inner diameter of the liner. Before use, spring retainers must be cleaned in accordance with the requirements in Section C4-2b.

- Coring tools must have an air-lock mechanism that opens to allow air inside the liners to escape as the tool is pressed into the waste (e.g., ball check valve). This air-lock mechanism must also close when the core is removed from the waste container.

- After disassembling the coring tool, a device (extruder) to forcefully extrude the liner from the coring tool must be used if the liner does not slide freely. All

surfaces of the extruder that may come into contact with the core must be cleaned in accordance with the requirements in Section C4-2(b) prior to use.

- Coring tools must be of sufficient length to hold the liner and must be constructed to allow placement of the liner leading edge as close as possible to the coring tools leading edge.

- All surfaces of the coring tool that have the potential to contact the sample core must be cleaned in accordance with the requirements in Section C4-2(b) prior to use.

- The leading edge of the coring tools must be sharpened and tapered to a diameter equivalent to, or slightly smaller than, the inner diameter of the liner. Based on tests conducted with the coring tools described in the Methods Manual, a diameter slightly smaller (e.g., 1/10 in.) has demonstrated a reduction in the drag of the homogenous solids and soil/gravel against the internal surfaces of the liner, thereby enhancing sample recovery.

- Rotational coring tools must have a mechanism to prevent the liner inside the coring tool from rotating with the coring tool during coring activities, thereby minimizing physical disturbance to the core.

- Rotational coring must be conducted in a manner that minimizes transfer of frictional heat to the core, thereby minimizing potential loss of VOCs.

- Nonrotational coring tools must be designed such that the tool's kerf width is minimized. Kerf width is defined as one-half of the difference between the outer diameter of the tool and the inner diameter of the tool's inlet.

Sample Collection

Sampling must be conducted in accordance with the following requirements:

- Sampling must be conducted as soon as possible after core collection. If a substantial delay (i.e., more than 60 minutes) is expected between core collection and sampling, the core must remain in the liner and the liner must be capped at each end. If the liner containing the core is not extruded from the coring tool and capped, then two alternatives are permissible: 1) the liner must be left in the coring tool and the coring tool must be capped at each end, or 2) the coring tool must remain in the waste container with the air-lock mechanism attached.

- Samples of homogenous solids and soil/gravel for VOC analyses must be collected prior to extruding the core from the liner. The sampling location must be randomly selected along the long axis of the liner and access to the waste must be gained by making a perpendicular cut through the liner and the core. Sites must develop procedures to select, and document the selection, of random sampling locations. True random sampling involves the proper use of random

numbers for identifying sampling locations. A sampling device such as the metal coring cylinder described in ASTM Designation: 4547-91 (ASTM 1991a), or modified disposable syringe described in Procedure 120.1 of the Methods Manual, or equivalent, must be immediately used to collect a 15-gram sample once the core has been exposed to air. Immediately after sample collection, the sample must be extruded into a 40-mL Volatile Organics Analysis (VOA) vial, the top rim of the vial visually inspected and wiped clean of any waste residue, and the vial cap secured. Sample handling requirements are outlined in Table C4-4. Additional guidance for this type of sampling can be found in *Soil Sampling and Analysis for Volatile Organic Compounds* (EPA, 1991).

- Samples of the homogenous solids and soil/gravel for semi-volatile organic compound, polychlorinated biphenyls, and metals analyses must be collected. These samples may be collected from the same location and in the same manner as the sample(s) collected for VOC analysis, or they may be collected by splitting or compositing a representative subsection of the core. The representative subsection is chosen by randomly selecting a location along the core. Sites must develop procedures to select, and document the selection, of random sampling locations. True random sampling involves the proper use of random numbers for identifying sampling locations. Guidance for splitting and compositing solid materials can be found in "Standard Practice for Reducing Field Samples of Aggregate to Testing Size" (ASTM, 1987). All surfaces of the sampling tools that have the potential to come into contact with the sample must be constructed of materials unlikely to affect the composition or concentrations of target analytes in the waste (e.g., Teflon®). Sample sizes and handling requirements are outlined in Table C4-4.

C4-2b Quality Control

QC requirements for sampling of homogenous solids and soil/gravel include collection of collocated cores to determine precision; equipment blanks to verify cleanliness of the coring tools and sampling equipment; and analysis of reagent blanks to ensure reagents, such as deionized or high pressure liquid chromatography (HPLC) water, are of sufficient quality. Coring and sampling of homogenous solids and soil/gravel must comply, at minimum, with the following QC requirements.

Co-located Cores

In accordance with the requirement to collect field duplicates required by Environmental Protection Agency (EPA) methods found in SW-846, co-located cores must be collected to determine the combined precision of the coring and sampling procedures. The co-located core methodology is a duplicate sample collection methodology intended to collect samples from approximately the same location within the drum. Cores must be collected side by side as close as feasible to one another, handled in the same manner, visually inspected through the transparent liner, and sampled in the same manner at the same randomly selected sample location. If the visual examination detects inconsistencies such as color, texture, or waste type in the waste at the sample location, another sampling location may be randomly selected, or the

cores may be invalidated and co-located cores may again be collected. Co-located cores must be collected at a frequency of one per sampling batch. A sampling batch is a suite of homogenous solids and soil/gravel samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which must be collected within 14 days of the first sample in the batch. Because of the normally slow rate of core collection (1-2 cores per day), daily collection of field QC samples would result in numerous QC samples being collected for each field sample. This is inappropriate for sampling operations and is unnecessary for QC purposes. The collection of field QC samples on a "per sampling batch" basis provides adequate control for sampling operations.

Equipment Blanks

In accordance with SW-846, equipment blanks must be collected from fully assembled coring tools prior to first use at a frequency of one per equipment cleaning batch. An equipment cleaning batch is the number of sampling equipment items cleaned together at one time using the same cleaning method. The equipment blank must be collected from the fully assembled coring tool, in the area where the coring tools are cleaned, prior to covering with protective wrapping and storage. The equipment blank must be collected by pouring clean water (e.g., deionized water, HPLC water) down the inside of the liners of the assembled coring tool. The water must be collected in a clean sample container placed at the leading edge of the coring tool and analyzed for the analytes listed in Tables C8-4, C8-6, and C8-9 of Appendix C8. The results of the equipment blank will be considered acceptable if the analysis indicates no analyte at a concentration greater than three times the MDLs listed in Tables C8-4 and C8-6 or in the Program Required Detection Limits (PRDL) in Table C8-9 of Appendix C8. If analytes are detected at concentrations greater than three times the MDLs, then the associated equipment cleaning batch of coring tools must be cleaned again and another equipment blank collected.

Equipment blanks must be collected from liners that are cleaned separately from the coring tools. These equipment blanks must be collected at a frequency of one per equipment cleaning batch. The equipment blanks must be collected by randomly selecting a liner from the equipment cleaning batch, pouring clean water (e.g., deionized water or HPLC water) across its internal surface, collecting the water in a clean sample container, and analyzing the water for the analytes listed in Tables C8-4, C8-6, and the PRDLs in C8-9 of Appendix C8. The results of the equipment blank analysis will be considered acceptable if the results indicate no analyte at a concentration greater than three times the MDLs listed in Tables C8-4, C8-6, or C8-9 of Appendix C8. If analytes are detected at concentrations greater than three times the MDLs (or PRDLs for metals), then the associated equipment cleaning batch of liners must be cleaned again and another equipment blank collected.

Sampling equipment (e.g., bowls, spoons, chisel, VOC sub-sampler) must also be cleaned. Equipment blanks must be collected for the sampling equipment at a frequency of one per equipment cleaning batch. After the sampling equipment has been cleaned, one item from the equipment cleaning batch is randomly selected, water (e.g., deionized water, HPLC water) is passed over its surface, collected in a clean container, and analyzed for the analytes listed in Tables C8-4, C8-6, and C8-9 of Appendix C8. The results of the equipment blank will be considered acceptable if the results indicate no analyte present at a concentration greater than

three times the MDLs listed in Tables C8-4 and C8-6 and in the PRDLs in C8-9 of Appendix C8. If analytes are detected at concentrations greater than three times the MDLs (or PRDLs for metals), then the associated equipment cleaning batch of sampling equipment must be cleaned again and another equipment blank collected.

The results of equipment blanks must be traceable to the items in the equipment cleaning batch that the equipment blank represents. It is recommended that the equipment blank results for the coring tools, liners, and sampling equipment be reviewed prior to use. A sufficient quantity of these items should be maintained in storage to prevent disruption of sampling operations.

A site may choose to discard liners and sampling tools after one use. In this instance, cleaning and equipment blank collection is not required.

Coring Tool and Sampling Equipment Cleaning

Coring tools and sampling equipment must be cleaned in accordance with the following requirements:

- All surfaces of coring tools and sampling equipment that will come into contact with the core and the samples must be clean prior to use. All items of sampling equipment must be cleaned in the same manner. Immediately following cleaning, coring tools and sampling equipment must be assembled and sealed inside clean protective wrapping.

- Each coring tool must have a unique identification number. Each number must be referenced to the waste container on which it was used. This information must be recorded in the field records. One coring tool from the equipment cleaning batch must be tested for cleanliness in accordance with the requirements specified above. The identification number of the coring tool from which the equipment blank was collected must be recorded in the field records. The results of the equipment blank analysis for the equipment cleaning batch in which each coring tool was cleaned must be submitted to the sampling facility with the identification numbers of all coring tools in the equipment cleaning batch.

- Sample containers must be cleaned in accordance with the *Specifications and Guidance for Obtaining Contaminant-Free Sample Containers* (EPA, 1992).

C4-2c Equipment Testing, Inspection and Maintenance

Prior to initiation of coring activities, coring tools must be tested in accordance with manufacturer specifications to ensure operation within the manufacturer's tolerance limits. Other specifications specific to the sampling operations (e.g., operation of containment structure and safety systems) should also be tested and verified as operating properly prior to initiating coring activities. Coring tools must be assembled, including liners, and tested. Air-lock mechanisms and rotation mechanisms must be inspected for free movement of critical parts. Coring tools found to be malfunctioning must be repaired or replaced prior to use.

Coring tools and sample collection equipment must be maintained in accordance with manufacturer's specifications. Clean coring tools and sampling equipment must be sealed inside clean protective wrapping and maintained in a clean storage area prior to use. Sampling equipment must be properly maintained to avoid contamination. A sufficient supply of spare parts should be maintained to prevent delays in sampling activities due to equipment down time. Records of equipment maintenance and repair must be maintained in the field records in accordance with site SOPs.

Inspection of sampling equipment and work areas shall include the following:

- Sample collection equipment in the immediate area of sample collection must be inspected daily for cleanliness. Visible contamination on any equipment (e.g., waste on floor of sampling area, hydraulic fluid from hoses) that has the potential to contaminate a waste core or waste sample must be thoroughly cleaned upon its discovery.

- The waste coring and sampling work areas must be maintained in clean condition to minimize the potential for cross contamination between cores and samples.

- Expendable equipment (e.g., plastic sheeting, plastic gloves) must be visually inspected for cleanliness prior to use and properly discarded after each sample.

- Prior to removal of the protective wrapping from a coring tool designated for use, the condition of the protective wrapping must be visually assessed. Coring tools with torn protective wrapping should be returned for cleaning. Coring tools visibly contaminated after the protective wrapping has been removed must not be used and must be returned for cleaning or properly discarded.

- Sampling equipment must be visually inspected prior to use. All sampling equipment that comes into contact with waste samples must be stored in protective wrapping until use. Prior to removal of the protective wrapping from sampling equipment, the condition of the protective wrapping must be visually assessed. Sampling equipment with torn protective wrapping should be discarded or returned for cleaning. Sampling equipment visibly contaminated after the protective wrapping has been removed must not be used and must be returned for cleaning or properly discarded.

C4-2d Equipment Calibration and Frequency

The scale used for weighing sub-samples must be calibrated as necessary to maintain its operation within manufacturer's specification, and after repairs and routine maintenance. Weights used for calibration must be traceable to a nationally recognized standard. Calibration records must be maintained in the field records.

C4-3 Radiography

C4-3a Methods Requirements

Radiography has been developed by the Department of Energy (DOE) specifically to aid in the examination and identification of containerized waste. There is no equivalent or associated method found in EPA sampling and analysis guidance documents. All activities required to achieve the radiography objectives must be described in site QAPjPs and SOPs.

A radiography system normally consists of an X-ray-producing device, an imaging system, an enclosure for radiation protection, a waste container handling system, an audio/video recording system, and an operator control and data acquisition station. Although these six components are required, it is expected there will be some variation within a given component between sites. The X-ray-producing device must have controls which allow the operator to vary the voltage, thereby controlling image quality. It should be possible to vary the voltage, typically between 150 to 400 kilovolts (k), to provide an optimum degree of penetration through the waste. For example, high-density material should be examined with the X-ray device set on the maximum voltage. This ensures maximum penetration through the waste container. Low-density material should be examined at lower voltage settings to improve contrast and image definition. The imaging system typically utilizes a fluorescent screen and a low-light television camera.

To perform radiography, the waste container is scanned while the operator views the television screen. An audio/videotape is made of the waste container scan and is maintained as a permanent record. A radiography data form is also used to document the matrix parameter category and estimated waste material parameter weights of the waste. The estimated waste material parameter weights should be determined by compiling an inventory of waste items, residual materials, and packaging materials. The items on this inventory should be sorted by waste material parameter and combined with a standard weight look-up table to provide an estimate of waste material parameter weights.

C4-3b Quality Control

The radiography system involves qualitative and semiquantitative evaluations of visual displays. Operator training and experience are the most important considerations for assuring quality controls in regard to the operation of the radiography system and for interpretation and disposition of radiography results. Only trained personnel must be allowed to operate radiography equipment.

Standardized training requirements for radiography operators must be based upon existing industry standard training requirements and must comply with the training and qualification requirements of NQA-1, Element 2, except for Supplement 2S-2 (ASME, 1994). Supplement 2S-2 is associated with radiography used in verifying safety-related parameters, such as welding, where quantitative comparisons can be utilized. As such, it is not applicable to waste management operations and not considered necessary or appropriate for training radiography operators involved in TRU waste characterization activities.

Each site must develop a training program that provides radiography operators with both formal and on-the-job (OJT) training. Radiography operators must be instructed in the specific waste generating practices, typical packaging configurations, and associated waste material parameters expected to be found in each matrix parameter category at the site. The OJT and apprenticeship must be conducted by an experienced, qualified radiography operator prior to qualification of the training candidate. The training programs will be site-specific due to differences in equipment, waste configurations, and the level of waste characterization efforts. For example, certain sites use digital radiography equipment, which is more sensitive than real-time radiography equipment. In addition, the particular physical forms and packaging configurations at each site will vary; therefore, radiography operators must be trained on the types of waste that are generated, stored, and/or characterized at that particular site.

Although each site must develop its own training program, all of the radiography QC requirements specified in this Waste Analysis Plan (WAP) and the Methods Manual must be incorporated into the training programs and radiography operations. In this way data quality and comparability will not be affected.

Radiography training programs will be the subject of the Generator/Storage Site Waste Screening and Acceptance Audit Program (Appendix C11).

Although the site-specific training programs will vary to some degree, each program will contain the following required elements based on NQA-1 requirements:

Formal Training

- Project Requirements
- State and Federal Regulations
- Basic Principles of Radiography
- Radiographic Image Quality
- Radiographic Scanning Techniques
- Application Techniques
- Radiography of Waste Forms
- Standards, Codes, and Procedures for Radiography
- Site-Specific Instruction

On-the-Job Training

- System Operation
- Identification of Packaging Configurations
- Identification of Waste Material Parameters
- Weight and Volume Estimation
- Identification of Prohibited Items

A radiography test drum will include items common to the waste streams to be generated/stored at the generator/storage site. The test drums must be divided into layers with varying packing densities or different drums may be used to represent different situations that may occur during

radiography examination at the site. The following is a list of required elements of a radiography test drum:

- Aerosol can with puncture
- Horsetail bag
- Pair of coveralls
- Empty bottle
- Irregular shaped pieces of wood
- Empty one gallon paint can
- Full container
- Aerosol can with fluid
- One gallon bottle with three tablespoons of fluid
- One gallon bottle with one cup of fluid (upside down)
- Leaded glove or leaded apron
- Wrench

These items must be successfully identified by the operator as part of the qualification process. Qualification of radiography operators must, at a minimum, encompass the following requirements:

- Successfully pass a comprehensive exam based upon training enabling objectives. This exam will be reviewed as part of the Generator/Storage Site Waste Screening and Acceptance Audit Program (Appendix C11)

- Perform practical capability demonstration in the presence of appointed site radiography subject matter expert. This person is an experienced radiography operator who is qualified as an OJT trainer.

Requalification of operators must be based upon evidence of continued satisfactory performance (primarily audio/videotape reviews) and must be done at least every two years. Unsatisfactory performance will result in disqualification. Unsatisfactory performance is defined as the misidentification of a prohibited item in a training drum or a score of less than 80% on the comprehensive exam. Retraining and demonstration of satisfactory performance are required before an operator is again allowed to operate the radiography system.

A training drum with various container sizes must be periodically scanned by each operator. The videotape must then be reviewed by a supervisor to ensure that operators' interpretations remain consistent and accurate. Imaging system characteristics must be verified on a routine basis.

Independent replicate scans and replicate observations of the video output of the radiography process must be performed under uniform conditions and procedures. Independent replicate scans must be performed on one waste container per day or once per testing batch, whichever is less frequent. Independent observations of one scan (not the replicate scan) must also be made once per day or once per testing batch, whichever is less frequent, by a qualified radiography operator other than the individual who performed the first examination. A testing batch is a suite of waste containers undergoing radiography using the same testing equipment. A testing batch can be up to 20 waste containers without regard to waste matrix.

Oversight functions include periodic audio/video tape reviews of accepted waste containers and must be performed by qualified radiography personnel other than the operator who dispositioned the waste container. The results of this verification must be available to the radiography operator. The site project QA officer shall be responsible for monitoring the quality of the radiography data and calling for corrective action, when necessary.

Visual Examination

As an additional QC check, the radiography results must be verified directly by visual examination of the waste container contents. Visual examination must be performed on a statistically determined portion of waste containers to verify the results of radiography. This verification must include the matrix parameter category and waste material parameter weights. The verification must be performed through a comparison of radiography and visual examination results. The results of the visual examination must be transmitted to the radiography facility.

The visual examination must consist of a semi-quantitative and/or qualitative evaluation of the waste container contents, and must be recorded on audio/videotape. The visual examination program has been developed by the DOE to provide an acceptable level of confidence in radiography. There is no equivalent method found in EPA sampling and analysis guidance documents. A detailed procedure that meets the requirements of this method can be found in the Methods Manual.

Standardized training for visual inspection must be developed to include both formal classroom and OJT. Visual inspectors must be instructed in the specific waste generating processes, typical packaging configurations, and expected waste material parameters expected to be found in each matrix parameter category at the site. The OJT and apprenticeship must be conducted by an operator experienced and qualified in visual examination prior to qualification of the candidate. The training must be site specific to include the various waste configurations generated/stored at the site. For example, the particular physical forms and packaging configurations at each site will vary so operators must be trained on types of waste that are generated, stored, and/or characterized at that particular site. Visual examination personnel must be requalified once every two years.

Although site-specific training programs will vary to some degree, each program will contain the following required elements based on NQA-1 requirements:

Formal Training

- Project Requirements
- State and Federal Regulations
- Application Techniques
- Site-Specific Instruction

On-the-Job Training

- Identification of Packaging Configurations
- Identification of Waste Material Parameters

- Weight and Volume Estimation
- Identification of Prohibited Items

Each visual examination facility must designate a visual examination expert. The visual examination expert must be familiar with the waste generating processes that have taken place at that site and also be familiar with all of the types of waste being characterized at that site. The visual examination expert shall be responsible for the overall direction and implementation of the visual examination at that facility. Site QAPjPs must specify the selection, qualification, and training requirements of the visual examination expert.

Figure C4-6 illustrates the overall programmatic approach to the visual examination of waste. If the waste is homogeneous, the expert may decide that a limited visual examination involving a confirmation of the radiography data is appropriate. If the waste is heterogeneous, the expert may decide a full visual examination by opening bags and segregating waste is warranted. Various degrees of segregation are possible based on the expert's judgment and availability of acceptable knowledge data. Site QAPjPs must specify decision-making criteria for the visual examination expert. In all cases, SOPs must be developed to support the visual examination process, and the basis for the expert's decisions must be documented.

A description of the waste container contents must be recorded on a data form as implemented in the site QAPjP. The description can be brief, but it must clearly identify the appropriate waste matrix parameters and provide enough information to estimate weights of waste material parameters. In cases where bags are not opened, a brief written description of the contents of the bags must contain an estimate of the amount of each waste type in the bags. The written records of visual examination must be supplemented with the audio/video recording.

C4-4 Sample Custody of Samples

Chain-of-Custody on field samples (including field QC samples) will be initiated immediately after sample collection or preparation. Sample custody will be maintained until the associated analyses are completed and the data have been validated at the project level. Sample custody will be maintained until the sample is expended or until the sample is removed from the sample analysis program. Site QAPjPs will include a copy of the sample chain-of-custody form; this form will include provisions for each of the following:

- Signature of individual initiating custody control, along with the date and time
- Documentation of sample numbers for each sample under custody
- Signatures of custodians relinquishing and receiving custody, along with date and time of the transfer
- Description of final waste container disposition, along with signature of individual removing waste container from custody
- Comment section

C4-5 Sample Packing and Shipping

In the event that the analytical facilities are not at the generator site, the samples must be packaged and shipped to an off-site laboratory. Sample containers must be packed to prevent any damage to the sampling container and maintain the preservation temperature, if necessary. Department of Transportation (DOT) regulations must be adhered to for shipment of the package.

When preparing SUMMA® canisters for shipment, special care must be taken with the pressure gauge and the associated connections. Metal boxes which have separate compartments, or cardboard boxes with foam inserts are standard shipping containers. The chosen shipping container may be required to meet selected DOT regulations. If temperatures must be maintained, cold packs can be added to the package.

Glass jars are wrapped in bubble wrap or another type of protection. The wrapped jar should be placed in a plastic bag inside of the shipping container, so that if the jar breaks, the inside of the shipping container and the other samples will not be contaminated. The plastic bag will enable the receiving analytical lab to prevent contamination of their shipping and receiving area. Plastic jars do not present a problem for shipping purposes. A DOT approved cooler, or similar package may be used as the shipping container. If temperatures must be maintained, cold packs can be added to the package. If a fill material is needed, compatibility between the samples and the fill should be considered.

Sample containers should be affixed with a tamper-proof seal so that it is apparent if the sample integrity has been compromised. A seal should also be placed on the outside of the shipping container for the same reason. Sample custody documentation must be placed inside of the shipping container, with the current custodian signing to release custody. The shipping documentation will serve as proof of custody during shipment, so the transporter does not need to sign the chain-of-custody documentation.

A Uniform Hazardous Waste Manifest is not required, since samples are exempted from the definition of hazardous waste. All other shipping documentation (i.e., bill of lading, site-specific shipping documentation) is required.

C4-6 List of References

American Society of Mechanical Engineers (ASME), 1994, Quality Assurance Requirements for Nuclear Facility Applications. ASME NQA-1-1994 Edition, New York, New York, American Society of Mechanical Engineers.

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U.S. Environmental Protection Agency (EPA), 1991, Soil Sampling and Analysis for Volatile Organic Compounds. EPA/540/4-91/001, T. E. Lewis, A. B. Crockett, R. L. Siegrist, K. Zarrabi, Office of Research and Development, U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency (EPA), 1992, Specification and Guidance for Obtaining Contaminant-Free Sample Containers. Directive No. 9240.0-05A, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency (EPA), 1988, "Compendium Method TO-14, The Determination of Volatile Organic Compounds (VOC) in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analyses." *Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air.* Research Triangle Part, North Carolina, Quality Assurance Division, Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency.

TABLES

TABLE C4-1

GAS SAMPLE CONTAINERS AND HOLDING TIMES

Parameter	Container	Minimum Drum Headspace Sample Volume[a]	Holding Temperatures	Field Holding Time[b]	Shipping Allowance	Laboratory Holding Time[c]
VOCs	SUMMA® Canister	250 ml	0-40 °C	4 days	2 days	28 days

[a] Alternatively, if available headspace is limited, a single 100 ml sample may be collected for determination of VOCs.
[b] From the time of headspace sample collection to shipment.
[c] Programmatic-based maximum holding time. Holding time begins at VTSR.

TABLE C4-2
SUMMARY OF DRUM FIELD QC HEADSPACE SAMPLE FREQUENCIES

QC Samples	Manifold	Direct Canister	On-Line Systems
Field blanks[a]	1 per sampling batch[d]	1 per sampling batch[d]	1 per on-line batch[f]
Equipment blanks[b]	1 per sampling batch[d]	once[e]	1 per on-line batch[f]
Field reference standards[c]	1 per sampling batch[d]	once[e]	1 per on-line batch[f]
Field duplicates	1 per sampling batch[d]	1 per sampling batch[d]	1 per on-line batch[f]

[a]Analysis of field blanks for VOCs (Table C8-2 of Appendix C8), only, is required. For on-line integrated sampling/analysis systems, if field blank results meet the acceptance criterion, a separate on-line blank is not required.

[b]One equipment blank or on-line sample must be collected, analyzed for VOCs (Table C8-2), and demonstrated clean prior to first use of the headspace gas sampling equipment with each of the sampling heads, then at the specified frequency, for VOCs only thereafter. Daily, prior to work, the sampling manifold, if in use, must be verified clean using an OVA.

[c]One field reference standard or on-line control sample must be collected, analyzed, and demonstrated to meet the QAOs specified in Appendix C8 prior to first use, then at the specified frequency thereafter.

[d]A sampling batch is a suite of samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which must be collected within 14 days of the first sample in the batch.

[e]One equipment blank and field reference standard must be collected after equipment purchase, cleaning, and assembly.

[f]An on-line batch is the number of samples collected and analyzed within a 12-hour period using the same on-line integrated sampling/analysis system.

TABLE C4-3
SUMMARY OF SAMPLING QUALITY CONTROL SAMPLE ACCEPTANCE CRITERIA

QC Sample	Acceptance Criteria	Corrective Action[a]
Field blanks	VOC amounts < 3 x MDLs in Table C8-2 of Appendix C8 for GC/MS and GC/FID; < PRQLs in Table C8-2 for FTIRS	Nonconformance if any VOC amount > 3 x MDLs in Table C8-2 of Appendix C8 for GC/MS and GC/FID; > PRQLs in Table C8-2 for FTIRS
Equipment blanks	VOC amounts < 3 x MDLs in Table C8-2 of Appendix C8 for GC/MS and GC/FID; < PRQLs in Table C8-2 for FTIRS	Nonconformance if any analyte amount > 3 x MDLs in Table C8-2 of Appendix C8 for GC/MS and GC/FID; > PRQLs in Table C8-2 for FTIRS
Field reference standards or on-line control sample	70 - 130 %R	Nonconformance if %R < 70 or > 130
Field duplicates or on-line duplicate	RPD ≤ 25	Nonconformance if RPD > 25

[a]Corrective action is only required if the final reported QC sample results do not meet the acceptance criteria.
MDL = Method detection limit
%R = Percent recovery
RPD = Relative percent difference

TABLE C4-4

SAMPLE HANDLING REQUIREMENTS FOR HOMOGENEOUS SOLIDS AND SOIL/GRAVEL

Parameter	Suggested Quantity[a]	Required Preservative	Suggested Container	Maximum Holding Time[b]
VOCs	15 grams	Cool to 4°C	Glass Vial[c]	14 Days Prep/ 40 Days Analyze[d]
SVOCs	50 grams	Cool to 4°C	Glass Jar[e]	14 Days Prep/ 40 Days Analyze[d]
Polychlorinated Biphenyls (PCBs)	50 grams	Cool to 4°C	Glass Jar[e]	14 Days Prep/ 40 Days Analyze[d]
Metals	10 grams	Cool to 4°C	Plastic Jar[g]	180 Days[h]

[a]Quantity may be increased or decreased according to the requirements of the analytical laboratory, as long as the QAOs are met.
[b]Holding time begins at sample collection (holding times are consistent with SW-846 requirements).
[c]VOA vial, must have septum cap.
[d]40-day holding time allowable only for methanol extract - 14-day holding time for non-extracted VOCs.
[e]Opaque glass container, must have Teflon® lined cap (example, amber jar).
[f]Analysis for PCBs is required only for waste streams in matrix parameter category S3220 (organics sludges).
[g]Polyethylene or polypropylene preferred, glass jar is allowable.
[h]Holding time for mercury analysis is 28 days.

FIGURES

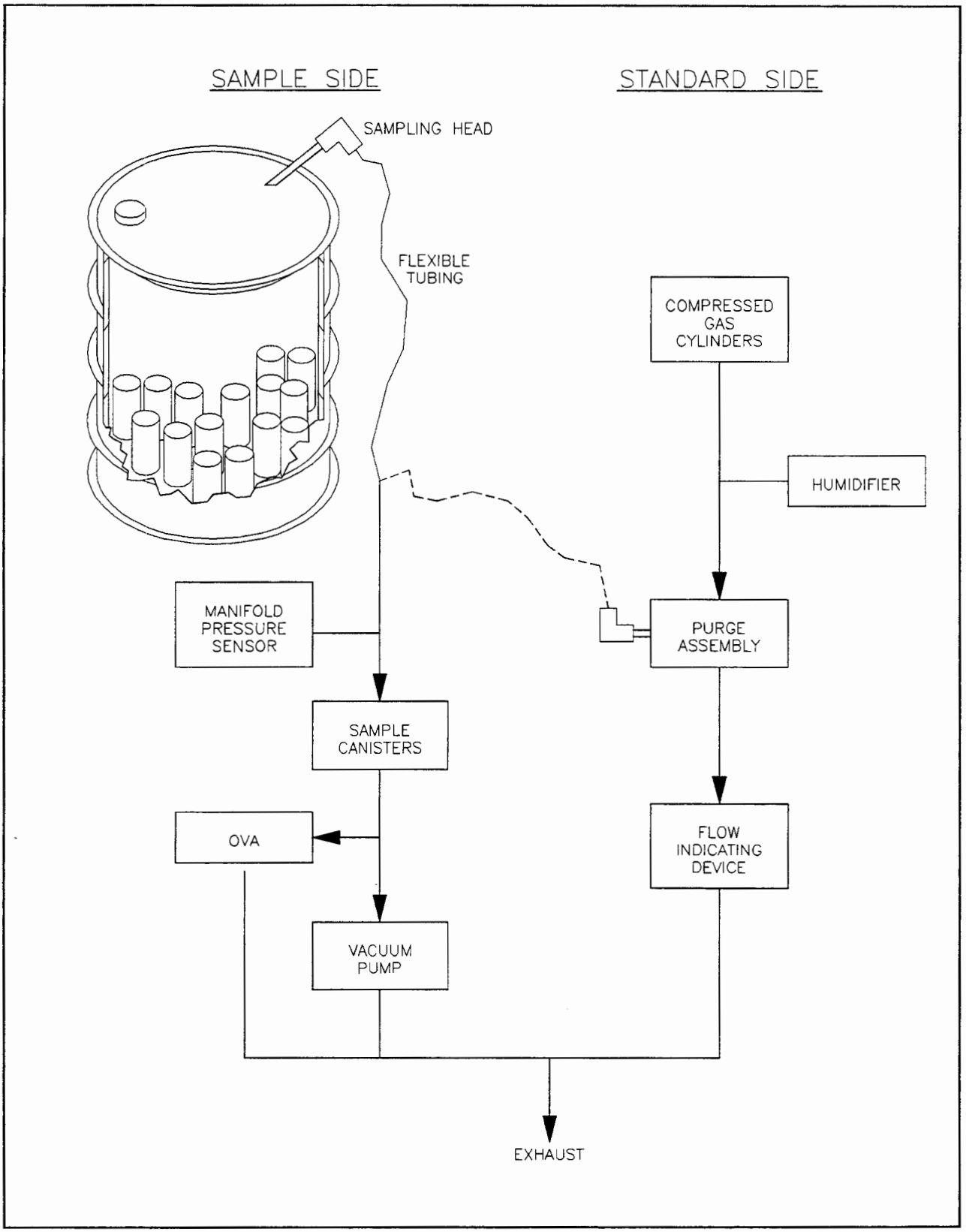


Figure C4-1
Headspace Sampling Manifold

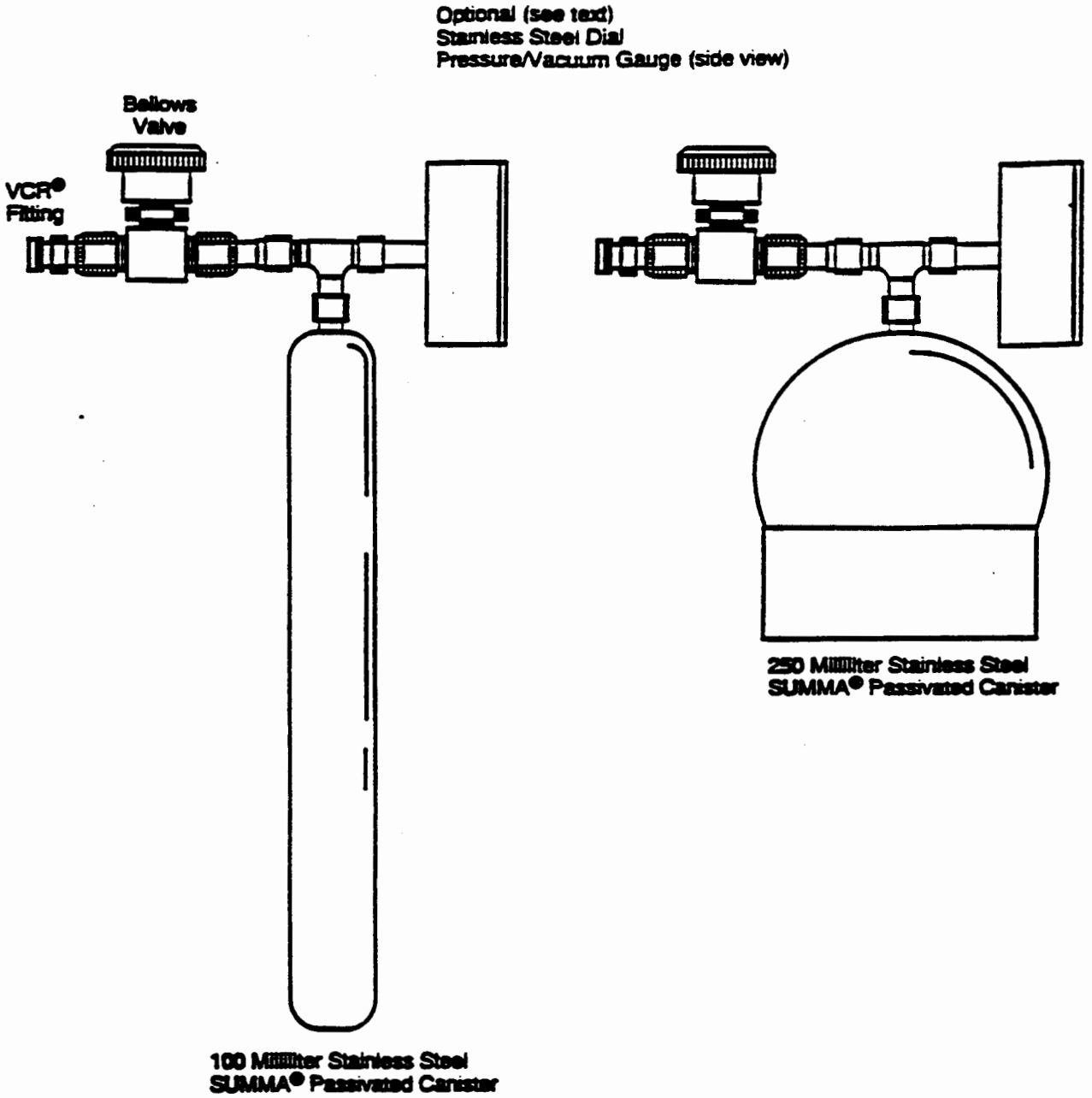


FIGURE C4-2
SUMMA® Canister Components Configuration
(Not to Scale)

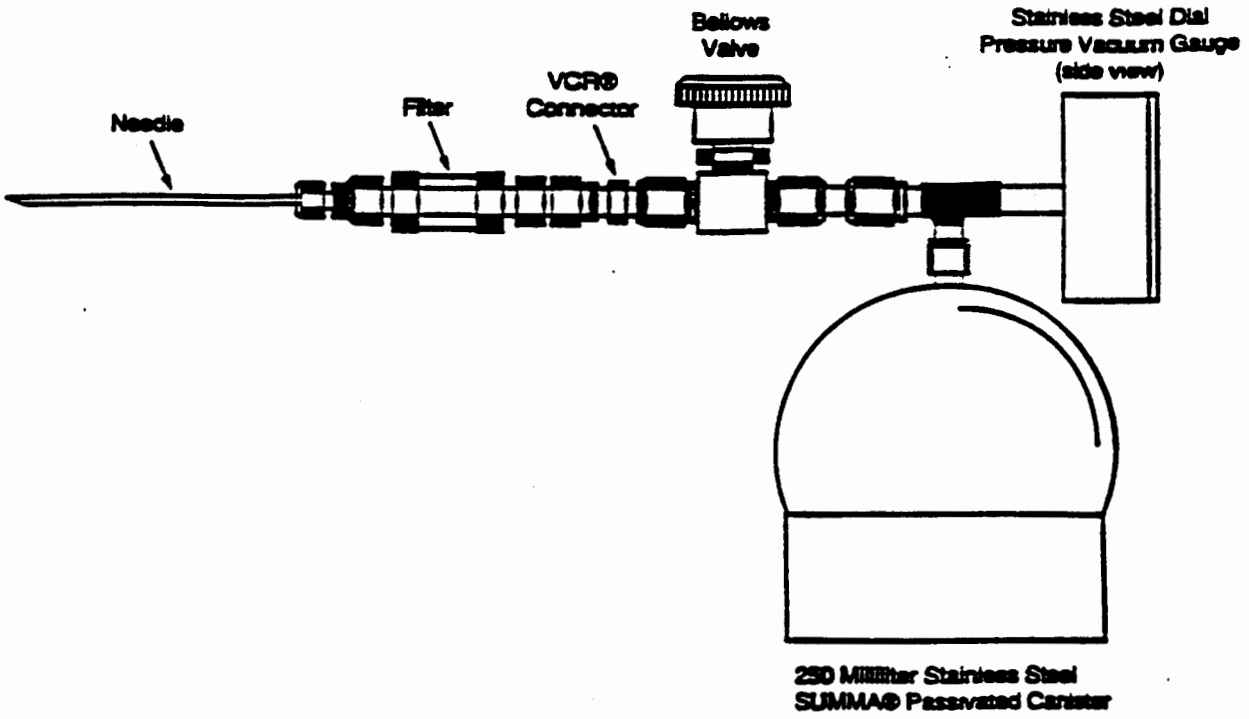
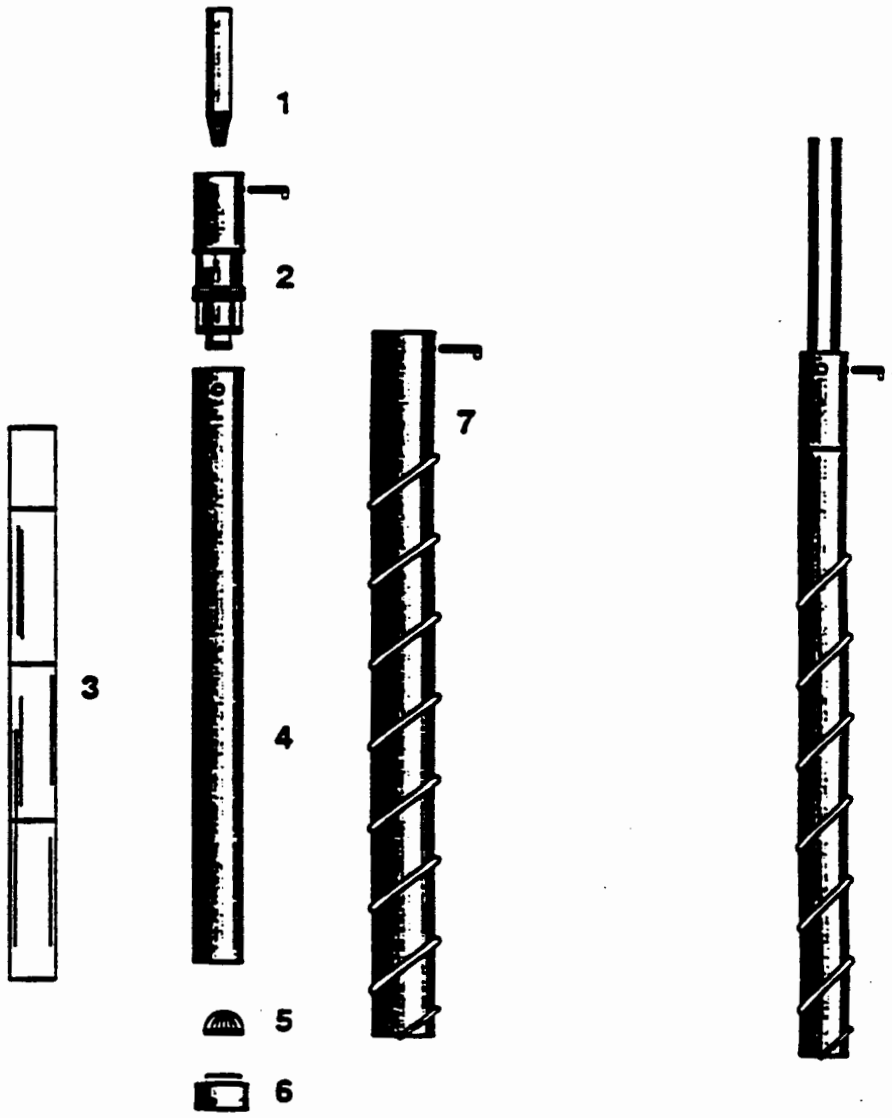
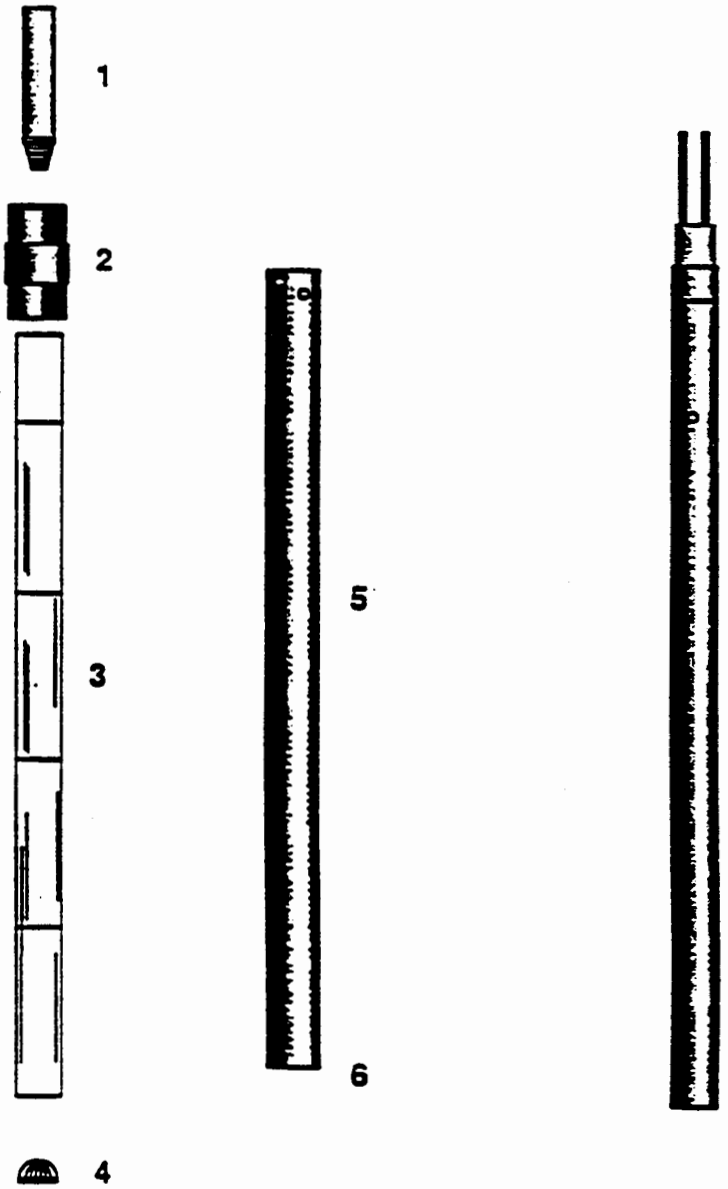


FIGURE C4-3
Schematic Diagram of Direct Canister with the Poly Bag Sampling Head



1 Drill Rod
2 Thrust Bearing Ball Check Valve
3 Clear Teflon® Liners
4 Core Barrel
5 Spring Retainer (optional)
6 Core Barrel Tip
7 Auger and Pin

FIGURE C4-4
Rotational Coring Tool
(Light Weight Auger)



1 Drill Rod
2. Ball Check Valve
3. Clear Teflon® Liners
4. Spring Retainer (optional)
5. Tube
6. Tapered Tip

FIGURE C4-5
Non-Rotational Coring Tool
(Thin Walled Sampler)

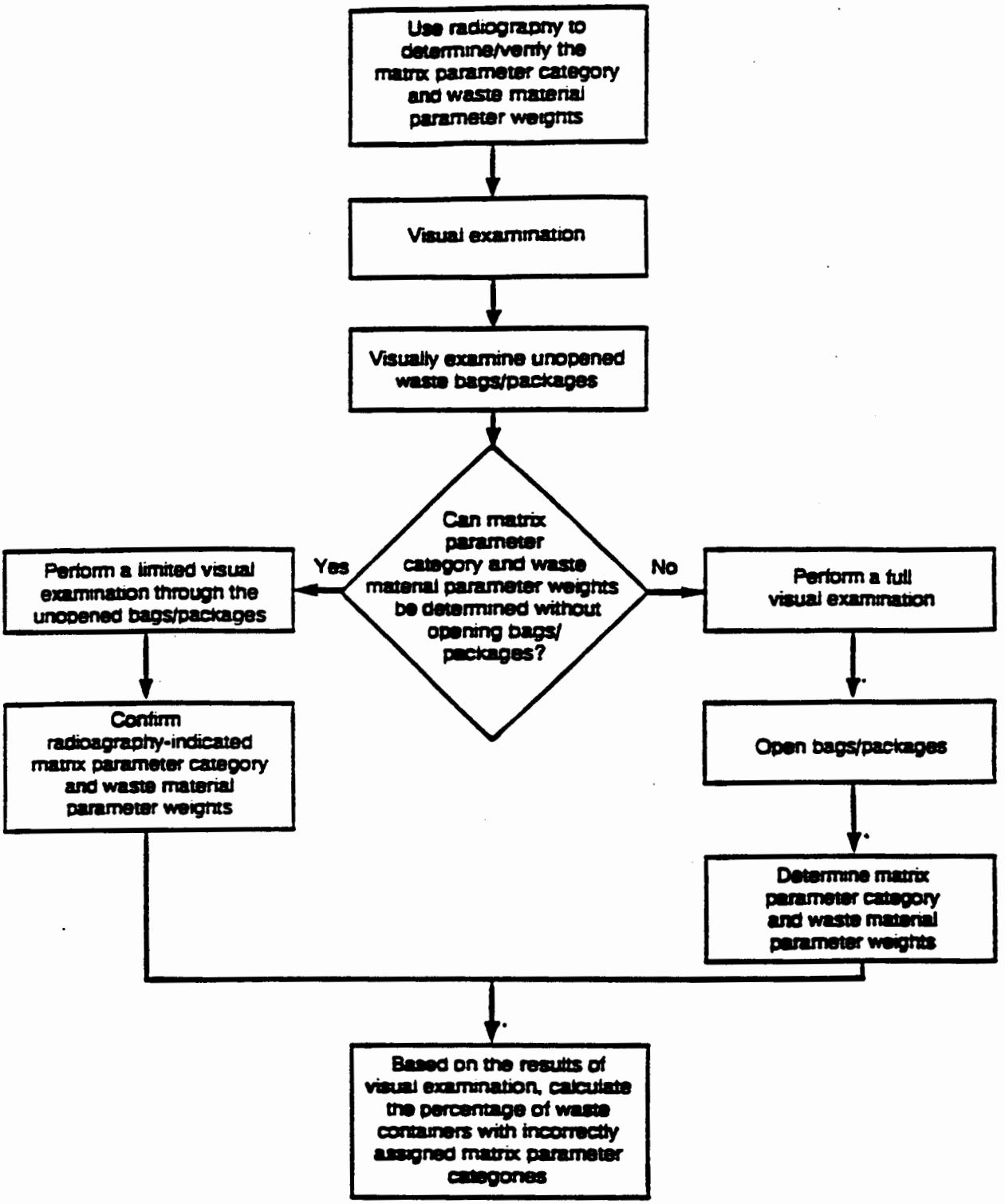


FIGURE C4-6

Overall Programmatic Approach to Visual Examination

APPENDIX C8
QUALITY ASSURANCE OBJECTIVES AND DATA VALIDATION TECHNIQUES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

APPENDIX C8
QUALITY ASSURANCE OBJECTIVES FOR WASTE CHARACTERIZATION SAMPLING AND ANALYTICAL METHODS

C8-1 Validation Methods

Validation of all data (qualitative as well as quantitative) shall be performed so that data used for Waste Isolation Pilot Plant (WIPP) compliance programs will be of known and acceptable quality. Validation includes a quantitative determination of precision, accuracy, completeness, comparability, and method detection limit (as appropriate) for analytical data (headspace Volatile Organics Compounds (VOC) and total VOCs, Semivolatile Organic Compounds (SVOC), and metals data). Quantitative data validations shall be performed by the data generation level Quality Assurance (QA) officer according to the conventional methods outlined below (equations C8-1 through C8-8). These quantitative determinations will be compared to the Quality Assurance Objectives (QAOs) specified in Sections C8-2 through C8-9. A qualitative determination of representativeness will also be performed.

The qualitative data or descriptive information generated by radiography is not amenable to statistical analysis. However, radiography and visual examination are complementary techniques yielding similar data for determining the waste matrix code and waste material parameter weights of waste present in a waste container. Therefore, visual examination results shall be used to verify the waste matrix code and waste material parameter weights determined by radiography.

Representativeness of waste containers from waste streams subjected to visual examination and homogeneous solids and soil/gravel sampling and analysis will be validated, through documentation, that a true random sample was collected. Since representativeness is a quality characteristic that expresses the degree to which a sample or group of samples represents the population being studied, the random selection of waste containers ensures representativeness on a Program level. The Site Project Manager shall document that the selected waste containers from within a waste stream were randomly selected. Sampling personnel shall verify that proper procedures are followed to ensure that samples are representative of the waste contained in a particular waste container or a waste stream.

Precision

Precision is a measure of the mutual agreement among multiple measurements of a single analyte, either by the same method or by different methods. Precision is either expressed as the relative percent difference (RPD) for duplicate measurements or as the percent relative standard deviation (%RSD) for three or more replicate measurements. For duplicate measurements, the precision expressed as the RPD is calculated as follows:

$$RPD = \frac{C_1 - C_2}{\frac{(C_1 + C_2)}{2}} \times 100 \qquad \text{(C8-1)}$$

where C_1 and C_2 are the two values obtained by analyzing the duplicate samples. C_1 is the larger of the two observed values.

For three or more replicate measurements, the precision expressed as the %RSD is calculated as follows:

$$\%RSD = \frac{s}{\bar{y}} \times 100 \qquad \text{(C8-2)}$$

where s is the standard deviation and $\bar{y}$ is the mean of the replicate sample analyses.

The standard deviation, s, is calculated as follows:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(y_i - \bar{y})^2}{n - 1}} \qquad \text{(C8-3)}$$

where y_i is the measured value of the ith replicate sample analysis measurement, and n equals the number of replicate analyses.

Another aspect of precision is associated with analytical equipment calibration. In these instances, the percent difference (%D) between multiple measurements of an equipment calibration standard shall be calculated as follows:

$$\%D = \left|\frac{C_1 - C_2}{C_1}\right| \times 100 \qquad \text{(C8-4)}$$

where C_1 is the initial measurement and C_2 is the second or other additional measurement.

Accuracy

Accuracy is the degree of agreement between a measured analyte concentration (or the average of replicate measurements of a single analyte concentration) and the true or known concentration. Accuracy is determined as the percent recovery (%R).

For situations where a standard reference material is used, the %R is calculated as follows:

$$\%R = \frac{C_m}{C_{srm}} \times 100 \qquad \text{(C8-5)}$$

where C_m is the measured concentration value obtained by analyzing the sample and C_{srm} is the "true" or certified concentration of the analyte in the sample.

For measurements where matrix spikes are used, the %R is calculated as follows:

$$\%R = \frac{S - U}{C_{sc}} \times 100 \qquad \text{(C8-6)}$$

where S is the measured concentration in the spiked aliquot, U is the measured concentration in the unspiked aliquot, and C_{sc} is the actual concentration of the spike added.

Method Detection Limit

The method detection limit (MDL) is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDL for all quantitative measurements (except for those using Fourier Transform Infared Spectroscopy [FTIRS]) is defined as follows:

$$MDL = t_{(n-1,1-\alpha=.99)} \times s \qquad \text{(C8-7)}$$

where $T_{(n-1,1-\alpha=.99)}$ is the t-distribution value appropriate to a 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom, n is the number of observations, and s is the standard deviation of replicate measurements.

For headspace-gas analysis using FTIRS, MDL is defined as follows:

$$\mathbf{MDL = 3s} \qquad \text{(C8-8)}$$

where s is the standard deviation. Initially, a minimum of seven samples of ambient air or seven blanks must be used to establish the MDLs. MDLs should be constantly updated using the results of the laboratory control sample or on-line control sample.

Completeness

Completeness is a measure of the amount of valid data (i.e., data that meets all Quality Assurance/Quality Control (QA/QC) requirements) obtained from the overall measurement system compared to the amount of data collected and submitted for analysis. Completeness must be expressed as the number of samples analyzed with valid results as a percent of the

total number of samples submitted for analysis. Completeness, expressed as the percent complete (%C), is calculated as follows:

$$\%C = \frac{V}{n} \times 100 \qquad \text{(C8-9)}$$

where V is the number of valid analytical results obtained and n is the number of samples submitted for analysis.

Comparability

Comparability is the degree to which one data set can be compared to another. Comparability of data generated at different sites will be assured through the use of standardized, approved testing, sampling, and analytical techniques and by meeting the QAOs specified in Sections C8-2 through C8-9. The techniques presented in Sections C8-2 through C8-9 are provided in detail in the Quality Assurance Program Plan (QAPP) and in the Transuranic Waste Characterization Sampling and Analysis Methods Manual (Methods Manual) (DOE,1995).

Representativeness

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that concerns the proper design of the sampling program.

C8-2 Headspace-Gas Sampling

Quality Assurance Objectives

Headspace-gas sampling may occur from three areas within drums of transuranic (TRU) waste (see Figure C6-1): 1) the drum headspace (i.e., the headspace directly under the drum lid), 2) the 55-gallon (gal) (208-liter [L]) polyethylene (poly) bag headspace, and 3) the headspace of the innermost layers of confinement. The precision and accuracy of the drum headspace-gas sampling operations must be assessed by analyzing field QC headspace-gas samples. These samples must include equipment blanks, field reference standards, field blanks, and field duplicates. If the QAOs described below are not met, a nonconformance report must be prepared, submitted, and resolved.

Precision

The precision of the headspace-gas sampling and analysis operation must be assessed by simultaneous collection of field duplicates for VOCs determination. Corrective actions must be taken if the RPD exceeds 25 percent.

Accuracy

A field reference standard must be collected using headspace-gas sampling equipment to assess the accuracy of the headspace-gas sampling operation. Corrective action must be taken if the %R of the field-reference standard is less than 70 or greater than 130.

Completeness

Sampling completeness shall be expressed as the number of valid samples collected as a percent of the total number of samples collected. Participating sampling facilities must achieve a minimum 90 percent completeness. The amount and type of data that may be lost during the headspace-gas sampling operation cannot be predicted in advance. The importance of any lost or contaminated headspace-gas samples must be evaluated by the Site Project QA Officer, and corrective action must be taken as appropriate.

Comparability

Consistent use and application of uniform procedures and equipment, as specified in the Methods Manual, should ensure that headspace gas sampling operations are comparable when sampling different layers of confinement and at the different sampling facilities.

Representativeness

Specific headspace-gas sampling steps to ensure samples are representative include:

- A sample canister cleaning and leak check
- Sampling equipment cleaning or disposal after use
- Sampling equipment leak check
- Use of sample canisters with passivated internal surfaces
- Use of low-internal-volume sampling equipment
- Collection of small-sample volume: low-sample volume to available headspace volume ratio
- Careful pressure regulation
- Performance audits
- Collection of equipment blanks, field reference standard, field blanks, and field duplicates

C8-3 Sampling of Homogenous Solids and Soils/Gravel

Quality Assurance Objectives

To ensure that sampling is conducted in a representative manner on a waste-stream basis for waste containers containing homogenous solids and soil/gravel, samples must be collected randomly in both the horizontal and vertical planes of each container's waste. For waste containers that contain homogenous solids and soil/gravel in smaller containers (e.g., 1 gal [4.0 L] poly bottles) within the waste container, one randomly chosen smaller container must be sampled.

Precision

Sampling precision must be determined by collecting and sampling field duplicates (e.g., co-located cores as described in Appendix C4-2.2) once per sampling batch or once per week during sampling operations, whichever is more frequent. A sampling batch is a suite of homogenous solids and soil/gravel samples collected consecutively using the same sampling equipment within a specific time period. A sampling batch can be up to 20 samples (excluding field QC samples), all of which must be collected within 14 days of the first sample in the batch. The RPD between co-located samples must be calculated and reported by the Site Project QA Officer.

The recommended method for establishing acceptance criteria for co-located cores is development of control charts for the RPD in the cores. Control charts will be developed for each constituent and for each waste matrix or waste type (e.g., pyrochemical salts or organic sludges), as needed, using historical analysis results. The historical analysis results currently do not exist, but would be collected over the course of future waste characterization activities. RPDs for at least 25 to 30 pairs of co-located cores would be used in the construction of the control charts. The limits for the control chart will be three standard deviations above or below the average RPD. Once constructed, RPDs for additional co-located pairs will be compared with the control chart to determine whether or not the co-located cores are acceptable. Periodically, the control charts will be updated using all available data.

In order to establish acceptance criteria to be used at the beginning of waste characterization activities, the variance between co-located cores will be compared to the variance measured within the waste stream (exclusive of containers with co-located core measurement) using a statistical test. The test will be performed for each constituent in each waste stream. The test is not considered sensitive and is presented as an interim method until the preferred method of control charting is established. Because of the expected difference between the co-located core variance and the waste stream variance, the test will rarely reject the hypothesis that the co-located core variance is less than the waste stream variance. However, without sufficient data to develop control charts and without established acceptance criteria for field duplicates (i.e., as specified by SW-846), the interim method is a reasonable approach for evaluating co-located cores.

The statistical test will involve calculating the variance for co-located cores by pooling the variances computed for each pair of co-located cores. The variance for the waste stream will be computed excluding any data from drums with co-located cores, because the test requires

the variance estimates to be independent. All data must be transformed to normality prior to computing variances and performing the test. The test hypothesis is evaluated using the F distribution and the method for testing the difference in variances. The method will be replaced with the control charting method once sufficient data are available.

Accuracy

Sampling accuracy shall not be measured. Because waste containers containing homogenous solids and soil/gravel with known quantities of analytes are not available, sampling accuracy cannot be determined. However, sampling methods and requirements described are designed to minimize sample degradation and hence maximize sampling accuracy.

Completeness

Sampling completeness shall be expressed as the number of valid samples collected as a percent of the total number of samples collected. Participating sampling facilities must achieve a minimum 90 percent completeness.

Comparability

Consistent use and application of uniform procedures, sampling equipment, and measurement units must ensure that sampling operations are comparable. The analysis results of field duplicates (samples taken of the same medium, under the same conditions, using the same procedures) are examined to determine the comparability. In addition, laboratories analyzing samples must participate in the Performance Demonstration Program (PDP).

Representativeness

Specific steps to ensure the representativeness of samples include the following for both waste containers and smaller containers:

- Coring tools and sampling equipment must be clean prior to sampling.
- The entire depth of the waste must be cored, and the core collected must have a length greater than or equal to 50 percent of the depth of the waste. This is called the core recovery and is calculated as follows:

$$\textit{Core recovery (percent)} = \frac{y}{x} * 100 \qquad \text{(C8-10)}$$

where

x = the depth of the waste in the container
y = the length of the core collected from the waste.

- Coring operations and tool selection should be designed to minimize alteration of the in-place waste characteristics. Minimal waste disturbance must be verified by visually examining the core and describing the observation (e.g., undisturbed, cracked, or pulverized) in the field logbook.

If core recovery is less than 50 percent of the depth of the waste, a second coring location shall be randomly selected. The core from the second location shall be used for sample collection regardless of the core recovery.

$$MDC = K_1 K_2 (2.71 + 4.65 * s_b) \qquad \text{C8-11}$$

C8-4 Radiography

Quality Assurance Objectives

The QAOs for radiography are detailed in this section. If the QAOs described below are not met, then corrective action, such as additional operator training must be taken. It should be noted that radiography does not have a specific MDL because it is primarily a qualitative determination. The objective of radiography for the program is to verify the waste matrix parameters for each waste container and to estimate each waste material parameter weight (Table C8-1). All activities required to achieve these objectives must be described in the site quality assurance project plan (QAPjP) and standard operating procedures (SOP).

Data to meet these objectives must be obtained from an audio/videotaped scan provided by trained radiography operators at the sites. Results must also be recorded on a radiography data form. The precision, accuracy, completeness, and comparability objectives for radiography data are presented below.

Precision

The qualitative determinations, such as verifying the waste matrix code, made during radiography do not lend themselves to statistical evaluation of precision. However, comparison of data derived from radiography and visual examination on the same waste containers at the Rocky Flats Environmental Technology Site and the Idaho National Engineering Laboratory indicates that radiography operators can provide estimated inventories and weights of waste items in a waste container. As a measure of precision, the Site Project QA Officer shall calculate and report the RPD between the estimated waste material parameter weights as determined by radiography and these same parameters as determined by visual examination.

Accuracy

The accuracy with which the waste matrix code and waste material parameter weights can be determined must be documented through visual examination of a randomly selected statistical portion of waste containers. The percentage of waste containers that require assignment to a

different waste matrix code after visual examination must be calculated and reported by the Site Project QA Officer as a measure of radiography accuracy.

Completeness

An audio/videotape of the radiography examination and a validated radiography data form will be obtained for 100 percent of the retrievably stored waste containers in the program.

Comparability

The comparability of radiography data from different sites shall be enhanced by using standardized radiography procedures and operator qualifications.

C8-5 Gas Volatile Organic Compound Analysis

Quality Assurance Objectives

The development of data quality objectives (DQO) specifically for this program has resulted in the QAOs listed in Table C8-2. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. Program-required limits, such as the program required quantitation limits (PRQL) associated with VOC analysis, are specified to ensure that the analytical data collected satisfy the requirements of all data users. A summary of the Quality Control Samples and the associated acceptance criteria is included in Table C8-3. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory duplicates and replicate analyses of laboratory-control samples and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table C8-2. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy as %R shall be assessed for the laboratory operations by analyzing PDP blind audit samples and laboratory-control samples. Results from these measurements must be compared to the criteria listed in Table C8-2. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Method Detection Limit

MDLs shall be expressed in nanograms for VOCs and must be less than or equal to those listed in Table C8-2. MDLs shall be determined based on the method described in the QAPP. The detailed procedures for MDL determination shall be included in site SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability to quantitate analytes at or below the PRQLs given in Table C8-2. Laboratories shall set the concentration of at least one calibration standard below the PRQL. The detailed procedures for PRQL demonstration shall be included in laboratory SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Participating laboratories must meet the completeness specified in Table C8-2.

Comparability

For VOC analysis, data generated through analysis of samples from different sites shall be comparable. Comparability will be achieved by using standardized methods and traceable standards and by requiring all sites to participate in the PDP.

Representativeness

Representativeness for VOC analysis shall be achieved by collecting sufficient numbers of samples using clean sampling equipment that does not introduce sample bias. Samples must be collected as described in Appendix C4.

C8-6 Total Volatile Organic Compound Analysis

Quality Assurance Objectives

The development of DQOs specifically for this program has resulted in the QAOs listed in Table C8-4. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. Program-required limits, such as the PRQL associated with VOC analysis, are specified to ensure that the analytical data collected satisfy the requirements of all data users. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory duplicates, replicate analyses of laboratory-control samples, matrix-spike duplicates, and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table C8-4. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy as %R shall be assessed for the laboratory operations by analyzing laboratory control samples, matrix spikes, surrogate compounds, and PDP blind-audit samples. Results from these

measurements must be compared to the criteria listed in Table C8-5. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Method Detection Limit

MDLs shall be expressed in milligrams per kilogram (mg/kg) for VOCs and must be less than or equal to those listed in Table C8-4. The detailed procedures for MDL determination shall be included in site SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability to quantitate analytes in samples at or below the PRQLs given in Table C8-4. Laboratories shall set the concentration of at least one calibration standard below the PRQL. The detailed procedures for PRQL demonstration shall be included in laboratory SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Participating laboratories must meet the completeness specified in Table C8-4.

Comparability

For VOC analysis, data generated through analysis of samples from different sites shall be comparable. Comparability will be achieved by using standardized methods and traceable standards and by requiring all sites to participate in the PDP.

Representativeness

Representativeness for VOC analysis shall be achieved by collecting unbiased samples. Samples must be collected as described in Appendix C4.

C8-7 Total Semivolatile Organic Compound Analysis

Quality Assurance Objectives

The development of DQOs specifically for this program has resulted in the QAOs listed in Table C8-6. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. Program-required limits, such as the PRQLs, are specified to ensure that the analytical data collected satisfy the requirements of all data users. A summary of Quality Control Samples and associated acceptance criteria for this analysis is included in Table C8-7. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory duplicates, replicate analyses of laboratory control samples, matrix spike duplicates, and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table C8-7. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy, as %R, shall be assessed for the laboratory operations by analyzing laboratory-control samples, matrix spikes, surrogate compounds, and PDP blind-audit samples. Results from these measurements must be compared to the criteria listed in Table C8-7. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Method Detection Limit

MDLs shall be expressed in mg/kg for SVOCs and must be less than or equal to those listed in Table C8-6. The detailed procedures for MDL determination shall be included in site SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability to quantitate analytes in samples at or below the PRQLs given in Table C8-6. Laboratories shall set the concentration of at least one calibration standard below the PRQL. The detailed procedures for PRQL demonstration shall be included in laboratory SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Participating laboratories must meet the level of completeness specified in Table C8-6.

Comparability

For SVOC analysis, data generated through analysis of samples from different sites shall be comparable. Comparability will be achieved by using standardized methods and traceable standards and by requiring all sites to participate in the PDP.

Representativeness

Representativeness for SVOC analysis shall be achieved by collecting unbiased samples. Samples must be collected as described in Appendix C4.

C8-8 Total Metal Analysis

Quality Assurance Objectives

The development of DQOs for the program has resulted in the QAOs listed in Table C8-8. The specified QAOs represent the required quality of data necessary to draw valid conclusions regarding program objectives. Program-required limits, such as the PRQLs associated with metal analysis, are specified to ensure that the analytical data collected satisfy the requirements of all data users. A summary of Quality Control Samples and the associated acceptance criteria for this analysis is provided in Table C8-9. Key data-quality indicators for laboratory measurements are defined below.

Precision

Precision shall be assessed by analyzing laboratory matrix spike duplicates, replicate analyses of laboratory-control samples, and PDP blind-audit samples. Results from measurements on these samples must be compared to the criteria listed in Table C8-8. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Accuracy

Accuracy shall be assessed through the analysis of laboratory matrix spikes, PDP blind-audit samples, and laboratory-control samples. Results from these measurements must be compared to the criterion listed in Table C8-8. These QC measurements will be used to demonstrate acceptable method performance and to trigger corrective action when control limits are exceeded.

Program Required Detection Limits

PRDLs, expressed in units of micrograms per L (μg/L), are the maximum values for instrument detection limits (IDL) permissible for program support under the QAPP. IDLs must be less than or equal to the PRDL for the method used to quantitate a specific analyte. Any method listed in Table C-11 of the application may be used if the IDL meets this criteria. For high concentration samples, an exception to the above requirements may be made in cases where the sample concentration exceeds five times the IDL of the instrument being used. In this case, the analyte concentration may be reported even though the IDL may exceed the PRDL. IDLs shall be determined semiannually (i.e., every six months). Detailed procedures for IDL determination shall be included in laboratory SOPs.

Program Required Quantitation Limit

Laboratories must demonstrate the capability of analyte quantitation at or below the PRQLs in units of mg/kg dry weight (given in Table C8-8). The PRDLs are set an order of magnitude less than the PRQLs (assuming 100 percent solid sample diluted by a factor of 100 during preparation). Laboratories shall set the concentration of at least one QC or calibration standard

at or below the solution concentration equivalent of the PRQL. Detailed calibration procedures shall be included in site SOPs.

Completeness

Laboratory completeness shall be expressed as the number of samples analyzed with valid results as a percent of the total number of samples submitted for analysis. Participating laboratories must meet the completeness specified in Table C8-8.

Comparability

Data generated through analysis of samples from different sites shall be comparable. Comparability will be achieved by using standardized methods and traceable standards and by requiring all sites to participate in the PDP.

Representativeness

Representativeness for metals analysis shall be achieved by the collection of unbiased samples. Samples must be collected as described in Appendix C4.

C8-9 Acceptable Knowledge

Acceptable knowledge documentation provides primarily qualitative information that cannot be assessed according to specific data quality goals that are used for analytical techniques. QAOs for analytical results are described in terms of precision, accuracy, completeness, comparability, and representativeness. Analytical results will be used to confirm the characterization of wastes based on acceptable knowledge (Section C9-4). To ensure that the acceptable knowledge process is consistently applied, sites must comply with the following data quality requirements for acceptable knowledge documentation:

- Precision - Precision is the agreement among a set of replicate measurements without assumption of the knowledge of a true value. The qualitative determinations, such as compiling and assessing acceptable knowledge documentation, do not lend themselves to statistical evaluations of precision. However, the acceptable knowledge information will be addressed by the independent review of acceptable knowledge information during internal and external audits.

- Accuracy - Accuracy is the degree of agreement between an observed sample result and the true value. The percentage of waste containers which require reassignment to a new waste matrix code and/or designation of different hazardous waste codes based an the reevaluation of acceptable knowledge and sampling and analysis data will be reported as a measure of acceptable knowledge accuracy.

- Completeness - Completeness is an assessment of the number of waste streams or number of samples collected to the number of samples determined to be useable through the data validation process. The acceptable knowledge record

must contain 100 percent of the required information (Section C9-3). The useability of the acceptable knowledge information will be assessed for completeness during audits.

- Comparability - Data are considered comparable when one set of data can be compared to another set of data. Comparability is ensured through sites meeting the training requirements and complying with the minimum standards outlined for procedures that are used to implement the acceptable knowledge process. All sites must assign hazardous waste codes in accordance with Section C9-4 and provide this information regarding its waste to other sites who store or generate a similar waste stream.

- Representativeness - Representativeness expresses the degree to which sample data accurately and precisely represent characteristics of a population. Representativeness is a qualitative parameter that will be satisfied by ensuring that the process of obtaining, evaluating, and documenting acceptable knowledge information is performed in accordance with the minimum standards established in Section C9-4. Sites also must assess and document the limitations of the acceptable knowledge information used to assign hazardous waste codes (e.g., purpose and scope of information, date of publication, type and extent to which waste parameters are addressed).

Each site must address quality control by tracking its performance with regard to the use of acceptable knowledge by: 1) assessing the frequency of inconsistencies among information, and 2) documenting the results of acceptable knowledge confirmation through radiography, headspace-gas analyses, and solidified waste analyses. In addition, the acceptable knowledge process and waste stream documentation must be evaluated through internal assessments by quality assurance organizations and assessments by auditors external to the organization (i.e., DOE/CAO).

C8-10 Data Review, Validation, and Verification Requirements

Data review, validation, and verification requirements include procedures for the review, validation, and verification of data at the data generation level; the validation and verification of data at the project level; and the verification of data at the CAO level. Data review determines if raw data have been properly collected and ensures raw data are properly reduced. Requirements for data reduction are provided in Sections 9.0 through 15.0 of the QAPP, as appropriate, and in the Methods Manual. Data validation confirms that the data reported satisfy the requirements defined by the user and is accompanied by signature release. Data verification authenticates that data are in fact that which is claimed. The procedures presented in this section ensure that Program records furnish documentary evidence of quality.

Data Generation Level

The following are minimum requirements for raw data collection and management:

- All raw data shall be signed and dated in black ink by the person generating it.

- All data must be recorded clearly, legibly, and accurately in field and laboratory records (bench sheets, logbooks), and include applicable sample identification numbers.

- All changes to original data must be lined out, initialed, and dated by the individual making the change. A justification for changing the original data may also be included. Original data must not be obliterated or otherwise disfigured so as not to be readable.

- All data must be transferred and reduced from field and laboratory records completely and accurately.

- All field and laboratory records must be maintained in permanent files according to NEIC guidelines.

- Data must be organized into a standard format for reporting purposes (testing, sampling, analytical or on-line batch data report), as outlined in specific sampling and analytical techniques.

- All electronic and video data must be stored appropriately to ensure that waste container, sample, and associated QC data are readily retrievable.

Data review, validation, and verification at this level involves scrutiny and signature release from qualified independent technical reviewer(s), technical supervisors(s), and a QA officer, as specified below. Any nonconformance identified during this process shall be documented on a nonconformance report (Section C8-13). Facilities may combine the positions of independent technical reviewer and QA officer. Individuals conducting this data review, validation, and verification must use checklists that address all of the items included in this section. Checklists must contain tables showing the results of sampling, analytical or on-line batch QC samples, if applicable. Completed checklists must be forwarded with testing, sampling, analytical and on-line batch data reports to the project level.

- One hundred percent of the batch data reports must receive an independent technical review. This review shall be performed by an individual other than the data generator who is qualified to have performed the initial work. The reviewer(s) must release the data as evidenced by signature, and as a consequence ensure the following:

  - Data generation and reduction were conducted in a technically correct manner in accordance with the methods used. Data were reported in the proper units and correct number of significant figures.

  - Calculations have been verified by a valid calculation program, a spot check of verified calculation programs, and/or 100 percent check of all hand calculations.

  - All variances from an accepted method and the rationale for the variations have been documented and approved (Section C8-13).

- The data have been reviewed for transcription errors.

- The testing, sampling, or analytical data QA documentation (testing batch, sampling batch, analytical or on-line batch) is complete and includes raw data, calculation records, chain-of-custody (COC) forms, calibration records, QC sample results, and gas canister sample tags (if applicable).

- QC sample results are within established control limits, and if not, the data have been appropriately qualified.

- Reporting flags were assigned correctly.

- Sample holding time and preservation requirements were met, or exceptions documented.

- Radiography tapes have been reviewed, at a minimum for every tenth waste container, against the data reported on the radiography form to ensure that the data are correct and complete.

- Field sampling records are complete.

• One hundred percent of the batch data reports must receive technical supervisory signature release for each testing batch, sampling batch, analytical batch and on-line batch. This release must ensure the following:

  - The data are technically reasonable based on the technique used.

  - All data have received independent technical review with the exception of radiography tapes, which shall receive periodic technical review as specified above.

  - The testing, sampling, or analytical data QA documentation (testing batch, sampling batch, analytical batch or on-line batch) is complete and includes raw data, calculation records, COC forms, calibration records, QC sample results, and gas sample canister tags (if applicable).

  - Sample holding time requirements were met, or exceptions documented.

  - Field sampling records are complete.

• One hundred percent of the batch data reports must receive QA officer signature release. This release must ensure the following:

  - Independent technical and technical supervisory reviews have been performed as evidenced by the appropriate signature releases.

- The testing, sampling, or analytical data QA documentation (testing batch, sampling batch, analytical batch or on-line batch) is complete as appropriate for the point of data generation (i.e., radiography, RA, sampling, and analysis).

- Sampling and analytical QC checks have been properly performed. QC criteria that were not met are documented.

- QAOs have been met according to the methods outlined in Section C8-11.

Project Level

Data validation and verification at this level involves scrutiny and signature release from the Site Project Manager (or designee) and the Site Project QA Officer (or designee). This must be accomplished by meeting the following minimum requirements for each waste container. Any nonconformance identified during this process shall be documented on a nonconformance report (Section C8-13).

- One hundred percent of the testing, sampling, and analytical batch data reports must have Site Project Manager signature release. This signature release must ensure the following:

  - Data generation level independent technical, technical supervisory, and QA officer review, validation, and verification have been performed as evidenced by the appropriate signature releases.

  - Testing, sampling, analytical and on-line batch data review checklists are complete.

  - Testing, sampling, analytical and on-line batch data reports are complete and data are properly reported (e.g., data are reported in the correct units, with the correct number of significant figures, and with qualifying flags).

  - Reconciliation with the DQOs was performed (Section C8-12).

- One hundred percent of the testing, sampling, and analytical batch data reports must receive Site Project QA Officer signature release. This signature release must ensure the following:

  - Sampling batch QC checks (e.g., equipment blanks, field duplicates, field reference standards) were properly performed, and meet the established QAOs.

  - Testing batch QC checks (e.g., replicate scans, measurement system checks, replicate counts) were properly performed.

- Analytical batch QC checks (e.g., laboratory duplicates, laboratory blanks, matrix spikes, matrix spike duplicates, laboratory control samples) were properly performed and meet the established QAOs.

- On-line batch QC checks (e.g., field blanks, on-line blanks, on-line duplicates, on-line control samples) were properly performed and meet the established QAOs.

- Proper procedures were followed to ensure representative samples of headspace gas and homogenous solids and soil/gravel were taken.

- Radiography data are complete and acceptable based on the videotape review of one waste container per testing batch, at a minimum.

- RA data are complete and acceptable.

• The Site Project Manager and Site Project QA Officer shall ensure that a repeat of the data generation level review, validation, and verification is performed on the data for a minimum of one randomly chosen waste container quarterly (every three months). This exercise will document that the data generation level review, validation, and verification is being performed according to implementing procedures.

In association with the project-level validation and verification described above, the Site Project QA Officer (or designee) must prepare a Site Project QA Officer Summary and the Site Project Manager (or designee) must prepare a Data Validation Summary. The Site Project QA Officer Summary includes, on a per waste container basis, a validation checklist for each testing, sampling, analytical and on-line batch. Checklists for the Site Project QA Officer Summary must be sufficiently detailed to validate all aspects of a testing, sampling, analytical or on-line batch that affect data quality. The Data Validation Summary provides confirmation that, on a per waste container basis, all data have been validated in accordance with the site QAPjP. The Data Validation Summary must list each testing, sampling, analytical or on-line batch, describe how the validation was performed and whether or not problems were detected, and include a statement indicating that all data are acceptable.

Once the data have received project-level validation and verification, the Site Project Manager must ensure that the laboratory is notified. Samples must be retained by the laboratory until this notification is received. Gas sample canisters may then be released from storage for cleaning, recertification, and subsequent reuse. Sample tags must be removed and forwarded to the Site Project QA Officer before recycling the canisters. If the site project manager requests that samples or canisters be retained for future use (e.g., an experimental holding time study), the same sample identification and COC forms shall be used and cross-referenced to a document which specifies the purpose for sample or canister retention.

CAO Level

The third and final level of data verification occurs at CAO and must, at a minimum, consist of an inventory check of the data packages to verify completeness. The CAO Office of Regulatory Compliance manager is responsible for the verification that data packages include the following:

- Project-level signature releases
- Listing of all waste containers being reported in the package
- Listing of all testing, sampling, and analytical batch numbers associated with each waste container being reported in the package
- Data package case narrative
- Site Project QA Officer Summary
- Data Validation Summary
- Complete summarized qualitative and quantitative data for all waste containers

The CAO Office of Regulatory Compliance manager must verify that each data package is complete and notify the originating site in writing of the acceptance status of the data within two weeks of data package receipt. CAO will maintain the data as appropriate for use in the regulatory compliance programs.

C8-11 Reconciliation with Data Quality Objectives

Reconciling the results of waste testing and analysis with the DQOs provides a way to ensure that data will be of adequate quality to support the regulatory compliance programs. Reconciliation with the DQOs will take place at both the project level and the CAO level. At the project level, reconciliation will be performed by the Site Project Manager; at CAO, reconciliation will be performed by the CAO Office of Regulatory Compliance manager.

Reconciliation at the Project Level

The Site Project Manager will ensure that all data generated and used in decision making meet the DQOs provided in Section C-4d of the text of Chapter C. To do so, the Site Project Manager must assess whether data of sufficient type, quality, and quantity have been collected. The Site Project Manager must determine if the variability of the data set is small enough to provide the required confidence in the results. The Site Project Manager must also determine if, based on the desired error rates and confidence levels, a sufficient number of valid data points have been determined. In addition, the Site Project Manager must document that random sampling of containers was performed for the purposes of waste stream characterization.

For each waste stream characterized, the Site Project Manager must determine if sufficient data have been collected to determine the following Program-required waste parameters:

- Waste matrix code
- Waste material parameter weights
- Average mass and activity of each radionuclide of concern
- If each waste container of waste is TRU radioactive waste
- Average concentration of hydrogen, methane, and each VOC in the headspace gas of waste containers in the waste stream
- Total masses of VOCs, hydrogen, and methane in the headspace gas of the waste stream
- The potential flammability of TRU waste headspace gases
- Mean concentrations, UCL_{90} for the mean concentrations, standard deviations, and number of samples collected for VOCs, SVOCs, and metals in the waste stream
- Total masses of VOCs, SVOCs, and metals in the waste stream
- Whether the waste stream exhibits a toxicity characteristic (TC) under 40 CFR Part 261, Subpart C
- Whether the waste stream can be classified as hazardous or nonhazardous at the 90-percent confidence level
- Whether a sufficient number of waste containers have been visually examined to determine with a reasonable level of certainty that the UCL_{90} for the miscertification rate is less than 14 percent

If the Site Project Manager determines that insufficient data have been collected to make the determinations listed above, additional data collection efforts must be undertaken.

The statistical procedure presented in Appendix C6 shall be used by participating Site Project Managers to evaluate and report waste characterization data from the analysis of homogenous solids and soil/gravel. The procedure, which calculates UCL_{90} values, shall be used to assess compliance with the DQOs in Section 1.5 as well as with RCRA regulations. The procedure must be applied to all laboratory analytical data for total VOCs, total SVOCs, and total metals. For RCRA regulatory compliance (40 CFR § 261.24), data from the analysis of the appropriate metals and organic compounds shall be compared to the TC levels expressed as total values. These total values will be considered the regulatory threshold limit (RTL) values for the Program. RTL values are obtained by calculating the weight/weight concentration (in the solid) of a TC analyte that would give the regulatory weight/volume concentration (in the toxicity characteristic leaching procedure (TCLP) extract), assuming 100-percent analyte dissolution.

Reconciliation at the CAO Level

CAO must also ensure that data of sufficient type, quality, and quantity have been collected to meet Program DQOs. The CAO Office of Regulatory Compliance manager is responsible for determining if sufficient data have been collected to determine the following:

- The concentration of headspace gas VOCs in the total waste inventory to support a demonstration that VOCs will not migrate through the air beyond the WIPP unit boundary in concentrations greater than Environmental Protection Agency (EPA)-determined health-based limits during WIPP operations;

- The concentration of VOCs, SVOCs, and metals in the total waste inventory to support a demonstration that hazardous constituents will not migrate beyond the WIPP unit boundary in concentrations greater than EPA-determined health-based limits;

- The total curie, hydrogen, and methane concentrations in TRU waste to support revision of the thermal power restrictions for shipment of waste in the Transuranic Package Transporter (TRUPACT-II);

- An inventory of radioactive materials and physical waste forms to support an assessment of repository performance;

- Whether waste streams proposed for disposal in WIPP have been adequately characterized; and

- Whether data supports the preparation of the WIPP facility no-migration variance petition, the WIPP RCRA permit application, the WIPP facility 40 CFR Part 191 Certification Application, and a revised safety analysis report for the TRUPACT-II.

C8-12 Data Reporting Requirements

Data reporting requirements define the type of information and the method of transmittal for data transfer from the data generation level to the project level and from the project level to CAO.

Data Generation Level

Data shall be transmitted by hard copy from the data generation level to the project level. Transmitted data shall include all testing, sampling, and analytical batch data reports, and data review checklists. The report forms and checklists used must contain all of the information required by the testing, sampling, and analytical techniques described in Sections 7.0 through 15.0 of the QAPP, as well as the signature releases to document the review, validation, and verification as described in Section C8-10. All testing, sampling, and analytical batch data reports and checklists shall be on approved forms, as provided in site-specific documentation.

Testing, sampling, and analytical batch data reports shall be forwarded to the site project office. Site QAPjPs shall specify the individual at the site project office who will receive these reports. Testing batch data reports shall be forwarded to the site project office within 28 days of the

testing of the last waste container in a testing batch. Sampling batch data reports shall be forwarded to the site project office within 28 days of sample collection of the last sample in a sampling batch. Analytical batch data reports shall be forwarded to the site project office within 28 days of the VTSR of the last sample in an analytical batch. After review by the Site Project QA Officer, all batch data reports will be forwarded to the Site Project Manager. All testing, sampling, and analytical batch data reports shall be assigned serial numbers, and each page shall be numbered at the bottom. The serial number used for data reports can be the same as the testing, sampling, or analytical batch number.

QA documentation shall be maintained in either testing, sampling, and analytical facility files, or site project files for those facilities located on sites. Contract waste operation facilities shall forward testing, sampling, and analytical QA documentation along with testing, sampling, and analytical batch data reports to the site project office for inclusion in site central files.

Project Level

There are two aspects to project level reporting. First, summarized testing, sampling, and analytical data must be reported on a per-waste container basis. Second, summarized characterization information must be reported on a waste stream basis.

Summarized testing, sampling, and analytical data shall be transmitted by hard copy from the Site Project Manager to CAO when requested. Participating sites shall combine data from individual waste containers into data packages for reporting. Hard copy data packages shall consist of the following:

- Cover page with the site name, program identification, waste container numbers for containers included in the data package, and release signatures of the Site Project Manager and Site Project QA Officer

- Table of contents; and

- A concise narrative that summarizes the results of the project-level review and briefly describes any problems or other noteworthy items of interest associated with the data (i.e., nonconformance reports, operational variances). The narrative shall include separate sections which address results of duplicates/replicates and nonconformance reports associated with the waste containers being reported in the package.

For each waste container being reported in the data package, the following information shall be included:

- Cover page with the site name, program identification, waste container number, and approval/release signatures of the Site Project Manager and Site Project QA Officer

- A table that relates sample numbers (testing, sampling, and analytical) to waste container number

- Table of contents
- Site Project QA Officer Summary
- Data Validation Summary
- Radiography results
- Radioassay (RA) results
- Waste container headspace gas hydrogen, methane, and VOC analytical results
- Innermost layer of confinement headspace gas hydrogen, methane, and VOC analytical results for waste containers with inner layers of confinement (if applicable)
- Total VOC, SVOC, and metal analytical results for homogenous solids and soil/gravel (if applicable)

WIPP Waste Information System (WWIS) Data Reporting

The WWIS Data Dictionary (Appendix C13) contains all of the data fields, the field format and the limits associated with the data as established by various waste acceptance criteria. This data will be subjected to edit and limit checks that are performed automatically by the database.

WIPP will coordinate the data transmission with each generator site using the Internet and the TCP/IP transmission protocol. Actual data transmission will use DES encryption technology to ensure the integrity of the data transmissions. The sites with large waste inventories and large databases will populate a data structure provided by WIPP that contains the required data dictionary fields that are appropriate for the waste stream (or waste streams) at that site. For example, totals analysis data will not be requested from sites that do not have homogeneous solids or soil/gravel waste. WIPP will access this data via the Internet to ensure an efficient transfer of this data. Small quantity sites will be given a similar data structure that is tailored to their types of waste. Sites with very small quantities of waste will be provided with the ability to assemble the data interactively to this data structure on the WWIS.

C8-13 Nonconformances and Operational Variances

The status of work and the Program activities at participating sites shall be monitored and controlled by the Site Project Manager and Site Project QA Officer. This monitoring and control shall include: 1) nonconformance identification, documentation, and reporting; and 2) operational variance identification, documentation, and reporting.

Nonconformances

Nonconformances are uncontrolled and unapproved deviations from an approved plan, procedure, or expected result. Nonconforming items and activities are those that do not meet the Program requirements, procurement document criteria, or approved work procedures.

Nonconforming items shall be identified by marking, tagging, or segregating, and the affected organization(s) notified. Participating sites shall disposition nonconforming items as appropriate in accordance with the Quality Assurance Program Description (QAPD). Disposition of nonconforming items shall be identified and documented. The QAPjPs shall identify the person(s) responsible for evaluating and dispositioning nonconforming items and shall include referenced procedures for handling them.

Management at all levels shall foster a "no-fault" attitude to encourage the identification of nonconforming items and processes. Nonconformances may be detected and identified by anyone performing Program activities, including

- Project staff - during field operations, supervision of subcontractors, data validation and verification, and self-assessment
- Laboratory staff - during the preparation for and performance of laboratory testing; calibration of equipment; QC activities; laboratory data review, validation, and verification; and self-assessment
- QA personnel - during oversight activities or audits

A nonconformance report shall be prepared for each nonconformance identified. Each nonconformance report shall be initiated by the individual(s) identifying the nonconformance. The nonconformance report shall then be processed by knowledgeable and appropriate personnel. For this purpose, a nonconformance report including, or referencing as appropriate, results of laboratory analysis, QC tests, audit reports, internal memoranda, or letters shall be prepared. The nonconformance report must provide the following information:

- Identification of the individual(s) identifying or originating the nonconformance
- Description of the nonconformance
- Method(s) or suggestions for correcting the nonconformance (corrective action) or description of the variance granted
- Schedule for completing the corrective action
- An indication of the potential ramifications and overall useability the data, if applicable
- Any approval signatures specified in the QAPjPs

The Site Project QA Officer shall oversee the nonconformance report process and be responsible for developing a plan to identify and track all nonconformances and report this information to the DOE field office. Documentation of nonconformances shall be made available to the Site Project Manager, who in turn is responsible for notifying project personnel of the nonconformance. Completion of the corrective action for nonconformances must be verified by the Site Project QA Officer.

Operational Variances

Variances are approved and controlled changes to Program-related plans or procedures. The need for a variance is caused by the identification of improvement opportunities or unusual or nonroutine occurrences that affect operations but not the ability to achieve the performance standards or quality requirements specified in this QAPP or site QAPjPs. Each person performing Program activities is responsible for the quality of their work and adherence to the applicable requirements contained in this QAPP and site QAPjPs. When a need to deviate from established procedures is identified, it is the responsibility of the person performing the work to initiate a variance.

When a variance is required, the person identifying the need for the variation shall complete a Record of Variance and have a direct supervisor approve it. A Record of Variance must be completed and approved before initiation of the activity to document the variation from normal, approved procedures. The Site Project QA Officer shall assess the significance of the variance and determine if changes to the plans or procedures and further notifications are required.

A Record of Variance must contain at least the following information:

- Title or heading, "Record of Variance"
- Waste container or sample identification number
- Reason for the deviation from the requirements contained in the QAPjP or SOP
- A description of the variation from the accepted sampling, testing, or analytical procedure
- A description of special equipment or personnel required
- Initiator's signature and date
- Supervisor's signature and date
- Site Project Manager's signature and date
- Site Project QA Officer's signature and date

DOE/CAO Corrective Action Process

DOE/CAO initiates a corrective action process when internal nonconformances and nonconformances at the generator/storage sites are identified. Activities and processes that do not meet requirements are documented as deficiencies. All deficiencies regardless of type and origin are processed through the CAO corrective action process.

When a deficiency is identified by the CAO, the following process action steps are initiated:

- The condition is documented on a Corrective Action Report (CAR) by the individual identifying the problem.

- The CAO QA Manager and the National TRU Programs (NTP) Team Leader review the CAR, determine validity of the finding (determine that a requirement has been violated), classify the significance of the condition, assign a response due date, and issue the CAR to the responsible party.

- The responsible organization reviews the CAR, evaluates the extent and cause of the deficiency and provides a response to the CAO, indicating remedial actions and actions to preclude recurrence that will be taken.

- The CAO reviews the response from the responsible organization and, if acceptable, communicates the acceptance to the responsible organization.

- The responsible organization completes remedial actions and actions to preclude recurrence of the condition.

- After all corrective actions have been completed, the CAO schedules and performs a verification to assure that corrective actions have been completed and are effective. When all actions have been completed and verified as being effective, the CAR is closed by the CAO QA Manager and the NTP Team Leader.

- As part of the planning process for subsequent audits and surveillances, past deficiencies are reviewed and the previous deficient activity or process is subject to reassessment.

C8-14 Special Training Requirements and Certifications

Before performing activities that affect Program quality, all personnel are required to receive indoctrination into the scope, purpose, and objectives of the Program and the specific QAOs of the assigned task. Personnel assigned to perform activities for the Program shall have the education, experience, and training applicable to the functions associated with the work. Evidence of personnel proficiency and demonstration of competence in the task(s) assigned must be demonstrated and documented. All personnel designated to work on specific aspects of the Program shall maintain qualification (i.e., training and certification) throughout the duration of the work as specified in this QAPP and applicable QAPjPs. Job performance shall be evaluated and documented at periodic intervals, as specified in the QAPjPs.

Personnel involved in Program activities shall receive continuing training to ensure that job proficiency is maintained. Training includes both education in principles and enhancement of skills. Each participating site shall include in its QAPjP a description of the procedures for implementing personnel qualification and training in accordance with the QAPD and 10 CFR § 830.120. All training records that specify the scope of the training, the date of completion, and documentation of job proficiency shall be maintained in the site project file.

Analytical laboratory line management must ensure that analytical personnel are qualified to perform the analytical method(s) for which they are responsible. The minimum qualifications for certain specified positions for the Program are summarized in Table C8-10. QAPjPs, or their implementing SOPs, shall specify the site-specific titles and minimum training and qualification requirements for personnel performing Program activities. QAPjPs shall also contain the requirements for maintaining records of the qualification, training, and demonstrations of proficiency by these personnel.

An evaluation of personnel qualifications shall include comparing and evaluating the requirements specified in the job/position description and the skills, training, and experience included in the current resume of the person. This evaluation also must be performed for personnel who change positions because of a transfer or promotion as well as personnel assigned to short-term or temporary work assignments that may affect the quality of the Program. QAPjPs shall identify the responsible person(s) for ensuring that all personnel maintain proficiency in the work performed and identify any additional training that may be required.

C8-11 List of References

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TABLES

TABLE C8-1
WASTE MATERIAL PARAMETERS AND DESCRIPTIONS

Waste Material Parameter	Description
Iron-based Metals/Alloys	Iron and steel alloys in the waste; does not include the waste container materials
Aluminum-based Metals/Alloys	Aluminum or aluminum-based alloys in the waste materials
Other Metals	All other metals found in the waste materials
Other Inorganic Materials	Nonmetallic inorganic waste including concrete, glass, firebrick, ceramics, sand, and inorganic sorbents
Cellulosics	Materials generally derived from high-polymer plant carbohydrates; (e.g., paper, cardboard, wood, and cloth)
Rubber	Natural or man-made elastic latex materials; (e.g., surgeons' gloves, and leaded rubber gloves)
Plastics (waste materials)	Generally man-made materials, often derived from petroleum feedstock; (e.g., polyethylene and polyvinylchloride)
Organic Matrix	Cemented organic resins, solidified organic liquids and sludges
Inorganic Matrix	Any homogeneous materials consisting of sludge or aqueous-based liquids that are solidified with cement, calcium silicate, or other solidification agents; (e.g., wastewater treatment sludge, cemented aqueous liquids, and inorganic particulates)
Soils/gravel	Generally consists of naturally occurring soils that have been contaminated with inorganic waste materials
Steel (packaging materials)	55-gal (208-L) drums
Plastics (packaging materials)	90-mil polyethylene drum liner and plastic bags

TABLE C8-2
GAS VOLATILE ORGANIC COMPOUNDS TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Compound	CAS Number	Precision[a] (%RSD or RPD)	Accuracy[a] (%R)	MDL[b] (ng)	FTIRS MDL[b] (ppmv)	PRQL (ppmv)	Completeness (%)
Benzene	71-43-2	≤25	70-130	10	5	10	90
Bromoform	75-25-2	≤25	70-130	10	5	10	90
Carbon tetrachloride	56-23-5	≤25	70-130	10	5	10	90
Chlorobenzene	108-90-7	≤25	70-130	10	5	10	90
Chloroform	67-66-3	≤25	70-130	10	5	10	90
1,1-Dichloroethane	75-34-3	≤25	70-130	10	5	10	90
1,2-Dichloroethane	107-06-2	≤25	70-130	10	5	10	90
1,1-Dichloroethylene	75-35-4	≤25	70-130	10	5	10	90
cis-1,2-Dichloroethylene	156-59-2	≤25	70-130	10	5	10	90
Ethyl benzene	100-41-4	≤25	70-130	10	10	10	90
Ethyl ether	60-29-7	≤25	70-130	10	5	10	90
Formaldehyde[c]	50-00-0	≤25	70-130	10		10	90
Hydrazine[d]	302-01-2	≤25	70-130	10		10	90
Methylene chloride	75-09-2	≤25	70-130	10	5	10	90
1,1,2,2-Tetrachloroethane	79-34-5	≤25	70-130	10	5	10	90
Tetrachloroethylene	127-18-4	≤25	70-130	10	5	10	90
Toluene	108-88-3	≤25	70-130	10	5	10	90
1,1,1-Trichloroethane	71-55-6	≤25	70-130	10	5	10	90
Trichloroethylene	79-01-6	≤25	70-130	10	5	10	90
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	≤25	70-130	10	5	10	90
m-Xylene[e]	108-38-3	≤25	70-130	10	5	10	90
o-Xylene	95-47-6	≤25	70-130	10	5	10	90
p-Xylene[e]	106-42-3	≤25	70-130	10	5	10	90
Acetone	67-64-1	≤25	70-130	150	50	100	90
Butanol	71-36-3	≤25	70-130	150	50	100	90
Methanol	67-56-1	≤25	70-130	150	50	100	90
Methyl ethyl ketone	78-93-3	≤25	70-130	150	50	100	90
Methyl isobutyl ketone	108-10-1	≤25	70-130	150	50	100	90

[a]Criteria apply to PRQL concentrations.
[b]Values based on delivering 10 mL to the analytical system.
[c]Required only for homogenous solids and soil/gravel from Los Alamos National Laboratory.
[d]Required only for homogenous solids and soil/gravel from Oak Ridge National Laboratory and the Savannah River Site.
[e]These xylene isomers cannot be resolved by GC/MS.

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
MDL = Method detection limit (maximum permissible value), for GC/MS and GC/FID; total number of nanograms delivered to the analytical system per sample (nanograms); for FTIRS based on 1m sample cell
PRQL = Program required quantitation limit (parts per million/volume basis)

TABLE C8-3
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR GAS VOLATILE ORGANIC COMPOUND ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet method QAOs	Repeat until acceptable
Laboratory duplicates or on-line duplicates	One (1) per analytical batch for GC/MS and GC/FID. One (1) per analytical batch or on-line batch for FTIRS	RPD $\leq$25[b]	Nonconformance if RPD >25
Laboratory blanks or on-line blanks	Daily prior to sample analysis for GC/MS and GC/FID. Daily prior to sample analysis and one (1) per analytical batch or on-line batch for FTIRS.	Analyte amounts <3 x MDLs for GC/MS and GC/FID; <PRQL for FTIRS	Nonconformance if analyte amounts > 3 x MDLs for GC/MS and GC/FID; >PRQL for FTIRS
Laboratory control samples or on-line control samples	One (1) per analytical batch for GC/MS and GC/FID. One (1) per analytical batch or on-line batch for FTIRS	70-130 %R	Nonconformance is %R <70 or >130
GC/MS comparison sample (for FTIRS only)	One (1) per analytical or on-line batch	RPD $\leq$25	Nonconformance if RPD >25
Blind audit samples	Samples and frequency controlled by the Gas PDP Plan	Specified in the Gas PDP Plan	Specified in the Gas PDP Plan

[a]Corrective action per section C8-13 when final reported QC samples do not meet the acceptance criteria.
[b]Applies only to concentrations greater than the PRQLs listed in Table C8-2.

MDL = Method Detection Limit
QAO = Quality Assurance Objective
PDP = Performance Demonstration Program
PRQL = Program Required Quantitation Limit
%R = Percent Recovery
RPD = Relative Percent Difference

TABLE C8-4
TOTAL VOLATILE ORGANIC COMPOUNDS TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Compound	CAS Number	Precision[a] (%RSD or RPD)	Accuracy[a] (%R)	MDL (mg/kg)	PRQL (mg/kg)	Completeness (%)
Benzene	71-43-2	≤45	37-151	1	10	90
Bromoform	75-25-2	≤47	45-169	1	10	90
Carbon disulfide	75-15-0	≤50	60-150	1	10	90
Carbon tetrachloride	56-23-5	≤30	70-140	1	10	90
Chlorobenzene	108-90-7	≤38	37-160	1	10	90
Chloroform	67-66-3	≤44	51-138	1	10	90
1,4-Dichlorobenzene[b]	106-46-7	≤60	18-190	1	10	90
ortho-Dichlorobenzene[b]	95-50-1	≤60	18-190	1	10	90
1,2-Dichloroethane	107-06-2	≤42	49-155	1	10	90
1,1-Dichloroethylene	75-35-4	≤250	D-234[c]	1	10	90
Ethyl benzene	100-41-4	≤43	37-162	1	10	90
Methylene chloride	75-09-2	≤50	D-221[c]	1	10	90
1,1,2,2-Tetrachloroethane	79-34-5	≤55	46-157	1	10	90
Tetrachloroethylene	127-18-4	≤29	64-148	1	10	90
Toluene	108-88-3	≤29	47-150	1	10	90
1,1,1-Trichloroethane	71-55-6	≤33	52-162	1	10	90
1,1,2-Trichloroethane	79-00-5	≤38	52-150	1	10	90
Trichloroethylene	79-01-6	≤36	71-157	1	10	90
Trichlorofluoromethane	75-69-4	≤110	17-181	1	10	90
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	≤50	60-150	1	10	90
Vinyl chloride	75-01-4	≤200	D-251[c]	1	4	90
m-xylene	108-38-3	≤50	60-150	1	10	90
o-xylene	95-47-6	≤50	60-150	1	10	90
p-xylene	106-42-3	≤50	60-150	1	10	90
Acetone	67-64-1	≤50	60-150	10[d]	100	90
Butanol	71-36-3	≤50	60-150	10[d]	100	90
Ethyl ether	60-29-7	≤50	60-150	10[d]	100	90
Formaldehyde[e]	50-00-0	≤50	60-150	10[d]	100	90
Hydrazine[f]	302-01-2	≤50	60-150	10[d]	100	90
Isobutanol	78-83-1	≤50	60-150	10[d]	100	90
Methanol	67-56-1	≤50	60-150	10[d]	100	90
Methyl ethyl ketone	78-93-3	≤50	60-150	10[d]	100	90
Pyridine[b]	110-86-1	≤50	60-150	10[d]	100	90

[a]Criteria apply to PRQL concentrations.
[b]Can also be analyzed as a semi-volatile organic compound.
[c]Detected; result must be greater than zero.
[d]Estimate, to be determined.
[e]Required only for homogenous solids and soil/gravel from Los Alamos National Laboratory.
[f]Required only for homogenous solids and soil/gravel from Oak Ridge National Laboratory and Savannah River Site.

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
MDL = Method detection limit (maximum permissible value) (milligrams per kilogram)
PRQL = Program required quantitation limit; calculated from the toxicity characteristic level for benzene assuming a 0.9 oz (25-gram [g]) sample, 0.1 gal (0.5 liter [L]) of extraction fluid, and 100 percent analyte extraction (milligrams per kilogram)

TABLE C8-5
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR TOTAL VOLATILE ORGANIC COMPOUND ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet total VOC analysis QAOs	Repeat until acceptable
Laboratory duplicates[b]	One (1) per analytical batch	Meet total VOC analysis RPDs	Nonconformance if RPDs > values in Table C8-4
Laboratory blanks	One (1) per analytical batch	Analyte concentrations < 3 x MDLs	Nonconformance if analyte concentrations > 3 x MDLs
Matrix spikes	One (1) per analytical batch	Meet total VOC analysis %Rs in QAP	Nonconformance if %Rs are outside the range specified in QAPP
Matrix spike duplicates	One (1) per analytical batch	Meet total VOC analysis RPDs and %Rs	Nonconformance if RPDs and %Rs > values in Table C8-4
Laboratory control samples	One (1) per analytical batch	80 - 120 %R	Nonconformance if %R < 80 or > 120
Surrogate compounds	Each analytical sample	Average %R from minimum of 30 samples for a given matrix ±3 standard deviations	Nonconformance if %R < (average %R - 3 standard deviation) or > (average %R + 3 standard deviation)
Blind audit samples	Samples and frequency controlled by the Solid PDP Plan	Specified in the Solid PDP Plan	Specified in the Solid PDP Plan

[a]Corrective Action per section C8-13 when final reported QC samples do not meet the acceptance criteria.
[b]May be satisfied using matrix spike duplicate; acceptance criteria applies only to concentrations greater than the PRQLs listed in Table C8-4.

MDL = Method detection limit
QAO = Quality assurance objective
PDP = Performance Demonstration Program
%R = Percent recovery
RPD = Relative percent difference

TABLE C8-6
SEMI-VOLATILE ORGANIC COMPOUND TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Compound	CAS Number	Precision[a] (%RSD or RPD)	Accuracy [a] (%R)	MDL (mg/kg)	PRQL (mg/kg)	Completenes s (%)
Cresols	1319-77-3	≤50	60-150	5	40	90
1,4-Dichlorobenzene[b]	106-46-7	≤86	20-124	5	40	90
ortho-Dichlorobenzene[b]	95-50-1	≤64	32-129	5	40	90
2,4-Dinitrophenol	51-28-5	≤119	D-172[d]	5	40	90
2,4-Dinitrotoluene	121-14-2	≤46	39-139	0.3	2.6	90
Hexachlorobenzene	118-74-1	≤319	D-152[d]	0.3	2.6	90
Hexachloroethane	67-72-1	≤44	40-113	5	40	90
Nitrobenzene	98-95-3	≤72	35-180	5	40	90
Polychlorinated Biphenyls				5	40	90
Aroclor 1016[c]	12674-11-2	≤33	50-114	5	40	90
Aroclor 1221[c]	11104-28-2	≤110	15-178	5	40	90
Aroclor 1232[c]	11141-16-5	≤128	10-215	5	40	90
Aroclor 1242[c]	53469-21-9	≤49	39-150	5	40	90
Aroclor 1248[c]	12672-29-6	≤55	38-158	5	40	90
Aroclor 1254[c]	11097-69-1	≤62	29-131	5	40	90
Aroclor 1260[c]	11096-82-5	≤56	8-127	5	40	90
Pentachlorophenol	87-86-5	≤128	14-176	5	40	90
Pyridine[b]	110-86-1	≤50	60-150	5	40	90

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
MDL = Method detection limit (maximum permissible value) (milligrams per kilogram)
PRQL = Program required quantitation limit; calculated from the toxicity characteristic level for nitrobenzene assuming a 100-gram (g) sample, 0.5 gal (2 liter [L]) of extraction fluid, and 100 percent analyte extraction (milligrams per kilograms)

[a]Criteria apply to PRQL concentrations
[b]Can also be analyzed as a volatile organic compound
[c]Required only for waste matrix code S3220 (organic sludges)
[d]Detected; result must be greater than zero

TABLE C8-7
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet Table C8-7 QAOs	Repeat until acceptable
Laboratory duplicates[b]	One (1) per analytical batch	Meet Table C8-7 RPDs	Nonconformance if RPDs > Table C8-7
Laboratory blanks	One (1) per analytical batch	Analyte concentrations <3 x MDLs	Nonconformance if analyte concentrations > 3 x MDLs
Matrix spikes	One (1) per analytical batch	Meet Table C8-7 %Rs	Nonconformance if %Rs are outside the range specified in Table C8-7
Matrix spike duplicates	One (1) per analytical batch	Meet Table C8-7 RPDs and %Rs	Nonconformance if RPDs and %Rs > Table C8-7 values
Laboratory control samples	One (1) per analytical batch	80 - 120 %Rs	Nonconformance if %R < 80 or > 120
Surrogate compounds	Each analytical sample	Average %R from minimum of 30 samples from a given matrix ±3 standard deviations	Nonconformance if %R < (average %R - 3 standard deviations) or > (average %R + 3 standard deviations)
Blind audit samples	Samples and frequency controlled by the Solid PDP Plan	Specified in the Solid PDP Plan	Specified in the Solid PDP Plan

[a]Corrective action per section C8-13 when final reported QC samples do not meet the acceptance criteria

[b]May be satisfied by using matrix spike duplicate; acceptance criteria applies only to concentrations greater than the PQRLs listed in Table C8-6.

MDL = Method Detection Limit
QAO = Quality Assurance Objective
PDP = Performance Demonstration Program
%R = Percent Recovery
RPD = Relative Percent Difference

TABLE C8-8
TOTAL METALS TARGET ANALYTE LIST AND QUALITY ASSURANCE OBJECTIVES

Analyte	CAS Number	Precision (%RSD or RPD)[a]	Accuracy (%R)[b]	PRDL[c] (μg/L)	PRQL (mg/kg)	Completeness (%)
Antimony	7440-36-0	≤30	80-120	100	100	90
Arsenic	7440-38-2	≤30	80-120	100	100	90
Barium	7440-39-3	≤30	80-120	2000	2000	90
Beryllium	7440-41-7	≤30	80-120	100	100	90
Cadmium	7440-43-9	≤30	80-120	20	20	90
Chromium	7440-47-3	≤30	80-120	100	100	90
Lead	7439-92-1	≤30	80-120	100	100	90
Mercury	7439-97-6	≤30	80-120	4.0	4.0	90
Nickel	7440-02-0	≤30	80-120	100	100	90
Selenium	7782-49-2	≤30	80-120	20	20	90
Silver	7440-22-4	≤30	80-120	100	100	90
Thallium	7440-28-0	≤30	80-120	100	100	90
Vanadium	7440-62-2	≤30	80-120	100	100	90
Zinc	7440-66-6	≤30	80-120	100	100	90

[a]≤ 30 percent control limits apply when sample and duplicate concentrations are ≥ 10 x IDL for ICP-AES and AA techniques, and ≥ 100 x IDL for Inductively Coupled Plasma—Mass Spectrometry (ICP-MS) techniques. If less than these limits, the absolute difference between the two values shall be less than or equal to the PRDL.
[b]Applies to laboratory control samples, laboratory matrix spikes, and PDP blind audit samples. If a solid laboratory control sample material which has established statistical control limits is used, then the established control limits for that material should be used for accuracy requirements.
[c]PRDL set such that it is a factor of 10 below the PRQL for 100 percent solid samples, assuming a 100 x dilution during digestion.

CAS = Chemical Abstract Service
%RSD = Percent relative standard deviation
RPD = Relative percent difference
%R = Percent recovery
PRDL = Program required detection limit (i.e., maximum permissible value for IDL) (milligrams per liter)
PRQL = Program required quantitation limit (milligrams pre kilogram)

TABLE C8-9
SUMMARY OF LABORATORY QUALITY CONTROL SAMPLES AND FREQUENCIES FOR TOTAL METALS ANALYSIS

QC Sample	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
Method performance samples	Seven (7) samples initially and four (4) semiannually	Meet Table C8-9 QAOs	Repeat until acceptable
Laboratory blanks	One (1) per analytical batch	≤ 3 x IDL (≤ 5 x IDL for ICP-MS)[b]	Redigest and reanalyze any samples with analyte concentrations which are ≤10 x blank value and ≥ 0.5 x PQRL
Matrix spikes	One (1) per analytical batch	80 - 120 %Rs	Nonconformance if %Rs are <80 or >120
Matrix spike duplicates	One (1) per analytical batch	RPD ≤ 30 80-120 %R	Nonconformance if RPD > 30 or if %R < 80 or > 120
Laboratory control samples	One (1) per analytical batch	80 - 120 %Rs	Redigest and reanalyze for affected analytes
Blind audit samples	Samples and frequency controlled by the Solid PDP Plan	Specified in the Solid PDP Plan	Specified in the Solid PDP Plan

[a]Corrective action per section C8-13 when final reported QC samples do not meet the acceptance criteria

[b] Applies only to concentrations greater than the PQRLs listed in Table C8-8.

IDL = Instrument Detection Limit
PDP = Performance Demonstration Program
PQRL = Program Required Detection Limit
%R = Percent Recovery
RPD = Relative Percent Difference

TABLE C8-10
MINIMUM TRAINING AND QUALIFICATIONS REQUIREMENTS[a]

Personnel	Requirements[a]
Radiography Operators[c]	Site-specific training based on waste matrix codes and waste material parameters; requalification every 2 years
Gas Chromatography Technical Supervisors[b] Gas Chromatography Operators[c]	B.S. or equivalent experience and 6 months previous applicable experience
Gas Chromatography/Mass Spectrometry Operators[c] Mass Spectrometry Operators[c]	B.S. or equivalent experience and 1 year independent spectral interpretation or demonstrated expertise
Gas Chromatography/Mass Spectrometry Technical Supervisors[b] Mass Spectrometry Technical Supervisors[b] Atomic Absorption Spectroscopy Technical Supervisors[b] Atomic Absorption Spectroscopy Operators[c] Atomic Mass Spectrometry Operators[c] Atomic Emission Spectroscopy Operators[c]	B.S. or equivalent experience and 1 year applicable experience
Atomic Mass Spectrometry Technical Supervisors[b]	B.S. and specialized training in Atomic Mass Spectrometry and 2 years applicable experience
Atomic Emission Spectroscopy Technical Supervisors[b]	B.S. and specialized training in Atomic Emission Spectroscopy and 2 years applicable experience.

[a]Based on requirements contained in *USEPA Contract Laboratory Program Statement of Work for Organics Analysis* (Document Number OLM 01.0) and *Statement of Work for Inorganics Analysis* (Document Number ILM 03.0).
[b]Technical Supervisors are those persons responsible for the overall technical operation and development of a specific laboratory technique. QAPjPs shall include the site-specific title for this position.
[c]Operators are those persons responsible for the actual operation of analytical equipment. QAPjPs shall include the site-specific title for this position.

1

FIGURES

1

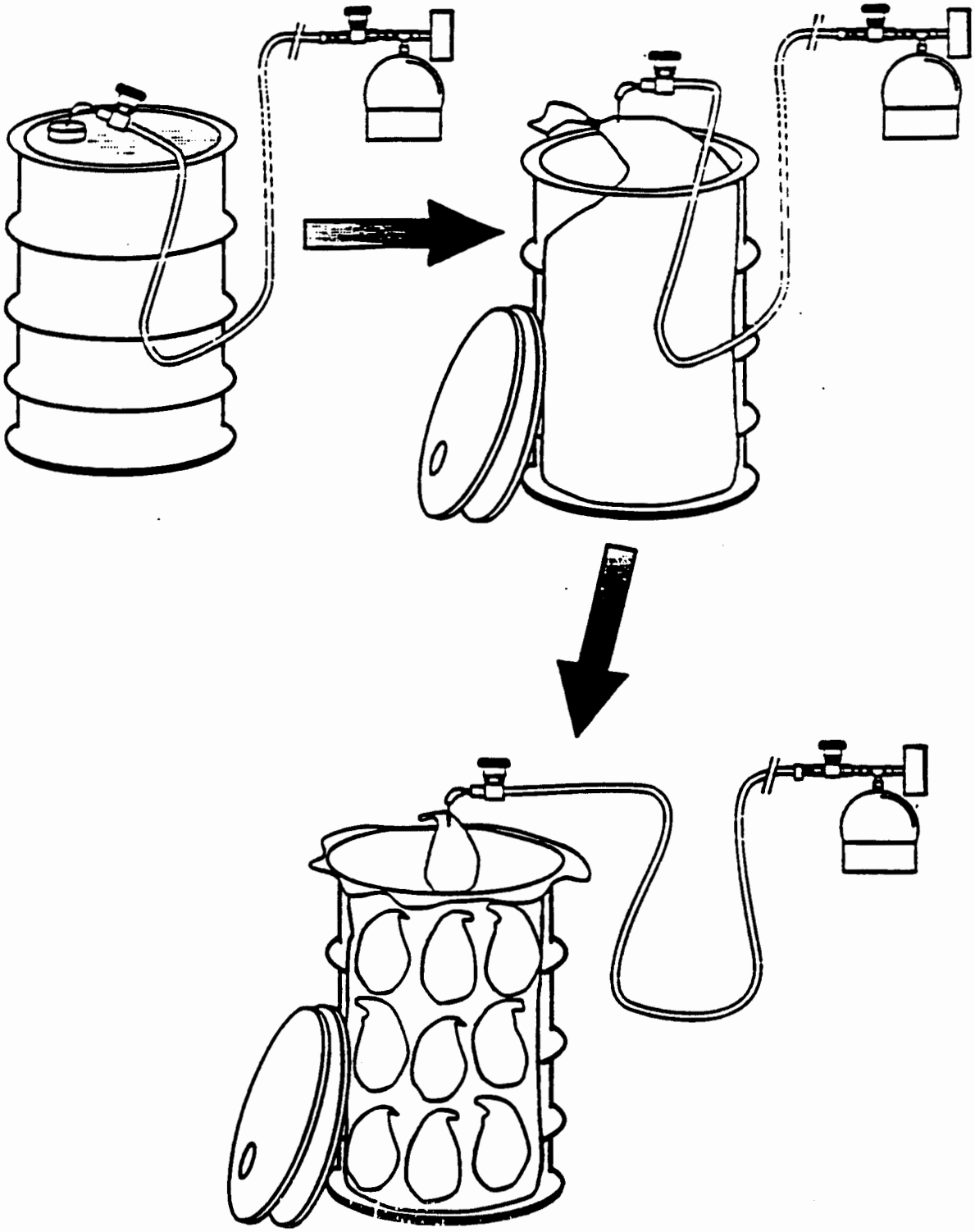

FIGURE C8-1
OVERALL HEADSPACE-GAS SAMPLING SCHEME ILLUSTRATING MANIFOLD SAMPLING

DOE/WIPP 94-024

WASTE ISOLATION PILOT PLANT

Environmental Monitoring Plan

Appendix D5
Rev 6.0

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This document is issued by Westinghouse Electric Corporation, Waste Isolation Division, as the Management and Operating Contractor for the Department of Energy, Waste Isolation Pilot Plant, Carlsbad, New Mexico, 88221.

DOE CONTRACT NUMBER: DE-AC04-86AL31950

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
AIBS	American Institute of Biological Scientists
ANSI	American National Standards Institute
ASER	Annual Site Environmental Report
ASTM	American Society for Testing and Materials
BLM	Bureau of Land Management
CAM	continuous air monitor
CAP88-PC	Clean Air Act Associated Package, 1988
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH	contact-handled
CMS	Central Monitoring System
DOE	Department of Energy
DOE/AL	DOE Albuquerque Operations Office
DOT	Department of Transportation
EC	electrical conductivity
EDE	effective dose equivalent
EEG	Environmental Evaluation Group
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
FAS	fixed air sampler
FEIS	Final Environmental Impact Statement

LIST OF ACRONYMS
(CONTINUED)

FSAR	Final Safety Analysis Report
HEPA	high efficiency particulate air
HPIC	high pressure ionization chamber
ICRP	International Commission on Radiological Protection
LD	limit of detection
LoVol	low volume air sampler
LWA	Land Withdrawal Act
NBS	National Bureau of Standards
NCR	Nonconformance Report
NCRP	National Commission on Radiation Protection and Measurements
NES	Nonradiological Environmental Surveillance
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Testing
NMD	No-Migration Determination
NMED	New Mexico Environment Department
NMVP	No-Migration Variance Petition
NRC	Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act
OEMP	Operational Environmental Monitoring Plan
PDR	Program Deficiency Rep[illegible]
QA/QC	Quality Assurance/Qu[illegible] Control
RBP	Radiological Baseline Program

LIST OF ACRONYMS
(CONTINUED)

RCA	Request for Corrective Action
RCRA	Resource Conservation and Recovery Act
RES	Radiological Environmental Surveillance
RH	remote-handled
SEIS	Final Supplement Environmental Impact Statement
SES	storage exhaust shaft
SNL	Sandia National Laboratories
SOP	standard operating procedure
STAR	Stability and Array File
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TKN	total kjeldahl nitrogen
TLD	thermoluminescent dosimeter
TRU	transuranic
TRUPACT	Transuranic Package Transporters
TSP	total suspended particulates
TSS	total suspended solids
USBM	United States Bureau of Mines
USGS	United States Geological Survey
VOC	volatile organic compound
WHB	Waste Handling Building

LIST OF ACRONYMS
(CONTINUED)

WID	Westinghouse, Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
WSB	WIPP Site Branch
WQSP	Water Quality Sampling Program

PREFACE

DOE Order 5400.1 (1990) requires each DOE site to prepare an Environmental Monitoring Plan (EMP). This document is to be reviewed annually and updated every three years. This is the first update of the EMP, formally known as the Operational Environmental Monitoring Plan (OEMP) (DOE/WIPP 88-025).

There is significant discussion throughout this EMP in reference to established environmental baselines that are the results of OEMP activities initiated in 1985. These baselines are noted below:

DOE/WIPP 92-037
Statistical Summary of the Radiological Baseline for the WIPP, 1992

DOE/WIPP 92-038
Summary of the Salt Impact Studies at the WIPP, 1984 to 1990, and 1992

DOE/WIPP 92-039
A Study of Disturbed Land Reclamation Techniques for the WIPP, 1992

DOE/WIPP 92-013
Background Water Quality Characterization Report for the WIPP, 1992

These documents may be obtained by referring to the DOE/WIPP number, or they may be found as attachments to the Annual Site Environmental Report for the WIPP for Calendar Year 1991, DOE/WIPP 92-007, 1992.

This EMP will be reviewed annually and will document any proposed changes in the environmental monitoring program. Changes to the environmental monitoring program may be necessary to allow the use of advanced technology and new data collection techniques.

The fundamental purpose of this document is to describe the programs established to evaluate long term effects of the WIPP on the environment. This plan should not be evaluated from the standpoint that monitoring is being conducted for release detection from the WIPP facility, but rather, for recorded historical trends.

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1.0 INTRODUCTION

U.S. Department of Energy (DOE) Order 5400.1, General Environmental Protection Program Requirements (DOE, 1990a), requires each DOE facility to prepare an Environmental Monitoring Plan (EMP). This document is prepared for the Waste Isolation Pilot Plant (WIPP) in accordance with the guidance contained in DOE Order 5400.1 (DOE, 1990a); DOE Order 5400.5, Radiation Protection of the Public and Environment (DOE, 1990b); and the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T, 1991). The WIPP project is operated by Westinghouse Electric Corporation, Waste Isolation Division (WID), for the DOE.

This plan defines the extent and scope of the WIPP effluent and environmental monitoring programs during the facility's preoperational and operational life. This document also discusses the WIPP's quality assurance/quality control programs.

This plan provides a comprehensive description of environmental activities at WIPP including:

- A summary of environmental programs including the status of environmental permits and monitoring activities (Section 1.0);
- A description of the WIPP project and its mission (Section 2.0);
- A description of the local environment including demographics (Section 3.0);
- An overview of the methodology used to assess radiological consequences to the public including brief discussions of potential exposure pathways, routine and accidental releases, and their consequences (Section 4.0);
- A summary of preoperational environmental monitoring and assessment activities (Section 5.0); and
- Responses to the requirements described in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T).

This document extensively references DOE Orders and other federal and state regulations affecting effluent and environmental monitoring programs at the site. WIPP procedure manuals, which implement the requirements of this program plan, are also referenced.

The DOE regulates its own activities for radiation protection of the public under the authority of the Atomic Energy Act of 1954, as amended. The effluent and environmental monitoring activities prescribed by DOE Order 5400.5 and the DOE/EH-0173T guidance manual are designed to ensure that DOE facilities collect the information required to estimate potential and actual radiation doses to site personnel and the surrounding population. Effluent and environmental monitoring also provide the data necessary to demonstrate compliance with applicable environmental protection regulations.

Other federal agencies, such as the U.S. Environmental Protection Agency (EPA), are empowered through specific legislation to regulate certain aspects of DOE activities potentially affecting public health and safety or the environment. Presidential Executive Order 12088, "Federal Compliance with Pollution Control Standards," requires the heads of executive agencies to ensure that all federal facilities and activities comply with applicable pollution control standards and to take all necessary actions for the prevention, control, and abatement of environmental pollution.

Beyond statutory requirements, the DOE has established a general environmental protection policy. The "Environmental Policy Statement" (issued by then Secretary Herrington on January 8, 1986, and extended on January 7, 1987) describes the DOE's commitment to national environmental protection goals by conducting operations "in an environmentally safe and sound manner . . . in compliance with the letter and spirit of applicable environmental statutes, regulations, and standards" (DOE, 1986a). This Environmental Policy Statement also states the DOE's commitment to "good environmental management in all of its programs and at all of its facilities in order to correct existing environmental problems, to minimize risks to the environment or public health, and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or public welfare." Additionally, "it is DOE's policy that efforts to meet environmental obligations be carried out consistently across all operations and among all field organizations and programs" (DOE, 1986a).

The WIPP complies with the terms of the Agreement for Consultation and Cooperation established in 1981 with the State of New Mexico. This agreement, required by the federal legislation which authorized the WIPP project (Public Law 96-164, 1980), specifies that DOE notify the State of New Mexico prior to commencement of key events. The Supplemental Stipulated Agreement requires DOE to provide the State with sufficient information to conduct an independent review of WIPP activities.

The 1992 WIPP Land Withdrawal Act (LWA), Public Law 102-579, requires the DOE to prepare and implement a Land Management Plan and Cooperative Agreement with the Bureau of Land Management (BLM). The primary objectives of the Land Management Plan are to preserve the ecological condition of the wildlife habitat within the WIPP withdrawal area, protect special status species, preserve cultural resources, manage rangeland resources, and monitor drilling and mining activity within one mile of the WIPP boundary.

Environmental activities at the WIPP project generally fall into three categories: (1) the performance of analyses and preparation of documents to address DOE requirements, as well as applicable regulations of the EPA and other federal and state agencies; (2) the conduct of environmental studies to monitor site impacts; and (3) the implementation of measures to mitigate adverse impacts.

A number of provisions taken to mitigate potential environmental impacts appear in Statements of Work issued to all contractors involved in the construction of the WIPP facility. These provisions are listed below:

- Protection of environmental resources including the avoidance of unnecessary damage to vegetation, wildlife, and soil by controlling traffic, minimizing disturbance zones, and cleaning up spills.

- Protection of air resources including the control of hydrocarbon emissions by using proper fuels, the suppression of dust by spraying with water, and the monitoring and control of noise.

- Protection of water resources including the use of retention ponds for controlling suspended materials, solutes, and other pollutants.

- Preservation and recovery of historical, archaeological, and cultural resources including the interruption of construction activities as necessary to investigate and mitigate impacts to historical or archaeological resources.

- Post-construction cleanup including the removal of temporary construction facilities, haul roads, stockpiles, and work areas, as well as the restoration of all damaged landscape features outside the limits of approved work areas.

WIPP must also comply with specified permitting and approval requirements of several federal and state regulating agencies. A database is maintained of all required permits, notices, and approvals which apply to the WIPP project. This database enables environmental personnel to anticipate commitments such as renewal dates, fee payments, and reclamation requirements. This database is updated annually and is available in the Annual Site Environmental Report (ASER) produced for the WIPP. The latest issued permit matrix is listed in the Site Environmental Report for the WIPP for Calendar Year 1991 (DOE/WIPP 92-007).

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2.0 PROJECT DESCRIPTION

The purpose of WIPP is to provide a research and development facility to demonstrate the safe disposal of TRU waste generated by the defense activities of the U.S. Government. The preoperational radiological and ecological environmental monitoring programs were detailed in earlier documents entitled: "Radiological Baseline Program for the Waste Isolation Pilot Plant" (Reith and Daer, 1985) and "Ecological Monitoring Program for the Waste Isolation Pilot Plant, Semi-annual Report" (Reith et al., 1985). A summary of those programs is presented in Section 5.0 of this document. The environmental monitoring program continues the established preoperational environmental monitoring efforts as appropriate and adds monitoring of the airborne and liquid effluent discharges. Details regarding the design and operation of the WIPP facility are in the Final Safety Analysis Report (FSAR) (DOE, 1990c).

Both contact handled (CH) and remote handled (RH) waste will be received and stored at the WIPP facility. CH waste consists of transuranic (TRU) waste that has a relatively low surface dose rate and therefore lends itself to direct handling. RH waste is TRU waste that, due to higher levels of penetrating radiation, must be shielded and handled remotely. Waste will be classed as CH or RH based on whether surface dose rates are less than or greater than 200 mrem/hr, respectively. TRU waste is radioactive waste that, without regard to source or form, is contaminated with alpha-emitting TRU radionuclides having atomic numbers larger than 92 and half-lives longer than 20 years in concentrations greater than 100 nanocuries per gram of waste. The CH and RH waste contain both alpha and beta-gamma emitting nuclides. Isotopes of plutonium, americium, and curium will be the predominant radionuclides contaminating the TRU waste. The waste will be in a variety of forms such as concrete stabilized sludges, decommissioned machine tools, glove boxes, etc. All wastes received by the WIPP will be restricted according to specific Waste Acceptance Criteria (WAC Rev. 4, 1991) which prohibit pressurized gases and explosives, and limits free liquids to less than one percent of the volume of each container. General criteria defining the various categories of radioactive waste, including TRU waste, appear in DOE Order 5820.2A and DOE/AL Order 5820.2. A portion of the waste that will be emplaced will also be contaminated with hazardous materials. The hazardous waste component is subject to regulation by the Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA), and consists largely of toxicity characteristic metals, halogenated organic compounds, and nonhalogenated organic compounds.

Waste will be delivered to the WIPP Waste Handling Building (WHB) via semi-trailer trucks. CH wastes will arrive in shipping containers known as TRUPACT IIs (TRansUranic PACkage Transporters). TRUPACT IIs are durable, Type B, Department of Transportation certified (DOT) transport containers, designed to accommodate both waste boxes and drums. The DOE has received a certificate of compliance from the Nuclear Regulatory Commission (NRC) for use of the TRUPACT II. Remote-handled transuranic (RH TRU) wastes will be packaged in waste canisters and shipped to WIPP in special transportation casks. The remote-handled casks are awaiting NRC approval.

The storage rooms prepared for the waste have been excavated from the Salado Formation, a thick sequence of salt beds deposited 250 million years ago (Permian age). The emplacement horizon is located at a depth of 655 meters (2,150 feet). The waste containers within the WHB will be removed from their shipping containers, placed on the waste-handling hoist, and lowered to the emplacement horizon. Waste containers will then be removed from the hoist and emplaced within the storage rooms. Eventually, specially designed seals and plugs will be placed in the excavated drifts and in the shafts. Geologic pressures and the plasticity of the salt will result in the excavation's gradual closure due to creep. This closure will encapsulate and isolate any waste within the Salado.

The underground area is ventilated by air entering via the Salt Handling, Air Intake, and Waste Handling Shafts and exiting through the Exhaust Shaft. In the event of an accident involving waste in the underground, air from the Exhaust Shaft will be directed, at a reduced flow rate, through the Exhaust Filter Building containing banks of high efficiency particulate air (HEPA) filters in order to remove potentially contaminated particulates. Exhaust ventilation from the WHB is continuously HEPA filtered and is not expected to represent a significant release point. Effluent monitoring is discussed in Section 5.3.2.

3.0 SITE CHARACTERISTICS

3.1 GEOGRAPHY

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 3-1) within the Pecos Valley section of the southern Great Plains physiographic province (Powers et al., 1978). The site is 42 km (26 miles) east of Carlsbad in an area known as Los Medanos (the dunes). Los Medanos is a relatively flat, sparsely inhabited plateau with little water and limited land uses.

The WIPP site (Figure 3-2) consists of 16 sections of federal land in Township 22 South, Range 31 East. The 16 sections of federal land were withdrawn from the application of public land laws by the WIPP Land Withdrawal Act (LWA), Public Law 102-579, that was signed on October 30, 1992. The LWA transferred the responsibility for the administration of the 16 sections from the Department of Interior, Bureau of Land Management, to the Department of Energy. This law specified that mining and drilling for purposes other than support of the WIPP project are restricted within this 16 section area with the exception of Section 31. Oil and gas activities are restricted in Section 31 from the surface down to 6,000 feet.

3.2 GEOLOGY

Los Medanos soils are sandy and well drained with a well developed caliche layer occurring below one meter. There are no integrated natural surface drainage features at the site. Scattered throughout the local area are numerous livestock watering ponds (tanks) and seasonally wet, shallow lakes (playas) which are located approximately 6 miles southeast of the site. Geologically, the site is located in the northern portion of the Delaware Basin, one of the westernmost sedimentary basins known collectively as the Permian Basin. Approximately 3,960 meters (13,000 feet) of strata are present in the Delaware Basin (Bachman, 1984) including hundreds of meters of evaporite sequences composed in part of halite, anhydrite, and gypsum. Figure 3-3 illustrates the local stratigraphy.

3.3 CLIMATOLOGY

Regional climate is semi-arid with generally warm temperatures. Approximately half the average annual precipitation, about 31 centimeters (12 inches), is received from summer thunderstorms during June through September. Daytime summer temperatures consistently exceed 32°C (90°F) and occasionally rise above 38°C (100°F). Winter temperatures often rise as high as 21°C (70°F) during the afternoon. Night time lows during winter average near -5°C (23°F), occasionally dipping below -10°C (14°F). Prevailing winds are from the southeast; however, strong winds are common and can blow from any direction creating potentially violent windstorms which carry large volumes of dust and sand. The wind test data have remained essentially the same from year to year. Detailed compilations of climatic data have appeared in the Ecological Monitoring Reports (Fischer et al., 1985; 1987) and in the Annual Site Environmental Reports for calendar years 1988, 1989, 1990, 1991, and 1992 (DOE/WIPP 89-005, DOE/WIPP 90-003, DOE/WIPP 91-008, DOE/WIPP 92-007, DOE/WIPP 93-017, respectively). Additional climatic information appears in the Final Environmental Impact Statement (FEIS) (DOE, 1980), Final Supplement Environmental Impact Statement (SEIS) (DOE, 1990d), and the FSAR (DOE, 1990c).

3.4 HYDROLOGY

Surface water is absent at the WIPP site. The nearest large surface water body, Laguna Grande de la Sal, is located approximately 13 kilometers (8 miles) west-southwest of the WIPP site in Nash Draw where shallow brine ponds occur. The Pecos River is located 22.4 kilometers (14 miles) southwest of the WIPP site.

Several water-bearing zones have been studied near the WIPP. The most significant are the Culebra and Magenta Dolomite Members of the Rustler Formation, which consist of interbedded anhydride, dolomite, siltstone, and halitic claystone. The dolomite units produce brackish to saline water. Limited amounts of potable water are found in the Dewey Lake Redbeds and the overlying Triassic Dockum Group. Another saline water-bearing zone identified is the Rustler-Salado contact, which contains very little water at the WIPP site. It was exposed during shaft construction and produced only small brine seepages. Other water bearing zones that have been evaluated as part of site characterization include the Bell Canyon and Castile Formations.

The Dewey Lake Formation is comprised of alternating thin, even beds of siltstone and mudstone with lenticular interbeds of fine-grained sandstone. Exploratory drilling during site hydrogeologic evaluation did not identify a continuous zone of saturation within the Dewey Lake. The few Dewey Lake wells yielding water for domestic and stock purposes are believed to be completed in the thin, discontinuous lenticular sands where favorable groundwater recharge occurs (Mercer, 1983). A more complete discussion of both the regional and site-specific groundwater hydrology is contained in the WIPP FSAR.

3.5 ECOLOGY

The biota of Los Medanos represent a transition between the northern Chihuahuan Desert and the southern Great Plains. The soils at the site include sandy surface soils with wind-blown particles, a thin soil crust, and a layer of moist subsoil. These sandy soils form stabilized coppice dunes interspersed with swales.

Shrubs and grasses are the most prominent components of the local flora. The development of specific plant communities is dependent on such factors as the infiltration rate of the surface soil, depth to a restrictive layer (e.g., caliche), and the extent to which the surface soil has been reworked by wind or water erosion. The area is dominated by the shinnery oak, mesquite, sand sage, and perennial grasses. Typical grassland and shrubland species dominate the fauna of the area. The primary mammals found at the site include the lagomorphs (rabbits and hares), desert dwelling rodent species, and carnivore species such as the coyote, gray fox, badger, and striped skunk.

A large variety of bird species are also found in the region. The following avian species are present in greatest densities: scaled quail, mourning dove, mocking bird, loggerhead shrike, pyrrhuloxia, black-throated sparrow, wester meadowlark, the lark bunting, vesper sparrow, Cassin's sparrow, and the white-crowned sparrow. The Harris hawk, the Chihuahuan raven, Swainson's hawk, the Northern Harrier, and the American kestrel are also found at the site.

Twenty-nine species of amphibians and reptiles are observed in the site vicinity. Characteristic reptiles in the region include the western box turtle, side-blotched lizard, western whiptail, bullsnake, and western rattlesnake. The primary amphibians are the tiger salamander, green toad, and plain's spadefoot.

A brief summary of the ecological baseline surveys appears in Appendix H of the FEIS (DOE, 1980). If there are any changes observed in the area ecology they will be noted in the WIPP ASERs.

3.6 DEMOGRAPHY

The distribution of the local 1990 population within 50 miles of the WIPP site is provided in Table 4-10. The nearest residents to the site include eight individuals living at the Mills Ranch, 5.8 km (3.5 miles) south-southwest of the center of the site, and two individuals living at the Smith Ranch, 10 km (6 miles) west-northwest of the center of the site (DOE/WIPP 93-017). Both neighboring ranches have been and will continue to be monitored as part of WIPP's environmental surveillance program. Detailed demographic summaries and projections are in the WIPP SEIS (DOE, 1990d) and WIPP FSAR (DOE, 1990c).

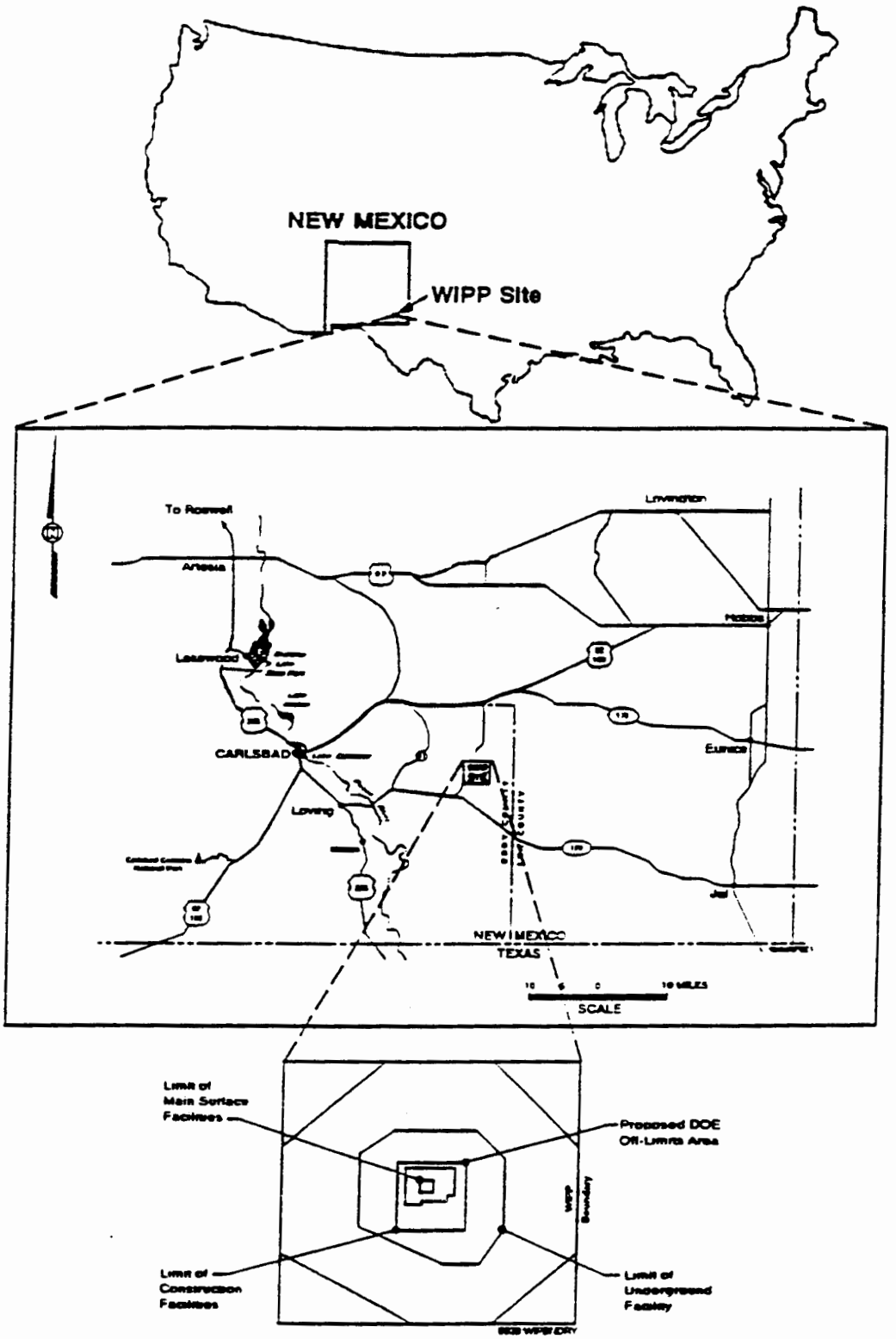

Figure 3-1 Location of the WIPP Site

394B:6434

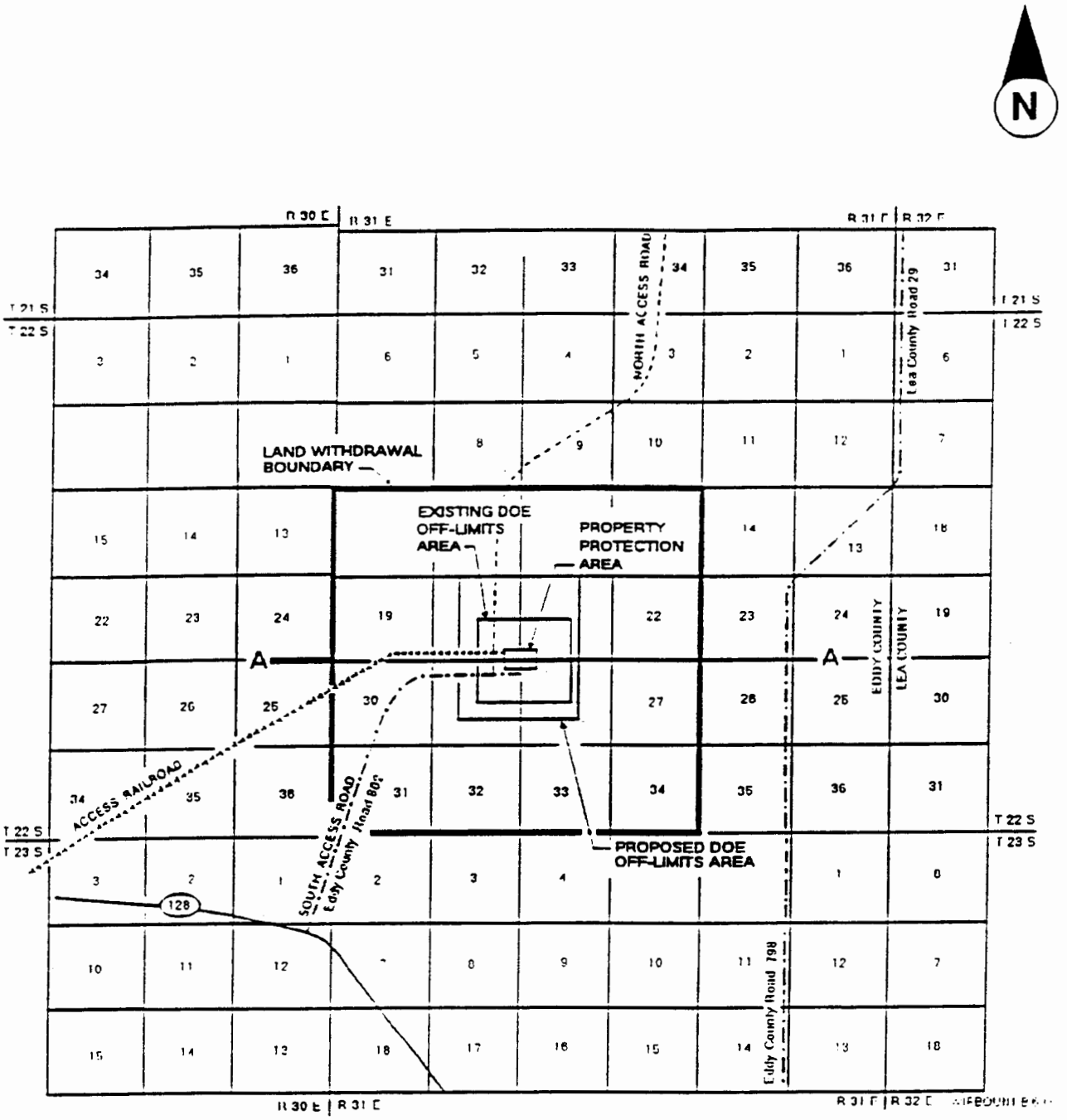

Figure 3-2 Plat of WIPP Site

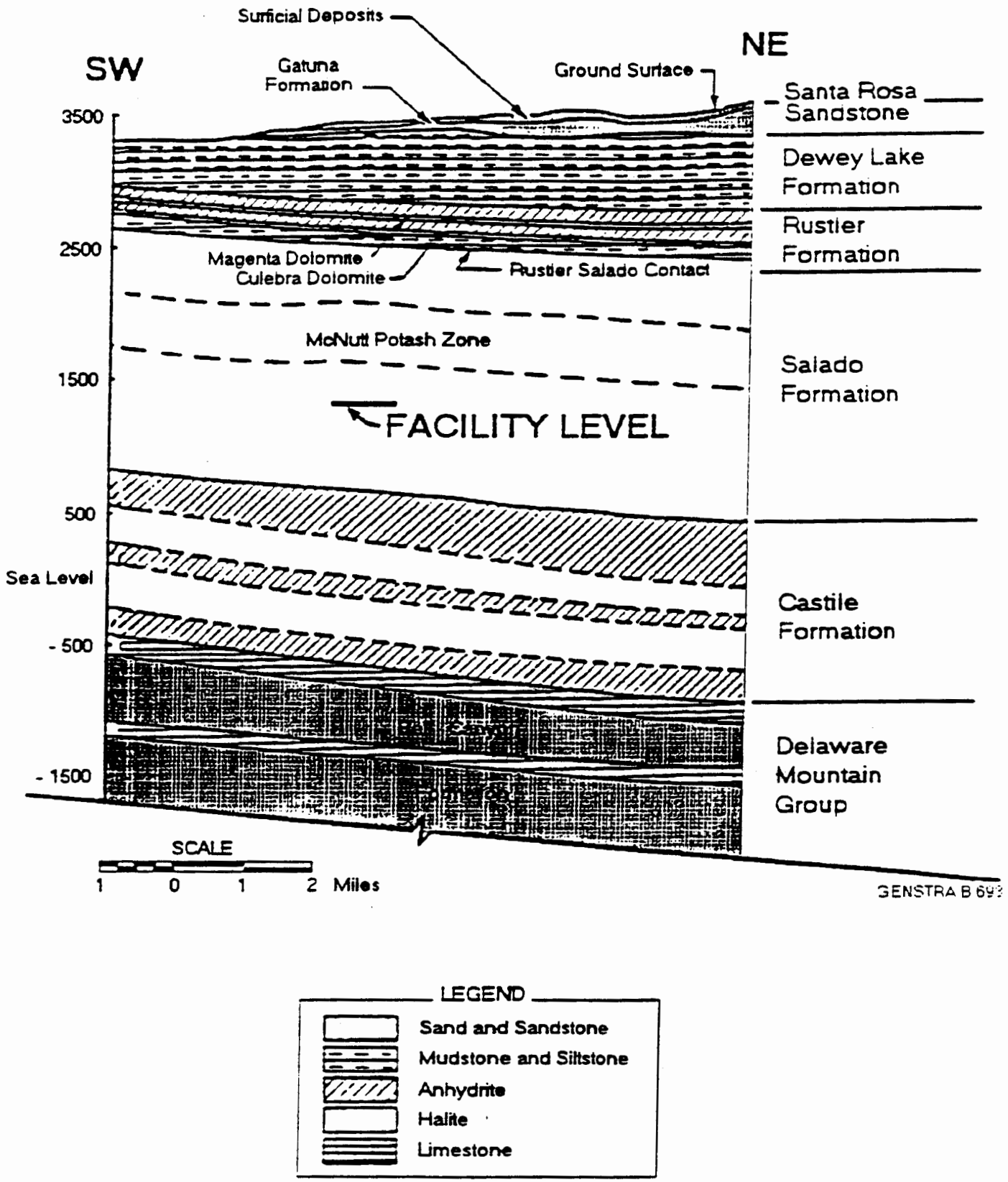

Figure 3-3 Generalized Stratigraphy of the WIPP Site

4.0 DOSE CALCULATIONS

This section provides an overview of the methodology and assumptions used to assess the radiological consequences to members of the public from potential releases of airborne radioactivity from the WIPP facility during normal operations. As discussed in Section 4.2, Pathway Analysis, it is determined that the air pathway is the only significant biosphere release and exposure pathway from the WIPP during normal operations. Determination of environmental transport and exposure pathways and estimates of dose consequences from routine operations may then be examined to verify the suitability and extent of the operational environmental monitoring program.

Nonradiological consequences to members of the public associated with potential airborne chemical releases from the WIPP facility during normal operations are assumed to be *de minimus*. This assumption is based on (1) extensive site exposure measurements and calculations which indicate that employee exposures are being maintained below Occupational Safety and Health Administration Permissible Exposure Limits (as stipulated in 29 CFR 1910.1000), (2) all chemicals used on site must receive approval prior to purchase, with approval based on the minimization of personnel exposure and environmental impact, and (3) the site Nonradiological Environmental Program which has been monitoring for nonradiological emissions from the time of the site's inception.

4.1 GENERAL

The dose assessment methodology used in this section evaluates radiation doses to the public from normal operations at the WIPP and assesses anticipated compliance with applicable regulations for radiation protection of the public and the environment. The WIPP's "Emergency Plan and Procedures" (WP 12-9) supplies basic methods for approximating doses resulting from emergency and accident situations.

The regulatory compliance assessment is based on evaluation of compliance with the radiation dose standards for the public in DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE, 1990b). As required by DOE Order 5400.5, the assessment determines the effective dose equivalent (EDE) to the maximally exposed individual for comparison with public dose limits and the collective population EDE within a radius of 80 km (50 mi) from the center of the WIPP.

The dose assessment methodology used is divided into the following steps:

1) Identify hazards considering physical characteristics of the waste;

2) Evaluate operations that may result in a release of radioactive material;

3) Conduct an exposure assessment by evaluating migration pathways and estimating concentrations of radiological and/or hazardous materials to which receptors are subjected;

4) Compare the resultant exposure consequences to appropriate compliance limits; and

5) Determine expected consequences of exposures.

Dose assessments using the above methodology for normal operations have been performed in the FSAR and SEIS. Additionally, a full characterization and evaluation of hazards, release scenarios for routine operations, and migration pathways were performed in the FSAR and SEIS. Section 4.2

discusses the pathway analysis. Section 4.3 discusses the methodology used for estimating radionuclide concentrations at receptor locations, the resulting radiological dose consequences, and the analyses of anticipated releases and consequences from routine operations.

4.2 PATHWAY ANALYSIS

As stated in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, DOE/EH-0173T (DOE, 1991), a critical pathway analysis should be performed to determine specific environmental sampling and analysis needs. Pathway analysis determines which environmental media might lead to a measurable annual dose of site origin to members of the public. Following pathway analysis, routine sampling and analysis (for the critical radionuclides to dose) and penetrating radiation measurements are performed for those identified media as part of an environmental monitoring and surveillance program.

4.2.1 Exposure Pathways

Potential exposure pathways to man involve direct exposure to radioactive materials in the air or materials deposited on the ground. Exposure to internal organs can occur by the ingestion of intermediary organisms or water, or by inhalation of contaminated air. The facility is designed to limit the amount of radioactivity or hazardous chemicals that could potentially reach the environment, as well as the available pathways to man. The mechanism for transporting radionuclides through the potential pathways depends on the mobility of their chemical forms in the environment. For example, some radionuclides deposited on the soil move from the soil through microbial populations to plant roots and concentrate in edible leaves. Other radionuclides may concentrate in the organs of animals which eat the plants and in soil clinging to the roots. The release pathways are characterized by five parameters:

1. Physical properties of the released material;
2. Radionuclide content of the released material;
3. Location of the release;
4. Process by which the release occurs; and
5. Depletion of the released radioactivity before it enters the biosphere.

For the WIPP facility, characterization of the above parameters requires consideration of WIPP operations, waste container design, quality control, handling procedures, transfer procedures, and storage methods.

The WIPP facility will receive and store radioactive waste in containers (drums and boxes). In addition to these wastes, small quantities of solid wastes generated on site as a result of waste handling operations are collected and disposed of as solid wastes. Site-generated solid wastes which meet the WIPP Waste Acceptance Criteria are emplaced at WIPP in the same manner as wastes received from off site and do not represent a source of radioactivity release during normal operations.

For the purposes of this assessment, it is assumed that the waste containers carry the maximum surface contamination allowed by the Waste Acceptance Criteria. During normal handling and storage operations at the WIPP facility, very small amounts of this external contamination may be released. Additionally, vapors and suspended particulates may be dispersed through the air due to off-gassing from the waste drums or boxes. If a release occurs by any of the above mechanisms,

the air transport pathway presents the most rapid and pervasive dispersion mechanism, whether the release occurs above or below ground. Deposition of radioactive particulates from airborne releases may also result in contamination of soils and surface waters.

As a result of analyses performed in the WIPP FSAR (DOE, 1990c) and the SEIS (DOE, 1990d), a complete characterization of the above five parameters was completed, concluding that the air pathway is the only credible biosphere release and exposure pathway from the WIPP during normal operations (DOE, 1990d). Direct releases of radionuclides to ground and surface waters and to soil during normal operations are not credible (DOE, 1990d). As a result of airborne radioactive particulates, dose to the public may result 1) internally from direct inhalation of airborne contaminants and ingestion of contaminated food or water, and 2) externally from ground-plane irradiation from contaminated soil and direct radiation as a result of immersion in contaminated air. For routine operations, air concentrations and surface deposition levels are calculated using annual average site meteorological conditions. Radiological exposures to members of the public are calculated by summing the exposures from the internal and external pathways. Dose calculations and applicable dose standards are fully discussed in Section 4.3.

The potential pathways for human exposure from WIPP activities form the basis for selection of environmental media to be monitored and the analytical methods to be used in the environmental monitoring program discussed in Section 5.0. Off-site radiation doses to members of the public may be estimated using measurements of emitted radionuclide concentrations in air, soil, water, vegetation, and biotic samples. Typically, the concentrations are quite low and challenge the sensitivity of analytical techniques. For this reason, radiation doses to the off-site collective population and to a maximally exposed individual are estimated using radionuclide emission rates, measured in the in-stack Fixed Air Sampler (FAS), as a source term. The Effluent Monitoring Program is discussed in Section 5.0.

Demonstration of compliance with requirements of DOE Order 5400.5 for routine releases from the WIPP are based upon calculations which make use of information obtained from the WIPP Effluent Monitoring and Environmental Surveillance Programs. Based on the pathway analysis above, the WIPP will primarily rely on the in-place effluent monitoring just discussed, monitoring of environmental transport and diffusion conditions, and its emergency monitoring capabilities to detect, quantify, and adequately respond to unplanned releases of radioactive material to the environment.

The Effluent Monitoring and Environmental Surveillance Programs (Section 5.0) evaluate both radiological and non-radiological parameters near effluent release points on site and at specific off-site locations. This monitoring, in conjunction with meteorological measurements, assists in establishing the relationships between radioactive effluent emissions and projected radiation doses to individuals off site via the potential internal and external exposure pathways discussed above.

4.3 CONSEQUENCE ANALYSIS

4.3.1 Overview of CAP88-PC

The total estimated annual airborne radioactivity released (source term), by isotope, is determined for each of the release locations as discussed in Section 4.3.8. The computer code Clean Air Act Associated Package, 1988 (CAP88-PC) is used to model the atmospheric transport of the calculated annual source terms. CAP88-PC uses a modified Gaussian plume model to estimate the average dispersion of radionuclides released. Using input of source term, stack information, and site specific annual meteorological conditions, the code estimates radionuclide concentrations in air, rates of deposition on ground surfaces, and ground surface and soil concentrations. In addition, using inputs of agricultural data, the code computes the concentrations in food and intake rates to humans from ingestion of food produced in the assessment area.

Dose and risk are estimated by combining the inhalation and ingestion intake rates, the computed air and ground surface concentrations, and dose and risk conversion factors. The effective dose equivalent is calculated using the weighting factor in the International Commission on Radiological Protection (ICRP) 26. Risks are based on lifetime risk from lifetime exposure, with a nominal value of 4E-04 cancers/rem. Dose and risk are tabulated by the code as a function of radionuclide, pathway, location, and organ. CAP88-PC also tabulates the frequency distribution of risk, showing the number of people at various levels of risk.

4.3.2 Stack Effluent Monitoring and Modeling

Based on the pathway analysis discussed in Section 4.2, the WIPP will primarily rely on the in-place effluent monitoring to determine radionuclide emission rates from the Waste Handling Building stack and/or the Storage Exhaust stack. The total annual airborne radioactivity released (source term), by isotope, is determined for each of the release locations as input to CAP88-PC. Table 4-1 lists the estimated total annual radioactivity released as a result of normal operations as presented in the FSAR. Measurements of radionuclide concentrations in effluent air streams will be made periodically during operations. Radionuclide concentrations are determined by laboratory analyses of FAS samples.

Additionally, CAP88-PC requires input describing the area or point of release. Because the air discharged from the stacks is released at a relatively high velocity, the release effectively takes place at a height above the physical stack heights. Input specified to the code and describing these stacks is summarized in Table 4-2.

4.3.3 Meteorological Modeling

The area surrounding the WIPP site is modeled as an 80-kilometer (50-mile) radius circular grid system with the site located at the center. Site-specific meteorological data, typical of annual average conditions, are used in the assessment of routine annual releases (See Table 4-3). Data are accumulated on a yearly basis for input to CAP88-PC in the form of Stability and Array File (STAR). Data are accumulated by frequency of occurrence that the wind is blowing from a particular direction, at a particular stability, at a particular wind speed in knots. A utility code supplied with CAP88-PC converts this STAR file to a format usable by the code.

CAP88-PC determines the frequency of atmospheric stability classes (Table 4-4), frequencies of wind directions and true-average wind speeds (Table 4-5), and frequencies of wind directions and reciprocal-average wind speeds (Table 4-6) for each of the 16 compass directions starting at the north and then proceeding counterclockwise. CAP88-PC uses reciprocal-averaged wind speeds in the atmospheric dispersion equations, which permit a single calculation for each wind speed category.

The average depth of the atmospheric mixing layer (lid) for the area is specified to limit the vertical dispersion of the plume after it travels some distance downwind of the source. The value used for the lid height is 1,435 m (4,735.5 ft) [the average of the 470 m (1,551 ft) mean morning lid and the 2,400 m (7,920 ft) mean afternoon lid].

4.3.4 Dispersion Modeling

The basic equation used by CAP88-PC to estimate plume dispersion in the downwind direction is a modified Gaussian plume model of Pasquill as modified by Gifford. The values of the horizontal and vertical dispersion coefficients (σ_y and σ_z) used for dispersion and depletion calculations are those recommended by Briggs. The code maintains a mass balance along the plume to reduce the concentration of the plume by accounting for removal of radionuclides due to deposition. With respect to deposition of radionuclides on ground surfaces, the code permits considering both dry

deposition and precipitation scavenging. Radionuclides are depleted from the plume by precipitation scavenging, dry deposition, and radionuclide decay.

Dry deposition is the process by which particles deposit on grass, leaves, and other surfaces by impingement, electrostatic deposition, chemical reactions, or chemical reactions with surface components. The rate of deposition on earth surfaces is proportional to the ground-level concentrations of the radionuclides in air:

$$R_d = V_d x$$

where:

R_d = Surface deposition rate, pCi/cm^2-s,
x = Ground level concentration in air, pCi/cm^3, and
V_d = Deposition velocity, cm/s.

Defaults for deposition velocity used by CAP88-PC are 1.8E-03 m/sec for particulates, and zero for gases.

The rate of deposition by scavenging is a function of the precipitation rate and is principally a mechanism of washout of particles from a plume by rain or snow. The scavenging coefficient is an average value for the entire year and includes all periods without rain or snowfall; i.e., the model treats scavenging as a continuous depletion, at a constant rate, of contaminants from the plume over the entire year. The scavenging coefficient has units of s^{-1}. The scavenging rate (R_s), in pCi/cm^2-s, is:

$$R_s = r x_{ave} L$$

where:

r = Scavenging coefficient, s^{-1}
x_{ave} = Average concentration of nuclide in a column of air to the lid height, pCi/cm^3
L = Height of the lid, cm.

The scavenging coefficient is calculated in CAP88-PC by multiplying the rainfall rate by 1E-07 yr/cm-s. Refer to Tables 4-7, 4-8, and 4-9 for values for radionuclide-dependent parameters used by CAP88-PC.

4.3.5 Terrestrial Modeling

As previously discussed, the area surrounding the WIPP site is modeled as an 80-kilometer (50-mile) radius circular grid system with the site located at the center. WIPP-specific data for population are used and are summarized in Table 4-10. Beef and dairy cattle, and vegetable crop productivity data used in the dose assessment is CAP88-PC default for the State of New Mexico and are summarized in Tables 4-11, 4-12, and 4-13. Table 4-14 summarizes radionuclide-independent default data used by CAP88-PC.

4.3.6 Dose Modeling

Radiation dose is calculated by multiplying radioactivity concentrations in air and water or on contaminated ground surfaces, by assumed human intake rates (for internal exposure) or exposure times (for external exposure to penetrating radiation), and then by the appropriate radiation dose conversion factors. That is:

Radiation Dose = (Radioactivity Concentration) x (Intake Rate/Exposure Time) x (Dose Conversion Factor)

Radioactivity concentrations may be determined by direct environmental measurements or by calculating them using computer models. Typically, the concentrations as a result of WIPP operations and/or background are quite low and challenge the sensitivity of analytical techniques. For this reason, radioactivity concentrations at off-site receptor locations, resulting of the atmospheric transport of radionuclides released from WIPP, are estimated by computer air dispersion modeling. As required by DOE Order 5400.5 and 40 CFR Part 61, the computer code used at WIPP is CAP88-PC (Clean Air Act Associated Package, 1988).

Using the calculated concentrations, the code then estimates the resulting annual EDE to the maximum individual and to the collective population that may result 1) internally from direct inhalation of airborne contaminants and ingestion of contaminated food or water, and 2) externally from ground-plane irradiation from contaminated soil and direct radiation as a result of immersion in contaminated air.

Dose and risk are estimated by CAP88-PC by multiplying the calculated concentrations by 1) the code default inhalation and calculated ingestion intake rates and external exposure rates and 2) by dose and risk conversion factors. Internal dose conversion factors are for a 50-yr dose commitment resulting from 1 year of chronic exposure. Continuous exposure for 1 year is assumed in calculating external exposure from ground-surface and air immersion irradiation. DOE Order 5400.5 allows the option of using dose conversions factors from DOE/EH-0070 and -0071 (DOE, 1988a,b) or using factors published by the EPA in EPA-520/1-88-020 (EPA,1988). CAP88-PC incorporates separate approved EPA dose conversion factors, and comparison indicates they are the most conservative.

The EDE is calculated using the weighting factors in ICRP Publication 26 (ICRP, 1977). Risks are based on lifetime risk from lifetime exposure, with a nominal value of 4E-04 cancers/rem of exposure.

4.3.7 Regulatory Compliance

Dose evaluations are conducted to the extent required by DOE 5400.5 for compliance with applicable DOE public dose standards and with 40 CFR Part 61 and 40 CFR Part 191. However, since it was determined in the FSAR that the air pathway is the only credible biosphere release and exposure pathway from the WIPP during operations, and the 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAPs) dose limit of 10 mrem EDE (applies to airborne pathways only) is the most restrictive, the 10 mrem EDE NESHAPS limit is designated as the off-site limit for WIPP (DOE, 1991b).

The public dose limits, against which compliance is assessed, apply to doses from exposures to radiation sources from routine activities only. The public dose limits do not apply to doses from medical exposures or consumer products, naturally occurring radiation sources, or from accidents where controls of exposures cannot be maintained.

Compliance with the DOE 5400.5 standards (and 40 CFR Part 61 and Part 191 standards contained within) is demonstrated through an annual assessment of radiation dose to the public documented in the WIPP Site Environmental Report.

4.3.8 Release and Dose Consequence Assessment

Very small amounts of contamination may be present on the surface of the waste containers when received at the WIPP. The WIPP FSAR discusses the development of radioactivity release quantities from normal operations (Table 4-1). The AIRDOS-EPA computer code was then used to estimate the radiation dose to man resulting from the atmospheric releases of radionuclides from the facility. Site-specific meteorological data typical of annual average conditions were used in the above calculations.

The FSAR conservatively estimates the Adult Maximum Individual Dose resulting from normal operations during the disposal phase to be 1.7E-06 rem/year effective dose equivalent (50 year dose commitment). These doses are far below the limits established by DOE Order 5400.5 and 40 CFR Parts 61 and 191. Additionally, the population dose was calculated to be 5.3E-04 person-rem/year (50-year dose commitment).

The locations where potentially contaminated air is discharged from the WIPP facilities are the WHB exhaust and the exhaust from the underground storage exhaust shaft (SES). The WHB exhaust is continuously filtered through two stages of HEPA filters. The SES exhaust flows through HEPA filters only when air monitors in the storage area or the shaft detect airborne radioactivity in excess of preset limits. If the air monitors detect sufficient activity, the underground ventilation air flow is reduced and diverted through HEPA filters in the Exhaust Filter Building.

TABLE 4-1

PROJECTED ANNUAL RADIOACTIVITY RELEASED AS A RESULT OF NORMAL CH AND RH OPERATIONS[1]

CH & RH Radionuclide	Waste Handling Building (Ci/yr)	Exhaust Shaft (Ci/yr)
Co-60	3.08E-15	3.88E-10
Sr-90	9.25E-14	1.16E-08
Ru-106	6.35E-16	7.99E-11
Sb-125m	2.00E-17	2.51E-12
Cs-137	7.80E-14	9.82E-09
Ce-144	6.17E-15	7.76E-10
Th-232	1.10E-18	2.34E-13
U-233	3.33E-14	8.99E-09
U-235	6.10E-17	1.57E-11
U-238	3.15E-17	1.90E-12
Np-237	8.00E-17	8.65E-11
Pu-238	1.53E-11	1.90E-06
Pu-239	2.02E-12	6.10E-07
Pu-240	5.25E-13	1.75E-07
Pu-241	7.19E-11	9.43E-05
Pu-242	9.28E-17	3.29E-11
Am-241	7.47E-12	8.72E-06
Cm-244	5.05E-14	6.37E-09
Cf-252	1.23E-14	1.07E-09

1. Data from FSAR (DOE,1990c, Table 6.1-12)

TABLE 4-2

STACK INFORMATION[1]

PARAMETER	WASTE HANDLING BUILDING	STORAGE EXHAUST FILTER BUILDING
Number of stacks	1	2
Stack Height	14.9 m	8.2 m
Stack Diameter	2.4 m[2]	4.4 m
Velocity of Stack Gas	9.5 m/s	6.7 m/s

1. Data from SEIS (DOE, 1990d)

2. Equivalent diameter

TABLE 4-3

METEOROLOGICAL DATA[1]

PARAMETER	VALUE
Lid Height	1,435 m
Average Temperature	15.56 °C
Average Rainfall	24.13 cm/yr
Frequency of Atmospheric Stability Classes	Table 4-4
Frequencies of Wind Directions and True-Average Wind Speeds	Table 4-5
Frequencies of Wind Directions and Reciprocal-Average Wind Speeds	Table 4-6

Pasquill Category	Vertical Temperature Difference (°C/100m)	Sigma Theta (degrees)
A	$\Delta T/\Delta Z \leq -1.9$	$\sigma\Theta \geq 22.5$
B	$-1.9 < \Delta T/\Delta Z \leq -1.7$	$22.5 > \sigma\Theta \geq 17.5$
C	$-1.7 < \Delta T/\Delta Z \leq -1.5$	$17.5 > \sigma\Theta \geq 12.5$
D	$-1.5 < \Delta T/\Delta Z \leq -0.5$	$12.5 > \sigma\Theta \geq 7.5$
E	$-0.5 < \Delta T/\Delta Z \leq 1.5$	$7.5 > \sigma\Theta \geq 3.8$
F	$1.5 < \Delta T/\Delta Z \leq 4.0$	$3.8 > \sigma\Theta \geq 2.1$
G	$4.0 < \Delta T/\Delta Z$	$2.1 > \sigma\Theta$

1. Data from SEIS (DOE, 1990d).

TABLE 4-4

FREQUENCY OF ATMOSPHERIC STABILITY CLASSES FOR EACH DIRECTION

Fraction of time in each stability class

Wind Direction	A	B	C	D	E	F	G
N	0.5740	0.0084	0.0042	0.0391	0.0705	0.0517	0.2521
NNW	0.3376	0.0084	0.0038	0.0287	0.0738	0.1937	0.3540
NW	0.2030	0.0071	0.0034	0.0240	0.0907	0.1979	0.4740
WNW	0.1869	0.0098	0.0045	0.0548	0.1209	0.1794	0.4437
W	0.2813	0.0246	0.0086	0.1044	0.1597	0.1413	0.2801
WSW	0.2627	0.0208	0.0091	0.1053	0.1756	0.1144	0.3121
SW	0.2320	0.0044	0.0132	0.0485	0.1498	0.1175	0.4347
SSW	0.2981	0.0154	0.0154	0.0615	0.1231	0.0712	0.4154
S	0.3701	0.0168	0.0037	0.0299	0.1252	0.1121	0.3421
SSE	0.4469	0.0163	0.0041	0.0265	0.0898	0.0714	0.3449
SE	0.5295	0.0153	0.0088	0.0306	0.0722	0.0481	0.2954
ESE	0.4420	0.0122	0.0020	0.0326	0.0570	0.0855	0.3686
E	0.5465	0.0178	0.0076	0.0293	0.0561	0.0726	0.2701
ENE	0.5657	0.0046	0.0061	0.0428	0.0413	0.0428	0.2966
NE	0.5731	0.0134	0.0134	0.0403	0.0538	0.0336	0.2723
NNE	0.6558	0.0061	0.0048	0.0400	0.0461	0.0218	0.2255

TABLE 4-5

FREQUENCIES OF WIND DIRECTIONS AND TRUE-AVERAGE WIND SPEEDS

Wind Toward	Frequency	Wind speeds for each stability class (m/s) A	B	C	D	E	F	G
N	0.091	3.90	2.62	2.62	3.69	3.29	3.58	2.40
NNW	0.151	4.36	3.91	3.25	3.94	4.79	5.54	3.03
NW	0.188	3.94	3.77	3.85	3.86	4.18	4.54	2.94
WNW	0.085	3.28	4.00	3.87	3.95	3.93	3.32	2.45
W	0.052	4.46	5.32	6.61	5.33	5.39	4.80	3.01
WSW	0.049	4.67	5.10	6.25	5.65	6.18	5.16	2.93
SW	0.043	4.40	2.98	3.05	4.17	4.90	4.04	2.65
SSW	0.033	4.06	3.38	4.36	4.23	4.29	3.57	2.65
S	0.034	4.25	4.28	3.15	3.87	4.40	3.74	2.70
SSE	0.031	4.02	2.26	2.25	3.16	3.52	3.97	2.94
SE	0.029	3.57	2.26	2.76	3.31	3.41	4.54	2.79
ESE	0.031	4.28	3.18	0.85	3.08	4.88	5.21	3.36
E	0.050	5.64	3.37	5.11	4.74	5.10	6.01	3.57
ENE	0.042	4.84	0.85	4.10	3.73	3.40	5.39	3.01
NE	0.038	3.75	3.60	4.08	2.73	3.58	2.90	2.63
NNE	0.053	3.54	2.27	3.15	2.74	2.75	2.11	2.23

TABLE 4-6

FREQUENCIES OF WIND DIRECTIONS AND RECIPROCAL-AVERAGE WIND SPEEDS

		Wind speeds for each stability class (m/s)						
Wind Toward	Frequency	A	B	C	D	E	F	G
N	0.091	3.11	2.00	2.00	2.71	2.58	2.78	2.40
NNW	0.151	3.46	2.74	2.99	2.76	3.35	4.45	3.03
NW	0.188	3.04	2.46	3.21	3.09	3.04	3.55	2.94
WNW	0.085	2.51	3.20	3.37	2.84	2.93	2.50	2.45
W	0.052	3.31	4.09	5.99	4.08	3.68	3.64	3.01
WSW	0.049	3.11	3.59	5.55	3.81	4.16	3.69	2.93
SW	0.043	3.12	1.80	2.80	2.85	3.46	2.57	2.65
SSW	0.033	2.84	2.28	2.84	2.75	3.21	2.34	2.65
S	0.034	3.00	2.12	2.89	1.99	2.70	2.08	1.91
SSE	0.031	2.75	1.47	2.25	1.71	2.04	2.51	2.02
SE	0.029	2.52	1.40	3.10	1.99	2.30	2.76	2.01
ESE	0.031	2.68	1.96	0.85	1.47	1.94	2.55	2.11
E	0.050	3.57	1.76	2.64	2.39	2.71	4.35	2.15
ENE	0.042	3.14	0.85	2.02	1.99	1.71	4.23	2.11
NE	0.038	2.50	2.42	2.05	1.62	2.19	1.76	1.83
NNE	0.053	2.70	1.21	2.89	2.04	1.83	1.46	1.63

TABLE 4-7

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS TABLE A

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
Co-60	Y	1.0	2.41E-06	1.80E-03
Sr-90	Y	1.0	2.41E-06	1.80E-03
Ru-106	Y	1.0	2.41E-06	1.80E-03
Sb-125	W	1.0	2.41E-06	1.80E-03
Cs-137	D	1.0	2.41E-06	1.80E-03
Ce-144	Y	1.0	2.41E-06	1.80E-03
Th-232	Y	1.0	2.41E-06	1.80E-03
U-233	Y	1.0	2.41E-06	1.80E-03
U-235	Y	1.0	2.41E-06	1.80E-03
U-238	Y	1.0	2.41E-06	1.80E-03
Np-237	W	1.0	2.41E-06	1.80E-03
Pu-238	W	1.0	2.41E-06	1.80E-03
Pu-239	W	1.0	2.41E-06	1.80E-03
Pu-240	W	1.0	2.41E-06	1.80E-03
Pu-241	W	1.0	2.41E-06	1.80E-03
Pu-242	W	1.0	2.41E-06	1.80E-03
Am-241	W	1.0	2.41E-06	1.80E-03
Cm-244	W	1.0	2.41E-06	1.80E-03
Cf-252	Y	1.0	2.41E-06	1.80E-03

TABLE 4-8

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS TABLE B

	DECAY CONSTANT (PER DAY)		TRANSFER COEFFICIENT		
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
Co-60	0.00E+00	5.48E-05	0.00E+00	2.00E-03	2.00E-02
Sr-90	0.00E+00	5.48E-05	0.00E+00	1.50E-03	3.00E-04
Ru-106	0.00E+00	5.48E-05	0.00E+00	6.00E-07	2.00E-03
Sb-125	0.00E+00	5.48E-05	0.00E+00	1.00E-04	1.00E-03
Cs-137	0.00E+00	5.48E-05	0.00E+00	7.00E-03	2.00E-02
Ce-144	0.00E+00	5.48E-05	0.00E+00	2.00E-05	7.50E-04
Th-232	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-06
U-233	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
U-235	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
U-238	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
Np-237	0.00E+00	5.48E-05	0.00E+00	5.00E-06	5.50E-05
Pu-238	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-239	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-240	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-241	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Pu-242	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
Am-241	0.00E+00	5.48E-05	0.00E+00	4.00E-07	3.50E-06
Cm-244	0.00E+00	5.48E-05	0.00E+00	2.00E-05	3.50E-06
Cf-252	0.00E+00	5.48E-05	0.00E+00	0.00E+00	0.00E+00

FOOTNOTES: (1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

Table 4-9

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS TABLE C

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
Co-60	2.00E-02	3.00E-03	5.00E-02	3.00E-01
Sr-90	2.50E+00	1.07E-01	1.00E-02	3.00E-01
Ru-106	7.50E-02	8.56E-03	5.00E-02	5.00E-02
Sb-125	2.00E-01	1.28E-02	1.00E-02	1.00E-01
Cs-137	8.00E-02	1.28E-02	9.50E-01	9.50E-01
Ce-144	1.00E-02	1.71E-03	3.00E-04	3.00E-04
Th-232	8.50E-04	3.64E-05	2.00E-04	2.00E-04
U-233	8.50E-03	1.71E-03	2.00E-03	2.00E-01
U-235	8.50E-03	1.71E-03	2.00E-03	2.00E-01
U-238	8.50E-03	1.71E-03	2.00E-03	2.00E-01
Np-237	1.00E-01	4.28E-03	1.00E-03	1.00E-03
Pu-238	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-239	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-240	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-241	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Pu-242	4.50E-04	1.93E-05	1.00E-03	1.00E-03
Am-241	5.50E-03	1.07E-04	1.00E-03	1.00E-03
Cm-244	8.50E-04	6.42E-06	1.00E-03	1.00E-03
Cf-252	0.00E+00	0.00E+00	1.00E-03	1.00E-03

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pastu and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

TABLE 4-10

POPULATION DATA[1]

Direction	Distance (m) 1650	5500	9200	13700	25000	41650	58350	75000
N	0	0	0	0	29	23	195	28
NNW	0	0	0	0	17	6	237	11
NW	0	0	0	0	28	17	61	15080
WNW	0	0	10	0	6	164	50	44
W	0	0	0	0	66	24952	39	33
WSW	0	0	0	0	1707	171	55	72
SW	0	5	0	0	0	17	11	44
SSW	0	0	0	8	6	28	105	17
S	0	0	0	0	6	16	56	17
SSE	0	0	0	0	0	29	12	47
SE	0	0	0	0	6	23	29	35
ESE	0	0	0	0	6	12	2150	315
E	0	0	0	0	6	18	2500	186
ENE	0	0	0	0	12	82	216	29115
NE	0	0	0	0	0	29	82	8224
NNE	0	0	0	0	29	5	58	6418

1. Data from SEIS (DOE, 1990d).

TABLE 4-11

NUMBER OF BEEF CATTLE[1]

	Distance (meters)							
Direction	1650	5500	9200	13700	25000	41650	58350	75000
N	9	39	45	133	673	1128	1580	2019
NNW	9	39	45	133	673	1128	1580	2019
NW	9	39	45	133	673	1128	1580	2019
WNW	9	39	45	133	673	1128	1580	2019
W	9	39	45	133	673	1128	1580	2019
WSW	9	39	45	133	673	1128	1580	2019
SW	9	39	45	133	673	1128	1580	2019
SSW	9	39	45	133	673	1128	1580	2019
S	9	39	45	133	673	1128	1580	2019
SSE	9	39	45	133	673	1128	1580	2019
SE	9	39	45	133	673	1128	1580	2019
ESE	9	39	45	133	673	1128	1580	2019
E	9	39	45	133	673	1128	1580	2019
ENE	9	39	45	133	673	1128	1580	2019
NE	9	39	45	133	673	1128	1580	2019
NNE	9	39	45	133	673	1128	1580	2019

1. CAP88-PC Default data for New Mexico; using Beef Cattle Density of 4.130E-2 (#/km^2)

TABLE 4-12

NUMBER OF MILK CATTLE[1]

	Distance (meters)							
Direction	1650	5500	9200	13700	25000	41650	58350	75000
N	0	1	1	4	19	31	44	56
NNW	0	1	1	4	19	31	44	56
NW	0	1	1	4	19	31	44	56
WNW	0	1	1	4	19	31	44	56
W	0	1	1	4	19	31	44	56
WSW	0	1	1	4	19	31	44	56
SW	0	1	1	4	19	31	44	56
SSW	0	1	1	4	19	31	44	56
S	0	1	1	4	19	31	44	56
SSE	0	1	1	4	19	31	44	56
SE	0	1	1	4	19	31	44	56
ESE	0	1	1	4	19	31	44	56
E	0	1	1	4	19	31	44	56
ENE	0	1	1	4	19	31	44	56
NE	0	1	1	4	19	31	44	56
NNE	0	1	1	4	19	31	44	56

1. CAP88-PC Default data for New Mexico; using Milk Cattle Density of 1.14E-03 (#/km^2)

TABLE 4-13

AREA OF VEGETABLE CROP PRODUCTION[1]

Distance (meters)

Direction	1650	5500	9200	13700	25000	41650	58350	75000
N	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NNW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0
NW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0
WNW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
W	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
WSW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E
SW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E
SSW	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0
S	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0
SSE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0
SE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
ESE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
E	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0
ENE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+05
NNE	3.0E+03	1.3E+04	1.5E+04	4.5E+04	2.2E+05	3.8E+05	5.3E+05	6.7E+0

1. CAP88-PC Default data for New Mexico: using land fraction cultivated for vegetable crops of 1.380E-03.

TABLE 4-14

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/m^2, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (y)	1.00E+02
For radionuclides deposited on ground/water (d)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transpr time from animal feed-milk-man (d)	2.00E+00
Time from slaughter to consumption (d)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/l vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/m^2)	2.80E-01
Produce/leafy veg for human consumption (kg/m^2)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

TABLE 4-14

CAP88-PC DEFAULT VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS
Continued

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/d, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/d)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (d)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	1.00E+00
Meat	1.00E+00
Milk	1.00E+00
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Actual fractions of food types from outside area can be greater than the minimum fractions listed below.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

5.0 ENVIRONMENTAL MONITORING PROGRAM

As required by DOE Order 5400.1, each facility is required to perform a "preoperational study to begin not less than one year, and preferably two years before start-up to evaluate seasonal changes." The DOE WIPP has complied with this requirement by compiling five years of preoperational environmental data. An analysis of the preoperational data is contained in the following documents: 1) Statistical Summary of the Radiological Baseline for the WIPP (DOE/WIPP 92-037), 2) Summary of the Salt Impact Studies at the WIPP, 1984 to 1990, (DOE/WIPP 92-038), 3) A Study of Disturbed Land Reclamation Techniques for the WIPP (DOE/WIPP 92-039), and 4) Background Water Quality Characterization Report for the WIPP (DOE/WIPP 92-013).

The environmental sampling programs used to establish the preoperational study are defined in Chapter 5 of the OEMP (DOE/WIPP 88-025). This is an update of the OEMP. This plan describes the environmental monitoring efforts at the WIPP as the project moves from the predisposal phase into the disposal phase.

The Westinghouse, Waste Isolation Division (WID) Environmental Monitoring Section at the WIPP is administered by the Environment, Safety, Health and Regulatory Compliance Department to ensure compliance with pertinent environmental regulations as required by DOE Order 5400.1. DOE Order 5400.1 states that environmental surveillance shall be conducted to monitor the effects, if any, of DOE activities on-site and off-site. An environmental surveillance program shall be undertaken at DOE sites to determine the need for a permanent surveillance program. In addition, environmental surveillance programs and components should be determined on a site-specific basis by the field organization. Programs should reflect facility characteristics; applicable regulations; hazard potential; quantities and concentrations of materials released; the extent and use of affected air, land, and water; and specific local public interest or concern (DOE, 1990a).

5.1 GUIDELINES

Under the Atomic Energy Act of 1954, as amended, the DOE is obligated to regulate its own activities so as to provide radiation protection for both workers and the public. Presidential Executive Order 12088, "Federal Compliance with Pollution Control Standards," further requires the heads of executive agencies to ensure that all Federal facilities and activities comply with applicable pollution control standards and to take all actions necessary for the prevention, control, and abatement of environmental pollution.

It is the policy of the DOE to conduct effluent monitoring and environmental surveillance programs that are appropriate for determining adequate protection of the public and the environment during DOE operations and to assure that operations are in compliance with DOE and other applicable Federal, State, and local radiation standards and requirements. It is also DOE policy that departmental monitoring and surveillance programs be capable of detecting and quantifying unplanned releases, while meeting high standards of quality and credibility. It is DOE's objective that all DOE operations properly and accurately measure radionuclides in effluent streams and in the ambient environmental media.

A Guide for Environmental Radiological Surveillance at DOE Installations (DOE/EP-0023) (Corley et al., 1981) states that the factors which should be considered in determining the relative level of environmental surveillance required at a facility include:

(1) the potential hazard of the materials released, considering both expected quantities and relative radiotoxicities;

(2) the extent to which facility operations are routine and unchanging;

(3) the need for supplementing and complementing effluent monitoring;

(4) the size and distribution of the exposed population;

(5) the cost-effectiveness of increments to the environmental surveillance program; and

(6) the availability of measurement techniques which will provide sufficiently sensitive comparisons with applicable standard and background measurements.

The above guidance, the risk analysis in the WIPP FSAR, and the dose criteria in DOE Order 5400.5 indicate that operational dose estimates for the WIPP are significantly below dose criteria. However, the purpose of the WIPP is to demonstrate that the long-term disposal of TRU waste in bedded salt can be accomplished safely, and that the natural environment will not be significantly impacted as a result of the construction and operation of the disposal facility. To this end, the WIPP EMP encompasses a comprehensive set of parameters that detect and quantify environmental impacts. As required in DOE Order 5400.1, the EMP is reviewed annually and updated every three years. The EMP scope and intensity is adjusted in response to changing facility processes, environmental parameters, and program results.

Parameters measured include ambient radiation levels, atmospheric conditions, air and water quality, soil properties, and the status of the local biological community. Nonradiological portions of the program focus on the immediate area surrounding the site, whereas radiological surveillance generally covers a broader geographical area including nearby ranches, villages, and cities. Environmental monitoring will continue at the site during project operations and through decommissioning activities. The Radiological Baseline Program (RBP) and the Ecological Monitoring Program have been incorporated, as appropriate, into the EMP.

The goal of the EMP is to determine if the local ecosystem has been impacted during the predisposal and disposal phases of the WIPP, and if so, to evaluate their severity, geographic extent, and environmental significance. Tables 5-1 and 5-2 summarize the EMP sampling schedule and analytical array. These tables list the sample types, number of sampling stations, approximate sampling schedule and the environmental/ecological parameters monitored or analyzed. It is important to emphasize the need for flexibility in the design and implementation of the EMP. Additional or different types of samples will be collected and analyzed as necessary to investigate and explain trends or anomalies that may have a bearing on the WIPP's environmental impacts. The EMP radiological sampling and analysis schedule is less extensive than that of the RBP. Baseline conditions were characterized by the RBP prior to waste emplacement at the WIPP and are summarized in the Statistical Summary of the Radiological Baseline for the WIPP (DOE/WIPP 92-037). RBP sampling was extensive because additional baseline data cannot be collected after wastes arrive. Environmental and ecological sampling during operations will be increased if warranted.

As recommended in DOE/EH-0173T, the EMP provides the guidance for monitoring levels of naturally occurring radionuclides, those associated with world-wide fallout, and those expected in the WIPP wastes. The geographic scope of radiological sampling is based on projections of potential release pathways for the types of radionuclides in the WIPP wastes. Also, the surrounding population centers are monitored even though release scenarios involving radiation doses to residents of those population centers are improbable. Ecological sampling activities will continue to be performed at the permanent ecological monitoring plots. These sampling locations are unchanged from those reported in the OEMP.

Sampling and related activities (sample logging, packaging, and shipping) are conducted in accordance with the procedures and instructions described in the WIPP Procedures. Standard sampling practices and techniques are used (see Section 6.0). Most samples are analyzed by a commercial laboratory selected using a prequalifying program.

Sample splits are made available to the Environmental Evaluation Group (EEG) and the NMED. The EEG has developed and implemented an environmental monitoring program at WIPP which provides independent verification of the WIPP's environmental monitoring results. The EEG environmental surveillance program has provided independent data verification for the WIPP Project during the preoperational phase to date. NMED oversight at the WIPP includes independent verification of environmental sampling, effluent and spill sampling, oversight of cleanup and environmental restoration activities, data validation/verification, and comprehensive program evaluations.

The Carlsbad Environmental Monitoring and Research Center, operated by New Mexico State University, is a research organization which also conducts independent environmental monitoring in the WIPP vicinity. The Center currently operates one underground and two surface aerosol monitoring sites at the WIPP. Studies are now being conducted to determine the size distribution for atmospheric aerosols as well as their chemical and radionuclide composition. The results of these studies will provide the basis for identifying the various sources of atmospheric aerosols (e.g., oil and gas, potash mining, soil, and WIPP). Additionally, the Center will be conducting in vivo bioassay monitoring of the general public and WIPP radiation workers starting in the summer of 1994.

Quality assurance/quality control has been established within the framework of the overall WID Quality Assurance Manual (WP 13-1) and is described in Section 8 of this EMP. When the WIPP data are received they are evaluated and presented in the WIPP Site Environmental Report.

5.2 SITE CHARACTERIZATION

Characterization studies were initiated to begin evaluating the adequacy of the site as a long-term repository and to obtain information necessary for modeling. These earlier studies have influenced the current WIPP environmental monitoring efforts described below.

5.2.1 WIPP Biology Program

The WIPP Biology Program (Best and Neuhauser, 1980) began in August 1975 with baseline studies of climate, soils, vegetation, arthropods, and vertebrates. The program was expanded in late 1977 to include studies of floristics, primary productivity, plant succession, microbial biogeochemistry, and the aquatic ecosystem of the lower Pecos River. The major objectives were: 1) to acquire baseline data on the WIPP environment, including information for environmental documentation; 2) to provide data useful in the determination of possible radionuclide pathways between the WIPP facility and humans; and 3) to aid in the establishment of a long-term ecological monitoring program.

In 1980, the program was re-oriented to emphasize studies that would help predict specific environmental impacts associated with construction and operations. Soils were experimentally treated with salt, and plants were trampled and grazed in order to make quantitative predictions of the effects of these potential impacts. The effects of salt on population of arthropods and decomposition of leaf litter were also studied because of the relatively high sensitivity of these ecosystem components and processes as possible indicators of chemical impacts. In 1984, the WIPP Biology Program was succeeded by the Ecological Monitoring Program.

5.2.2 United States Geological Survey (USGS) Studies

Before the WIPP project was proposed, the region was studied intensively by the USGS because of its potential potash (USBM, 1977; AIM, 1979) and oil and gas (Keesey, 1979) resources. At the request of DOE, the USGS has conducted investigations of the geohydrology of the WIPP area. Their research documented naturally occurring radionuclide levels in subsurface water of the three major members of the Rustler Formation. Data on gross alpha/beta, radium, and uranium levels in each member from a total of 20 well locations were obtained (USGS, 1983). Also, the USGS

maintains a routine surface sampling program on the Pecos River (USGS, 1978-1984). Summaries of the USGS mineral, petroleum, and geohydrology studies are presented in the WIPP FEIS (DOE, 1980).

Additionally, Columbia University personnel under Nuclear Regulatory Commission (NRC) contract performed a study of radionuclide mobility in the highly saline groundwater of the Delaware Basin, which is the area underlying the WIPP (Simpson et al., 1985). This study documented radium, uranium, thorium, and plutonium levels in groundwater and surface waters of the Delaware Basin. A summary of the data from the Columbia University study is presented in Bradshaw and Louderbough (1987).

5.2.3 Project Gnome

Although not a part of the WIPP studies, Project Gnome is also of interest when considering environmental monitoring at the WIPP and the radiological history of southeastern New Mexico. In December 1961, as part of the Plowshare Program sponsored by the Atomic Energy Commission (AEC), a three-kiloton nuclear device was detonated underground approximately 12 km (7.5 miles) southwest of the present WIPP Site (USAEC, 1962a; Lantz and Berry, 1978). The detonation and subsequent activities released some radionuclides into the surrounding environment. Radiological monitoring of air, water, and biological media was conducted by the AEC before and after the Gnome detonation (USAEC, 1962a, b, c, d).

In 1963, the AEC initiated a study of the mobility of radionuclides in the Salado Formation. As part of this study, two wells at the Gnome Site were intentionally contaminated with ^{3}H, ^{131}I, ^{90}Sr, and ^{137}Cs. The EPA annually samples these wells and others in the area of Project Gnome. Tritium values in the two wells (USGS Wells 4 and 8) are still elevated, as are levels of Strontium-90 and Cesium-137 (USAEC, 1973).

The EPA established a program in 1972 to monitor radionuclide levels in surface water and groundwater in the area potentially affected by the Project Gnome activities. Included in the program are several USGS wells, municipal water supplies for Carlsbad and Loving, New Mexico, and the Pecos River. Other wells in the area show radionuclide levels consistent with normal background activity. Results are published in EPA's "Off-Site Environmental Monitoring Reports for Nuclear Test Areas Around the United States" (EPA, 1984 and 1985c). An aerial radiological survey of the area in 1981 indicated that the AEC's post-shot decontamination efforts had reduced radioactivity (DOE, 1981b).

In 1988, an additional aerial gamma survey was conducted (AMO-8809). A machine-aided search of the data for man-made radiation sources indicated the presence of Cs-137 at the Gnome Site, which was expected from previous work done in the area. No other sources of man-made radiation were found.

5.3 RADIOLOGICAL ENVIRONMENTAL MONITORING

The environmental surveillance program will continue to measure, with some modifications, the preoperational program and parameters monitored during the RBP and Ecological Monitoring Program. Each sampling subprogram of the EMP is described below.

5.3.1 Effluent Monitoring - Liquid Releases

The Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T) requires that monitoring of liquid waste effluent streams be adequate to demonstrate compliance with dose limits in DOE Order 5400.5, Radiation Protection of the Public and the Environment. Liquid effluent monitoring is also required to quantify radionuclides released and to alert operators of process inconsistences and malfunction of emission controls.

The only credible source of waste-generated liquid contamination at the WIPP is the WHB. There is no direct connection between the WHB and the sewage treatment system; therefore, there is no direct pathway for radioactive or hazardous contaminants associated with the TRU wastes to enter the WIPP sewage treatment system. There is a sump in the WHB that collects liquids from throughout the WHB. Should there ever be any liquid accumulation in the drains or sump as a result of stored TRU mixed waste leaking or fire-suppression water collection, the water in the sump will be sampled and analyzed for contamination as shown in Table 5-2. The following would then be performed in order to assure proper management of the waste:

- If the fire water is radioactive, it will be assumed to be TRU mixed waste and will be managed as derived waste. Solidification will occur as the water is transferred to the derived waste drum. Characterization will be in accordance with the Resource, Conservation, and Recovery Act Part B Permit Application.

- If the fire water is nonradioactive, a determination will be made if the water is hazardous waste. The determination will include sampling and analysis. Any waste determined to be nonradioactive hazardous waste will be managed in accordance with WIPP facility procedures for such waste.

- If the fire water is nonhazardous, as described in the New Mexico Environment Department (NMED) Discharge Plan for the WIPP (DP-831), it will be discharged to the WIPP facility sewage lagoon.

If the sump contents are radioactive or hazardous, or both, the WIPP will use a qualified contractor to remove and solidify the contents of the sump.

The WIPP sewage treatment system is a zero discharge facility made up of parallel synthetically lined settling and polishing cells that gravity flows treated effluent into a chlorination system, and then flows through lined evaporation ponds. The facility is designed to accommodate normal sewage effluent and to provide for disposal of nonhazardous brine waters.

Although the sewage treatment facility is a zero discharge facility, when it was expanded in 1993 the NMED required that a Discharge Plan be prepared which would stipulate monitoring requirements for water quality, and effluent volume. WP 02-EM1001, "Sewage Discharge Monitoring" incorporates the requirements of the Discharge Plan. Sewage system effluent water samples are collected quarterly from the primary settling ponds and evaporation ponds. Samples are analyzed for Nitrates (NO_3), Total Kjeldahl Nitrogen (TKN), Total Dissolved Solids (TDS), and Radium 226 and 228.

The volume of site generated and Water Quality Sampling Program brine waters are pumped into the evaporation basin. Brine waters discharged into the sewage evaporation basin result from observation well pumping around the WIPP site. The drinking water supplied to the WIPP is also sampled annually to monitor differences between the influent and effluent.

The WIPP conducts oversight sampling twice annually for nitrates, TKN, ammonia, total metals, dissolved metals, biological oxygen demand, chemical oxygen demand, cyanide, total organic compounds, oil/grease, phenols, pesticides, semi-volatiles, volatiles, pH, hexavalent chromium, total suspended solids, and total dissolved solids. The EMP radiological sampling is completed annually for specific radionuclides (constituents are listed in Table 5-2).

The level of sludges accumulating in the sewage system are monitored by WID operations as part of routine maintenance. If sludges accumulate in the sewage lagoon to a level that could impact facility storage capacity, representative samples of the solids will be collected and analyzed for

the parameters defined in 40 CFR 503, "Standards for the use of Disposal of Sewage Sludge." Based on the analytical results, the sludge will be handled and disposed in accordance with 40 CFR Part 503.

5.3.2 Effluent Monitoring - Airborne Emissions

Airborne effluent monitoring is especially important to the WIPP EMP. There are two potential sources of contaminated airborne emissions from the WIPP operations: releases generated above ground in WHB operations, and those generated underground which are released through the Exhaust Shaft (Figure 5-1). As recommended by DOE/EH-0173T both potential sources are sampled as appropriate.

Two effluent monitoring stations, A and B, sample exhaust from the underground operations. Sample extraction probes sample the unfiltered exhaust stream in the Exhaust Shaft (Station A), the filtered exhaust down stream of the Exhaust Filter Building (Station B), and the filtered exhaust of the Waste Handling Building (Station C). The filtered exhaust passes through HEPA filter banks prior to reaching the sample extraction probes at Stations B and C.

Because significant concentrations of salt dust are potentially present in the airstream at Station A, standard isokinetic sampling probes have been demonstrated to be ineffective. Therefore, an anisokinetic, shrouded probe system has been designed, developed and tested specifically for use at the WIPP. The Station A sampling array is composed of the anisokinetic shrouded probe, a flow controlling device, and a sample-collection filter. Station B, in the Exhaust Filter Building, is configured similarly. The exhaust air from the WHB is continuously routed through two stages of HEPA filters. After the air is filtered, it is sampled with an isokinetic sampling array connected to a flow-control and sampling system as at Stations A and B.

After Transuranic waste is received at the WIPP, filters (samples) from the systems at Stations A, B, and C will be collected each working day, and counted for gross alpha and gross beta activity, after a 72-hour period to allow for the decay of radon progeny. Selected effluent air samples will be analyzed for specific radionuclides on site (Table 5-2) or at an off-site lab if significant gross alpha or beta activity is indicated.

Gross alpha and beta counting are performed in gas-flow proportional counters. These counters provide a Minimum Detectable Activity level of 1 E^{-14} μCi/ml for a ten-minute count. If a sample is counted and activity is recorded equal to, or less than 2 E^{-13} μCi/ml alpha, or 2 E^{-10} μCi/ml beta, the sample is classified as nonradioactive.

Quality assurance in this process is rigorous and extensive. The components of quality assurance are described in the document DOE/WIPP 93-042, Final Quality Assurance Project Plan for Sampling Emissions of Radionuclides to the Ambient Air at the Waste Isolation Pilot Plant.

5.3.3 External Radiation

Thermoluminescent Dosimetry

Environmental dosimetry was conducted at the WIPP site beginning in 1976 and concluding in 1990. From 1985 (when the WIPP initiated the Radiological Baseline Program) until 1990 the WIPP employed a network of 44 TLDs located in two rings encompassing the WIPP site, at local points of interest, and in neighboring communities. These TLDs were used to measure penetrating radiation levels, and were processed on a quarterly basis to support the RBP.

Originally, it was intended that the program be continued through the operational period of the WIPP. However, in 1990 a decision was made to discontinue the environmental dosimetry program. The rationale for this decision was based on an internal study and a University of

Michigan study performed for the Environmental Evaluation Group in 1987. Both studies concluded that the WIPP Environmental Dosimetry Program could be discontinued since: 1) Environmental dosimetry is used to quantify levels of external penetrating radiation (i.e., gamma ray or x-ray sources). The TRU wastes that will be accepted at the WIPP are primarily alpha emitters, therefore environmental dosimetry would not be expected to be a very good indicator of offsite impacts. 2) The effluent sampling program and offsite airborne particulate sampling program are much more sensitive than an environmental dosimetry program for assessing potential offsite impacts of postulated releases from the WIPP.

There are no plans to reinitiate environmental dosimetry at the WIPP.

Continuous Exposure Rate Measurements

DOE/EH-0173T recommends:

> "For the monitoring of intermittent or unplanned releases, and for better identification of source terms, exposure-rate instrumentation should be available. . . . The deployment of at least one continuously-recording exposure-rate instrument is recommended, preferably near the site boundary, in the expected direction of a plume. Effluent monitors should provide detection and approximate magnitude of sudden changes in ambient radiation levels."

A High Pressure Ionization Chamber (HPIC) was established at the northwest corner of zone 1 in 1985. In 1988 the HPIC was moved to the WIPP Far Field site. The Far Field site is the primary environmental monitoring location for the WIPP releases. The HPIC provides a detection range of 1 μR/h to 100 μR/h.

5.3.4 Airborne Particulates

The WIPP SEIS identifies the atmospheric pathway as the most credible exposure pathway to man from the WIPP. Therefore, airborne particulate sampling for alpha-emitting radionuclides is emphasized in the EMP. Air sampling results are used to trend environmental radiological levels and determine if there has been a deviation from established background radiological levels. The inhalation of airborne radionuclides, either directly from the source (facility) or from resuspension following deposition, may result in their absorption from the lung, the gastro-intestinal tract, or the skin. Absorption and subsequent distribution in the human body depends on the particle size and the chemical state of the radionuclide. DOE/EH-0173T and DOE/EP-0023 provide guidance on deployment, operations, and program management of an airborne particulate monitoring program.

DOE/EH-0173T recommends that:

> "Air sampling locations should be selected to represent radionuclide concentrations breathed by the population surrounding the nuclear facility. Selection of background sampling and measurement locations for air must be made with special care. For measurements to be compared with the effects of airborne releases, a minimum distance of 15 to 20 km from the larger sites and 10 to 15 km from the smaller sites in the least prevalent wind direction is suggested for background sampling.
>
> Off-site air samplers should be employed at each DOE site having potential airborne releases that could result in an annual effective dose equivalent greater than 1 mrem to the maximally exposed individual. Sample locations should include the

following: a background or control location; locations of maximum predicted ground-level concentration from stack (or vent) releases, averaged over a period of 1 year where members of the public reside or abide; and locations in the nearest community within a 15-km radius of the site.

The exact number of samplers will be determined by meteorology, demography, and the magnitude of projected doses to the surrounding population. Unless documented site-specific evidence exists to justify otherwise, the sample(s) at each air sampling station should be collected at a height of 2 m above ground level (approximately the height of inhalation for adults), in a location free from unusual localized effects or other conditions (e.g., in proximity to a large building, vehicular traffic, or trees) that could result in artificially high or low concentrations. Locations should be selected to avoid areas where large-particle (nonrespirable) fugitive dusts can dominate the sample (Ludwig 1976)."

A method similar to th: developed (Waite 1973b) and evaluated by Waite (1973a) was used to determine the number of air sampling stations and their placement. Waite's method entails examining demographic and meteorologic data for the site to determine the distance to local population centers, their population, and the wind frequency distribution and weighing factors that are scaled to equal the desired number of sampling locations.

Continuous Low volume (two cubic feet per minute) fixed air samplers (Lo-Vols) are used to collect airborne particulates. As recommended in DOE/EH-0173T, the samplers are, where possible, located approximately 2 meters (6.5 feet) above ground level in sites free from unusual micrometeorological or other conditions (e.g., proximity of large buildings, vehicular traffic) that could result in air concentration measurements that are artificially high or low. The Carlsbad and Eunice stations are currently located on top of municipal buildings, primarily to provide greater equipment security.

The current Lo-Vol sampling array (Figure 5-2) consists of eight sampling stations, the locations of which are based primarily on meteorological and demographic considerations and the need to provide as much continuity as possible between baseline and operational data. Lo-Vol samplers are at Carlsbad, Eunice, Smith Ranch, Mills Ranch, WIPP South, WIPP East, and the WIPP Far Field sites. The original WIPP northwest location was discontinued due to its location being in a high vehicular traffic area. This location received heavy filter loading from dusts being resuspended by the traffic. As recommended in DOE/EH-0173T, a sampling station was added to incorporate a control site in the predominant upwind direction of the WIPP (the southeast control location approximately 12 miles southeast of the WIPP).

Lo-Vol filters are exchanged weekly, weighed to calculate total suspended particulates and individually counted for gross alpha and beta activity levels. Quarterly composites of filters from each location undergo specific radionuclide analysis in accordance with Table 5-2. Analyses are performed by a qualified contract laboratory.

Modifications have been proposed to the airborne emissions monitoring program. These changes would include incorporating a ring of High volume air samplers around the WIPP site, and increasing the number of samplers used in the program. An environmental health physicist was recently contracted to conduct a study of the potential benefits of these program modifications, both for environmental monitoring and dose assessment, and to point out suitable locations for the new air samplers. This study should be completed and a determination made based on study recommendations by the end of 1994. Any changes to the air sampling program will be documented and approved in the EMP.

5.3.5 Vegetation

Collection and analysis of vegetation samples serves three useful purposes: evaluating the potential radiation doses received by people consuming such vegetation; predicting the possible concentrations in meat, eggs, and milk from animals consuming contaminated forage (and resultant radiation doses to consumers of the animal products); and monitoring trends in environmental contamination and possible long-term accumulation of radionuclides.

EMP vegetation samples are collected from the permanent locations shown in Figure 5-3. In addition, if vegetable gardens are grown at the Smith and/or Mills Ranches, a leafy vegetable sample may be collected annually, and analyzed as specified in Table 5-2. Each sample will be collected as specified in the Environmental Procedures Manual (WP 02-3). Sufficient material will be collected to meet the needs of the analytical laboratory. The sample will be analyzed for the specific radionuclides indicated in Table 5-2.

5.3.6 Beef

The WIPP SEIS indicates beef is not a significant pathway at the WIPP facility. Samples of meats are not good indicator materials because of the time delay for transfer of radionuclides from the point of release through vegetation to beef, pork, and poultry. Therefore, frequent sampling of meat is normally required only when it is necessary to evaluate the radiation doses received via this foodstuff. With a few exceptions, radiation doses from ingestion of radionuclides are a measure of secondary importance.

Annual muscle samples are taken from locally grown beef, preferably from one animal that has been grazed northwest of the WIPP site and from one animal grazed at a control station. Since beef is not a significant pathway, the samples are collected only if they are readily available. The samples will be analyzed as indicated in Table 5-2.

5.3.7 Game Animals

As previously stated, muscle tissue is not a significant exposure pathway. However, DOE/EH-0173T indicates that game birds and mammals hunted locally should be sampled during the hunting season in the vicinity (within 25 km) of the site.

Rabbits and quail are collected annually. Quail are trapped at the facility, while rabbits are collected when found on roads in the WIPP site vicinity. A composite sample of muscle tissue from each type of animal is analyzed as shown in Table 5-2. Tissue samples acquired are provided to the state for independent analysis.

5.3.8 Soil Sampling

EMP surface soil samples are collected annually from the six locations shown in Figure 5-4. Sampling sites are co-located at air particulate sampling locations as recommended in HASL-300 and DOE/EH-0173T. The frequency of sampling also follows the guidance contained in DOE/EH-0173T for obtaining long-term accumulation trends. Samples are collected at each site at depths of 2 to 5 cm and 5 to 10 cm. Samples are collected as described in the Environmental Procedures Manual (WP 02-3), and analyzed as indicated in Table 5-2.

5.3.9 Surface/Drinking Water

Surface water is absent within the WIPP site. The EMP surface water samples are collected annually from the 12 locations in the WIPP vicinity specified in Figure 5-5. These locations comprise the major bodies of surface water in the WIPP vicinity and provide adequate data

concerning the surface water pathway. Analyses are performed as specified in Table 5-2. The practice of long-term storage of replicate water samples as was done for the RBP will no longer be conducted, in accordance with procedures recommended by EPA (1986b).

Drinking water is collected through "end of pipe" sampling from the WIPP water line which brings fresh water to the site. The drinking water is sampled annually and analyzed for constituents in Table 5-2.

5.3.10 Groundwater

DOE 5400.1 requires that groundwater that may potentially be affected by DOE operations be monitored to detect and document the effects of such operations on groundwater quality and quantity and to show compliance with applicable Federal and State laws and regulations. The groundwater monitoring programs should be conducted on-site and in the vicinity of DOE facilities to:

- Obtain data to determine baseline conditions of groundwater quality and quantity;
- Demonstrate compliance with and implementation of all applicable regulations and DOE Orders;
- Provide data for the early detection of groundwater pollution or contamination;
- Identify existing and potential groundwater contamination sources and to maintain surveillance of these sources; and
- Provide data upon which decisions can be made concerning land disposal practices and the management of groundwater resources.

The WIPP Groundwater Surveillance Program supports Performance Assessment and the EMP. The Groundwater Surveillance Program consists of two subprograms, the Groundwater Level Monitoring Program and the Water Quality Sampling Program. The protocols specified in the Groundwater Monitoring Program Plan and Procedures Manual (WP 02-1) are followed in collecting water samples from existing wells around the WIPP site. Eight groundwater samples are collected each year from the Culebra dolomite. Samples taken from the Culebra dolomite are analyzed for chemical and physical parameters, as well as specific radionuclides (Table 5-2).

Groundwater has been sampled and analyzed at the WIPP site since 1985. In 1991 the number of wells monitored was reduced to 10, and in 1994 the number of wells was further reduced to 8, eliminating those wells not within the WIPP sixteen sections (with the exception of the H-4 well which is just outside the WIPP boundary). The area between the waste storage horizon boundary and the Dewey Lake Redbeds, where the monitoring was discontinued, does not contain a continuous zone of saturation.

It is currently being proposed that the existing monitoring wells be replaced with six new wells equipped with fiberglass casings (fully grouted) and well screens (refined silica gravel packed). The monitoring wells now in use at the WIPP pose some problems to obtaining quality data.
These monitoring wells, the majority of which are over 13 years old, were designed and drilled for the short term characterization of the Rustler Formation, and were not intended for use in a water quality surveillance program extending throughout the life of the WIPP. The existing wells utilize mild steel casings. Since the formation waters are corrosive in nature, they react with the well casings which results in artificially high iron readings in chemical analyses. Furthermore, most of the completions in the monitored formations are either perforations in the casings or open hole. Many existing wells that have perforated openings are beginning to close due corrosion or bacterial

growth, and the wells with open holes are beginning to collapse below the casing. Although these wells are not rendered useless, their efficiency is very limited. Continued use of the existing wells will result in increased equipment replacement and maintenance costs, and gaps in test data.

Since discontinuance of groundwater sampling is not an option due to site commitments, replacement of the existing monitoring seems the only viable option. Fiberglass construction will enhance the quality of the groundwater data collected, and provide a monitoring well life expectancy of 35 to 40 years. Contingent upon funding, new well construction should begin in May 1994. Specific locations for the new monitoring wells will be provided in the EMP.

5.3.11 Aquatic Foodstuffs

Fish are analyzed to quantify the dietary radionuclide intake by humans, and secondarily, as indicators of radioactivity in the ecosystem. In fresh water the principal nuclides to be expected in fish or shellfish (in addition to the naturally occurring K-40 and U-nat) include ^{3}H, ^{137}Cs, and ^{90}Sr, although any nuclide present in the water will be present in the fish.

Although aquatic foodstuffs are not considered a significant pathway from the WIPP operations, catfish are collected annually from the Pecos River near Carlsbad and from a control location at Brantley Lake which is located on the Pecos River between Artesia and Carlsbad, New Mexico. The samples are composited and analyzed for gross alpha and beta activity and the specific radionuclides indicated in Table 5-2. Catfish are appropriate for analysis in this program because they dwell and feed in bottom sediments where transuranic radionuclides may accumulate. Again, replicate samples are available for analysis to the NMED.

5.3.12 Sediment Sampling

Sediment samples are collected annually from Hill and Indian tanks and on the Pecos River near Artesia and Malaga, New Mexico (Figure 5-7). The Hill and Indian tanks primarily collect sediments from large surface drainage areas, whereas the river collection locations are monitored to detect changes in the Pecos river drainage. Sediments will also be collected from the sewage lagoon outfall when sediment buildup is sufficient to sample. Data results will be presented in the ASER.

5.4 NONRADIOLOGICAL ENVIRONMENTAL MONITORING

Nonradiological environmental monitoring activities at the WIPP consist of a comprehensive set of sampling programs designed to detect and quantify impacts of construction and operational activities, and surface storage of salt on the local ecosystem. The requirements and objectives of both preoperational and operational nonradiological environmental monitoring are described in the WIPP FEIS (DOE, 1980). The ecological monitoring program functions as an "operational program" prior to waste emplacement, because it focuses on nonradiological effects which are ongoing.

Section 2.5 of Appendix J of the FEIS states:

> "The operational ecological monitoring program, building on the foundation established through preoperational ecological monitoring, will document the ecological effects of construction and operation . . . and will focus primarily on indicator organisms and selected abiotic parameters."

Primary guidance for ecological monitoring was derived from the WIPP FEIS and the American Institute of Biological Scientists (AIBS) evaluation of the WIPP Biology Program.

Projected construction impacts on the ecosystem include the deposition of fugitive dust generated by the handling of materials such as salt, caliche, and topsoil at the site, as well as noise and other unnatural conditions associated with human activities at the site (Figure 5-8). A detailed

description of the rationale and sampling strategy for the ecological studies appears in the first semiannual Ecological Monitoring Program Report (Reith et al., 1985). Table 5-2 lists parameters which will be monitored by the EMP for evidence of possible site impacts. Results of these studies are published in the ASER.

5.4.1 Meteorological Monitoring

The DOE/EH-0173T guidance manual lists guidance for each DOE site to establish a meteorological monitoring program appropriate for the activities at the site and the local topography and demography. Weather data must be monitored and recorded to supplement characterization of the local environment and facilitate the interpretation of data from other environmental monitoring activities at the WIPP.

Meteorological conditions were monitored by SNL at the WIPP from 1975 through 1980. Between 1984 and 1988, temperature, wind speed, and wind direction were continuously monitored from a 10-meter (33 feet) tower at the northwest corner of Zone I. Equipment to monitor precipitation and barometric pressure were added to this station during that period.

Use of the 10-meter (33 feet) tower as the primary meteorological monitoring station was discontinued in 1988, and the 10-meter station was relocated to the WIPP Far Field sampling location along with the air quality monitoring station and the Reuter-Stokes pressurized ionization chamber. The WIPP Far Field site is in the predominantly downwind direction from the WIPP exhaust releases and is the principal air quality sampling location for the EMP.

The primary meteorological monitoring station, is a 40-meter (132 feet) tower located northeast of the WIPP as shown in Figure 5-1. Temperature, wind speed, and wind direction are monitored at 3, 10, and 40 meters (10, 33, and 132 feet). Barometric pressure, dew point, and precipitation are also monitored at this location. Measurements are recorded at the Central Monitoring Station (CMS), which tracks numerous real-time parameters on a centralized computer system.

The meteorological data as well as supplementing characterization of the local environment is applied to the CAP-88 program to perform radiological dose assessments in the event of a radiological release from the WIPP site.

5.4.2 Volatile Organic Compound Monitoring Program

The Volatile Organic Compound (VOC) Monitoring Program was established at the WIPP as required by the EPA. The EPA defined the requirements for the program published in the Federal Register, Volume 55, No. 220 (November 14, 1990), "Conditional No-Migration Determination (NMD) for the WIPP". The DOE's decision to cancel the Bin-Scale and Alcove Test Phase activities has resulted in amending the VOC Monitoring Program's objectives.

In support of the Accelerated Waste Disposal Decision, the Volatile Organic Compound (VOC) Monitoring Program will redefine the Disposal Phase VOC Monitoring system criteria based on baseline field and analytical VOC data. The criteria will consist of precision, accuracy, system recovery, method detection limits, cleaning/certification criteria which will be required in performing the design, testing, manufacturing, and installation of Disposal Phase VOC Monitoring stations. A minimum of one year data is needed to measure background VOC concentration variances.

REGULATORY REQUIREMENTS

The EPA has determined that air migration at the WIPP would be a potential concern during both testing and operations at the facility. Federal Register, Volume 55, No. 67 (April 1990), requires a no-migration variance be obtained before mixed waste could be placed in the WIPP for purposes

other than testing or experimentation. No-Migration Variance for Disposal Phase and/or operations demonstration would take place according to the full variance approval procedures of 40 CFR 268.6(g).

EPA further stated in the Federal Register, Volume 55, No. 220 (November 1990), that the results of the test phase monitoring will be critical for the Agency's review of the Disposal Phase No-Migration Variance petition. The needed results are not available due to the cancellation of the Bin-scale and Alcove tests. The WIPP plans to submit a petition for Disposal Phase No-Migration Variance in early 1995. Preliminary design and testing of disposal phase VOC monitoring will be needed for the petition. Surface and underground VOC baseline data will be required to determine system criteria which would otherwise not be obtained and available for use in the preparation of the petition.

VOC MONITORING PLAN

As part of the initial No-Migration Variance Petition (NMVP) for Test Phase, the DOE submitted a VOC Monitoring Plan for the WIPP (January 1990). This program is intended to fulfill the monitoring requirements of 40 CFR 268.6.

Five VOC sampling stations were installed for Test Phase at the WIPP facility. Four of the locations are designated to be air monitoring stations which use commercially available portable VOC sampling equipment. The fifth one is designated to be a source monitoring station. The four air monitoring stations are defined as follows:

- Station VOC-1 is located at Station A near the top of the exhaust shaft
- Station VOC-2 is located on the surface near the air intake shaft
- Station VOC-8 is located in the Panel 1 ventilation air intake passageway
- Station VOC-9 is located in the Panel 1 ventilation air outlet passageway

Station VOC-10 is located in Room 1 of Panel 1, and is designated as a source monitoring station. The sampler deployed at station VOC-10 directly monitored gas released from the bins included in the bin-scale experiments. However, due to the cancellation of the Bin-Scale test this station is abandoned in place and deactivated.

With the exceptions of stations VOC-9 and VOC-10, existing instrumentation at VOC-1 (exhaust shaft), VOC-2 (air intake shaft), and VOC-8 (underground) are being used for this baseline monitoring. Results of VOC-1 will be used to define baseline concentrations at the top of the exhaust shaft. Data obtained at VOC-2 will be used to define ambient VOC concentrations. Operation of the VOC-8 station will provide baseline data for the underground.

VOC sampling and analysis are performed at the WIPP using guidance in the EPA Compendium Method TO-14, "Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Summa® Passivated Canister Sampling and Gas Chromatographic Analysis", as a basis. The VOC samplers are operated by the WIPP facility personnel, and sample analyses performed by a contract laboratory. Laboratory analyses are designed to routinely quantify five VOC target compounds:

- Carbon tetrachloride
- Methylene chloride
- Trichloroethylene (TCE)
- 1,1,1-Trichloroethane (TCA)
- 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)

Once every other week, six-liter SUMMA® passivated stainless-steel canisters are used to collect an integrated sample at all locations over a 24-hour sample period. In addition, field quality assurance samples (duplicates, matrix spike and matrix duplicates) are collected and analyzed at a frequency of twenty percent at each monitoring station.

The VOCs in the air sample are separated by gas chromatography and quantified and quantitated by mass spectroscopy. The limits of detection of the methods are less than 1 ppbv, so extremely low concentrations can be quantified.

The VOC Monitoring program will continue baseline monitoring throughout the duration of 1994 calendar year. Design, installation, testing, procedure development, and personnel training/qualification for Disposal Phase VOC Monitoring stations will be completed prior to Disposal Phase readiness review.

To date, as required by the Conditional No-Migration Determination for the WIPP, the following three annual reports have been submitted to the EPA: DOE/WIPP 93-062, No-Migration Determination Annual Report for the Period September 1992 through August 1993; DOE/WIPP 92-057, No-Migration Determination Annual Report for the Period October 1991 through August 1992; and DOE/WIPP 91-059, No-Migration Determination Annual Report for the period of November 1990 through September 1991.

5.4.3 Airborne Gases

The decision to initiate the WIPP facility requires that air quality parameters, which may be influenced by construction and the WIPP operations, be monitored in the preoperational and the operational environmental programs. Total suspended particulates, carbon monoxide, hydrogen sulfide, sulfur dioxide, ozone, and nitrogen oxides are to be monitored at the WIPP. These gases are monitored at the WIPP site using ambient gas monitoring instruments. Data are logged in 15-minute, hourly, and daily averages.

5.4.4 Ecological Monitoring Plot Selection

Sampling for the nonradiological environmental portions of the EMP focus on components of the ecosystem immediately surrounding the site and on the ecological parameters most likely to reflect the impact of construction and operational activities (see Section 3.5 for a discussion of the ecosystem at the WIPP). Sampling activities are performed at seven permanently marked ecological monitoring plots whose locations are unchanged from the preoperational EMP. An identification sign located at the center of each plot serves as a permanent reference for the selection of sampling locations. Each plot is approximately 150 meters (492 feet) by 150 meters (492 feet), although the size of some plots are slightly restricted by roads and other barriers.

Ecological monitoring plots have been located with several criteria in mind:

- Some plots are in areas not directly disturbed by construction, but where the probability and extent of ecological impacts is greatest;
- Controls have been cited where potential impacts from the site are small or negligible; and
- Comparability among the plots has been maximized by situating them where soil, vegetation, and general appearance are judged to be as similar as possible.

Figure 5-9 illustrates the location of the permanent ecological monitoring plots. The plots likely to be impacted by site activities are Southeast 1 (SE1), Northwest 1 (NW1), and East 1 (E1). These three plots are adjacent to the two stockpiles where excavated salt is stored. NW1 is downwind

from the facility and the active salt pile according to the prevailing winds, that blow from the southeast. Westerly winds tend to blow during the spring, and can be strong and persistent. During the spring westerlies, E1 is downwind of the site and the active storage pile. SE1 is adjacent to the smaller salt pile, but is outside the path of either primary or secondary wind directions.

Both SE1 and NW1 have counterparts (SE2 and NW2 respectively) located approximately 150 meters (492 feet) farther from the site and the salt piles to help determine the range of any ecological impacts. Finally, Control 1 (CT1) and Control 2 (CT2) are located more than two kilometers (1.2 miles) from the center of the WIPP activities. These are believed to be sufficiently distanced from the facility to minimize exposure, and be an effective "control" site to evaluate and compare ecological impacts.

5.4.5 Aerial Photography

The most conspicuous and readily documented impacts of the WIPP on the local ecology occur because of the removal of native habitat due to construction of roads, parking lots, buildings, and salt storage piles. The extent of this habitat replacement is documented in aerial photographs. These photographs are taken annually.

Aerial photographic missions produce color stereo-pair photographs for stereoscopic examination as well as enlarged "spot photos" of the WIPP installation. The large-negative spot photographs are enlarged in both color and black and white, and used for planimetric and/or dot-matrix evaluation of the displacement of native habitat by the WIPP facilities. Project personnel and local emergency response agencies are also provided with spot photos for their own use. Selected key locations are temporarily flagged with conspicuous plastic sheeting to facilitate their recognition on the aerial photographs. Mission parameters may be altered as necessary to investigate phenomena of special interest.

5.4.6 Salt Impact Studies

The surface photography, soil chemistry, vegetation sampling, and vertebrate census subprograms make up the salt-impact studies of the ecological monitoring activities. The salt-impact studies define salt impacts on the living components of the ecosystem. A summary report of the EMP salt-impact studies and resulting data has been prepared and is entitled, Summary of the Salt Impact Studies at the WIPP, 1984 to 1990 (DOE/WIPP 92-038). This report indicated that there have been no significant salt-related impacts to the surrounding environment. Therefore, the soil sampling frequency has been reduced from quarterly to annually. The continuance of each segment of the salt-impact studies will be evaluated on a year-to-year basis. Any further changes to these studies will be reviewed and approved in the EMP.

5.4.6.1 Surface Photography

Surface photography is used to monitor visually detectable impacts of the facility on the landscape and provides a long-term chronological record of those impacts. Oblique (taken at a height of about five feet above ground level) photographs are taken annually at each ecological monitoring plot (see Figure 5-9), as recommended by the AIBS in their 1980 evaluation of the WIPP Biology Program. Environmental photography activities are conducted in accordance with the Nonradiological Environmental Surveillance (NES) Procedure WP 02-340, Environmental Photography. Photographs are taken from the central sign post in each of eight directions (N, NE, E, SE, S, SW, W, NW). Each exposure centers on a permanent marker installed five meters away from the central sign to ensure comparability among photos from one season to the next. Each photograph is identified for plot, direction, and date. A 24-mm wide-angle lens is used to ensure photo overlap, and a color chart on the permanent marker provides seasonal comparability.

5.4.6.2 Soil Chemistry

The goal of the soil subprogram is to monitor for changes in properties of the sandy dune soil around the WIPP site using the Ecological Monitoring plots shown in Figure 5-9. Of significant interest are changes in salt-related parameters such as electrical conductivity, pH, and ion concentrations. These are indicators of salt transport from initial storage areas to surrounding soils. Sampling activities are conducted according to WP 02-336, the NES Soil Sampling Procedure. Sample analyses are performed by a laboratory using standard EPA-approved analytical methods.

5.4.6.3 Vegetation Survey

The deposition of salt on vegetation or soil may affect plant and soil chemistry to the extent that normal biological processes are inhibited. For example, elevated levels of soluble salt in the soil can osmotically inhibit the germination and growth of seedlings. These changes in chemistry and osmotic potential may affect the soil microbial community which in turn affects decomposition and nutrient flow within the ecosystem. The FEIS (DOE, 1980) predicts these impacts may be present, but minor based on observations of salt piles at local potash mines and at the nearby Project Gnome Site where Salado salt was excavated prior to an underground nuclear test.

The vegetation within each of the permanent monitoring plots (Figure 5-9) is surveyed annually to detect possible impacts of salt transport and the resultant changes in soil chemistry on extant vascular plants. Although measurement of vegetation parameters is not as sensitive an indicator of salt deposition as the direct measurement of ion concentrations in the soil, the importance of vegetation as a soil stabilizer and wildlife habitat requires that it be monitored closely for trends which may develop as the result of salt impacts.

The vegetation parameters measured in each plot include foliar cover for all species, density of annual species, species richness, and the structure of the vegetative community. The NES Vegetation Sampling Procedure (WP 02-337) and the Plant Specimen Collection and Herbarium Management Procedure (WP 02-346) define the survey activities. Changes in community structure are documented by means of the fixed-location comparative photographs. Field data is compiled and averaged for each species in each plot.

5.4.6.4 Vertebrate Census

Birds and mammals comprise the upper levels of the food chain in the natural ecosystem around the WIPP. These organisms may be impacted by noise and human presence as well as by changes in habitat structure due to salt impacts. Population densities are monitored annually to define normal cycles of abundance and to detect major changes in populations or communities which may be due to activities at the WIPP facility.

The FEIS (DOE, 1980) suggests that local animal populations may be affected by activities in addition to the destruction of a small portion of their natural habitat. Some species may be frightened or otherwise repulsed by the noise and light generated by the project and by associated vehicular traffic. Other animal species exploit man-made structures and may invade the environment around the WIPP. Some of the above impacts (e.g., habitat removal) were projected with relative certainty by the FEIS; others (e.g., salt effects) were projected tentatively in terms of likelihood and severity.

Selected wildlife populations are surveyed annually to determine the effects of the WIPP construction activities and consequent habitat modifications on natural populations of wildlife species. Survey methods are based on standard techniques such as described by Emlen (1971) for birds and Hayne (1949) for mammals. Wildlife species are generally more dispersed than the other populations monitored in the EMP, necessitating the use of survey techniques that sample larger areas than encompassed by the ecological monitoring plots. Therefore, the wildlife surveys are

performed in association with the established monitoring plots, but are not necessarily contained within them. Field activities are detailed in the WIPP Procedures WP 02-362 (NES Bird Census) and WP 02-363 (NES Small Mammal Census).

Results of the Emlen transects (breeding bird densities) are calculated separately for each bird species. Breeding densities of birds are reported for each species in the ASER.

Currently the small mammal studies have been discontinued due to the outbreak of the deadly Hanta virus. This virus has been recently found in deer mice, pinon mice, chipmunks, woodrats, and the common house mouse. Since the mammal studies require the trapping and tagging of several of the above rodents, personnel will be trained to properly handle potentially infected rodents prior to resuming these studies.

TABLE 5-1

EMP SAMPLING SCHEDULE

TYPE OF SAMPLE	SAMPLING LOCATIONS	SAMPLING FREQUENCY
Liquid Influent	1	Annual
Liquid Effluent		
DP-831	1	Quarterly
WIPP Oversight	1	Biannual
Airborne Effluent	3	Continuous
Meteorology	2	Continuous
Exposure Rate Meter	1	Continuous
Atmospheric Particulate	8	Weekly
Air Quality	1	Continuous
Vegetation	4	Annual
Beef	WIPP Vicinity	Annual
Game Birds	WIPP Vicinity	Annual
Rabbits	WIPP Vicinity	Annual
Soil	6	Annual
Surface Water	12	Annual
Groundwater	8	Annual
Fish	2	Annual
Sediment	4	Annual
Aerial Photography	Site Wide	Annual
Salt Impact Studies		
Surface Photography	7	Annual
Soil Chemistry	7	Annual
Vegetation Survey	7	Annual
Ambient Air (to quantify VOCs)	3	Biweekly

TABLE 5-2
EMP ANALYTICAL ARRAY

TYPE OF SAMPLE	ANALYSIS
Liquid Influent	(1) Specific Radionuclides
Liquid Effluent	(1) Specific Radionuclides
DP-831	(3) DP-831 Constituents
WIPP Oversight	(4) Oversight Constituents
Airborne Effluent (Stations A, B, and C)	Gross α, Gross β, ^{238}Pu, ^{239}Pu, ^{241}Am
Meteorology	Temperature, Wind Speed, Wind Direction, Precipitation, Dew Point, Barometric Pressure
Thermoluminescent Dosimeters	Penetrating Radiation
Exposure Rate Meter	Penetrating Radiation
Atmospheric Particulate	Gross α, Gross β, Total Suspended Particulates (TSP), (2) Specific Radionuclides
Air Quality	O_3, CO, H_2S, SO_2, NO_x
Vegetation	(1) Specific Radionuclides
Beef/Deer	(1) Specific Radionuclides
Game Birds	(1) Specific Radionuclides
Rabbits	(1) Specific Radionuclides
Soil	(1) Specific Radionuclides
Surface Water	(1) Specific Radionuclides
Sediment	(1) Specific Radionuclides
Groundwater	(1) Specific Radionuclides, (5) Chemical Analysis, (6) [illegible]ical Properties
Fish	(1) Specific Radionuclides
Aerial Photography	Area of Land Disturbed

TABLE 5-2

EMP ANALYTICAL ARRAY
(continued)

TYPE OF SAMPLE	ANALYSIS
Salt Impact Study	
Surface Photography	Visual Impacts
Soil Chemistry	pH
Vegetation Survey	Foliar Coverage, Species Richness, Annual Plant Density
Wildlife Survey	Bird Population Densities

BOD5 = Biochemical Oxygen Demand (5 days)
COD = Chemical Oxygen Demand
TDS = Total Dissolved Solids
TOC = Total Organic Compounds
TKN = Total Kjeldahl Nitrogen
TSP = Total Suspended Particulates
TSS = Total Suspended Solids

(1) Specific Radionuclides: ^{241}Am, ^{60}Co, ^{137}Cs, ^{40}K, ^{210}Pb, ^{210}Po, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{226}Ra, ^{228}Ra, ^{90}Sr, ^{228}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, and ^{238}U.

(2) Specific Radionuclides: ^{241}Am, ^{7}Be, ^{60}Co, ^{137}Cs, ^{40}K, ^{210}Pb, ^{210}Po, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{233}U, ^{234}U, ^{235}U, and ^{238}U.

(3) DP-831 Constituents: NO_3, TKN, ^{226}Ra, ^{228}Ra, and TDS.

(4) WIPP Oversight Constituents: pH, NH_3, BOD5, COD, TOC, oil, grease, metals, dissolved metals, cyanide, phenols, volatiles, semi-volatiles, pesticides, TSS, TDS, TKN

(5) Chemical Analysis: alkalinity, bromide, chloride, fluoride, iodide, nitrate, phenolics, phosphate, sulfate, total organic halogens, TOC, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, iron, lead, lithium magnesium, mercury, potassium, selenium, silica, silver, sodium, carbon tetrachloride, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, and 1,1,2-trichloro-1,2,2-trifluoroethane.

(6) Physical Properties: pH, specific gravity, specific conductance, TDS, and TSS.

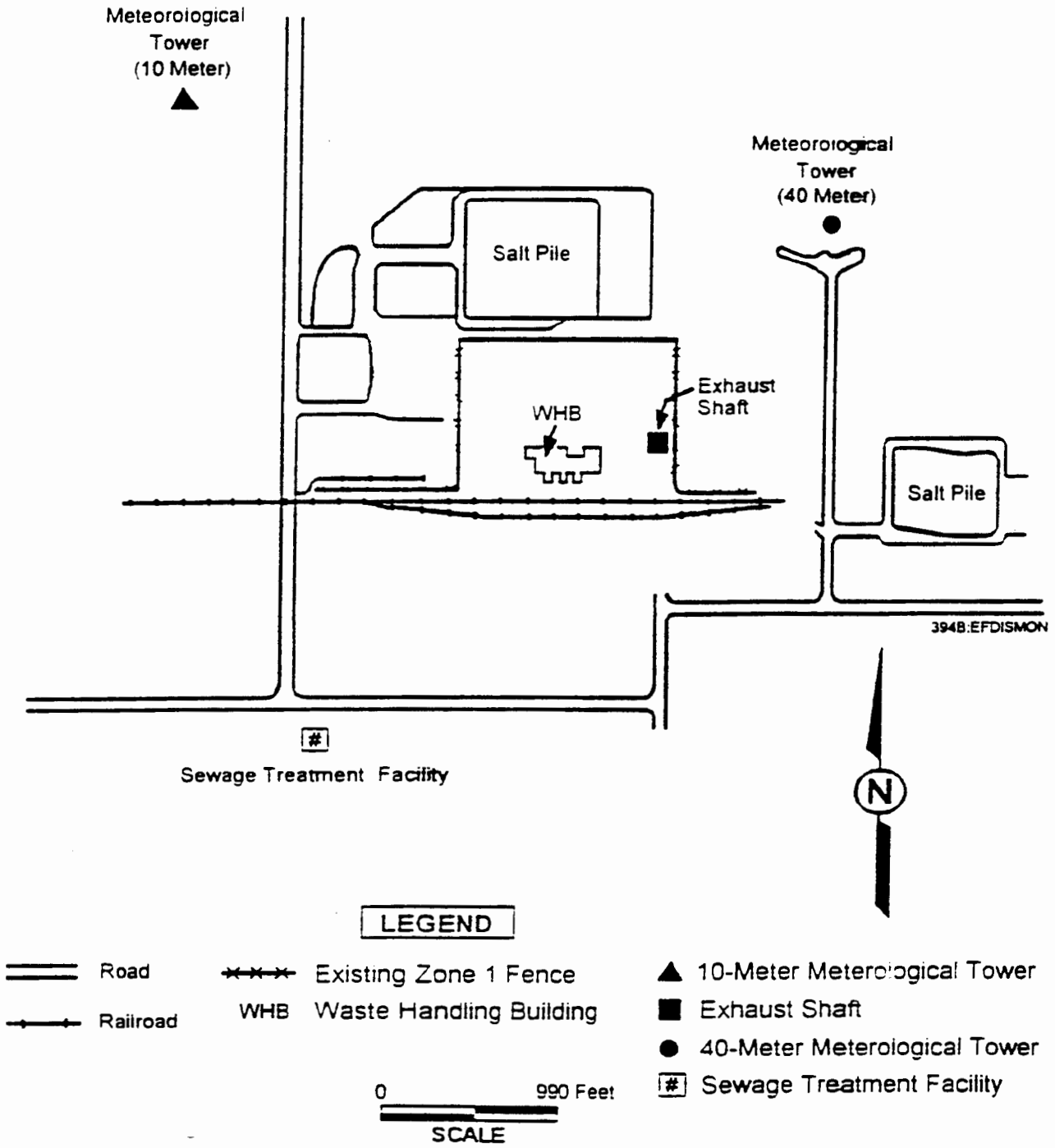

Figure 5-1 EMP Effluent Discharge and Meterological Monitoring Locations

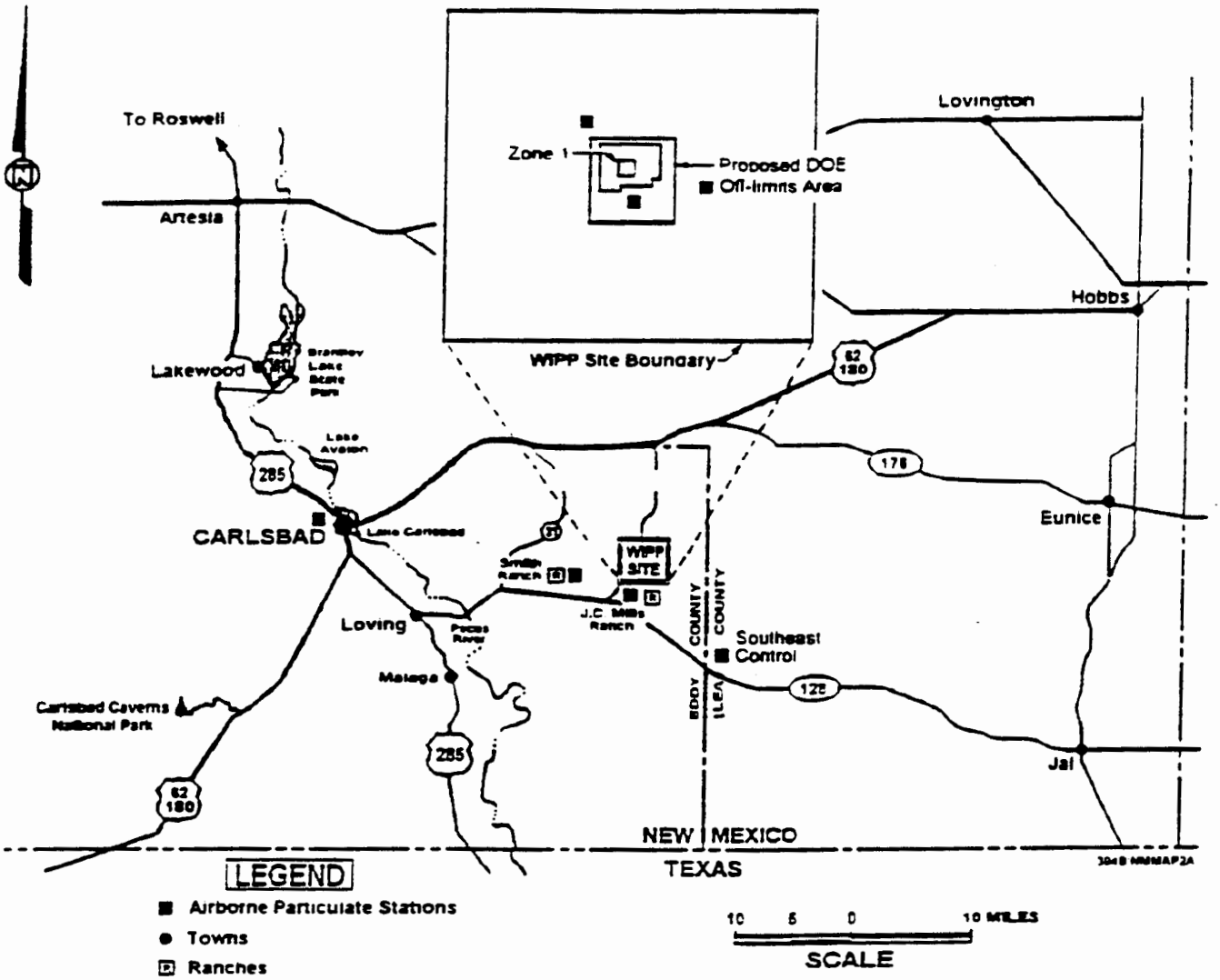

Figure 5-2 EMP Airborne Particulate Sampling Stations

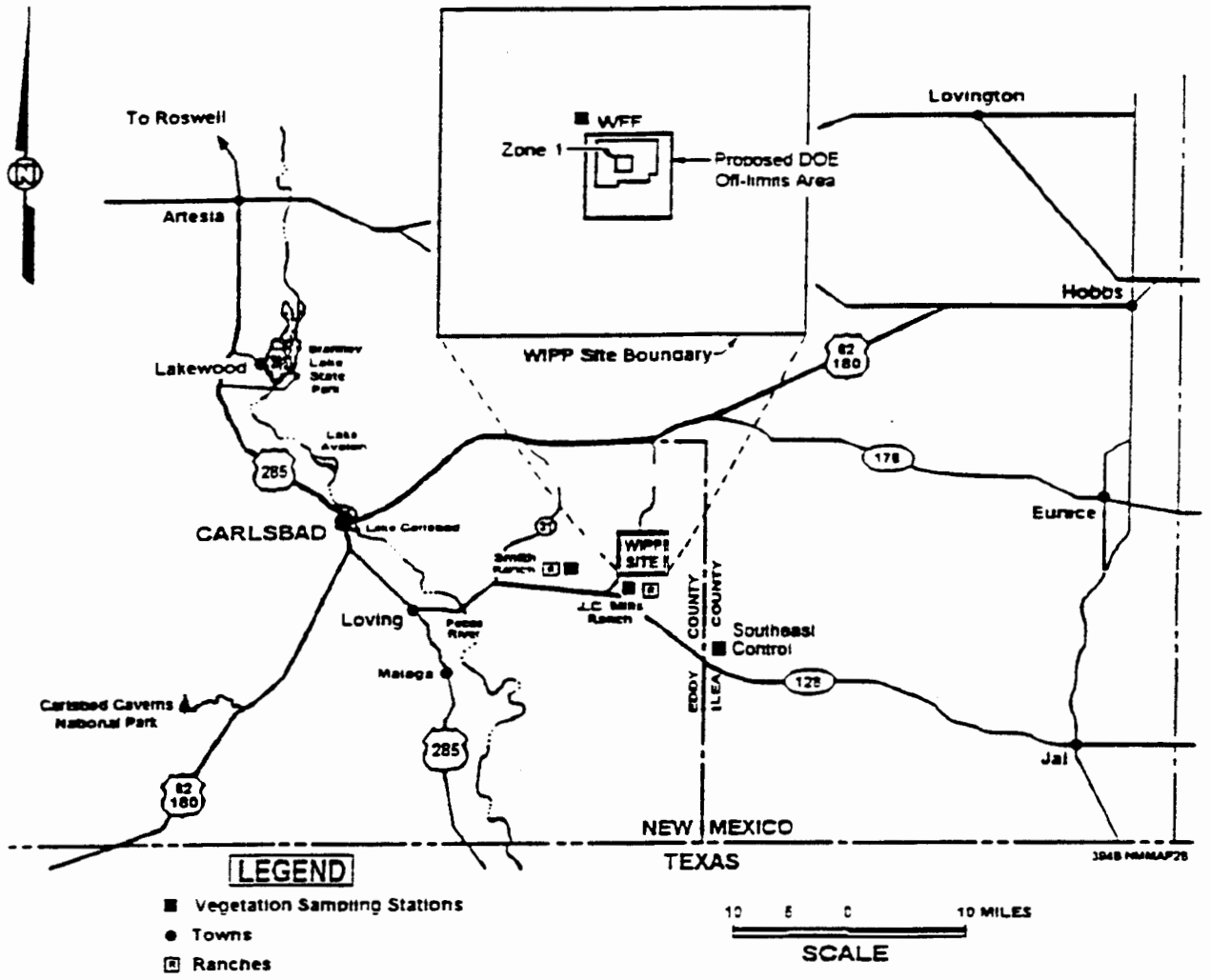

Figure 5-3 EMP Vegetation Sampling Stations for Radioanalysis

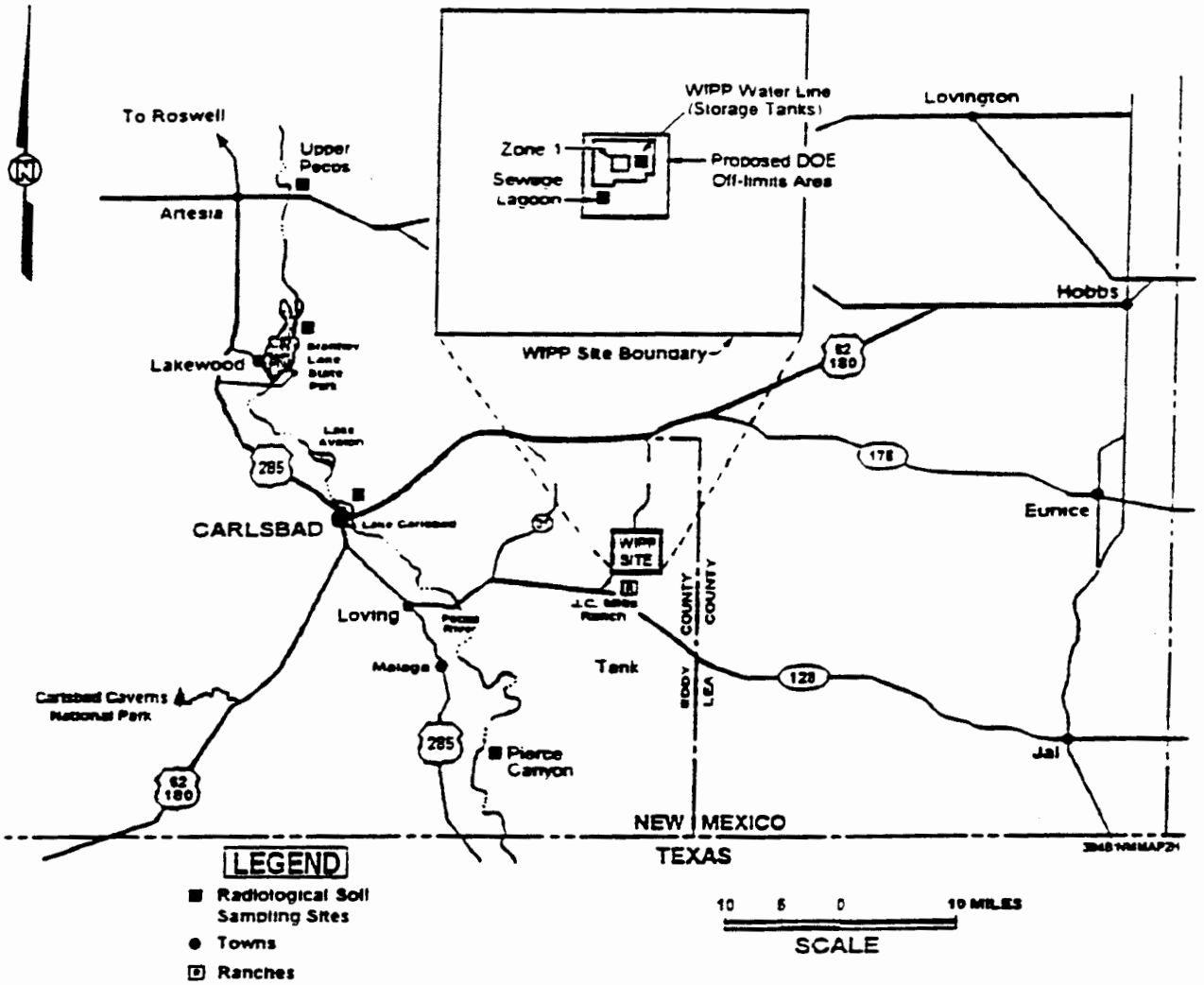

Figure 5-4 EMP Radiological Soil Sampling Sites

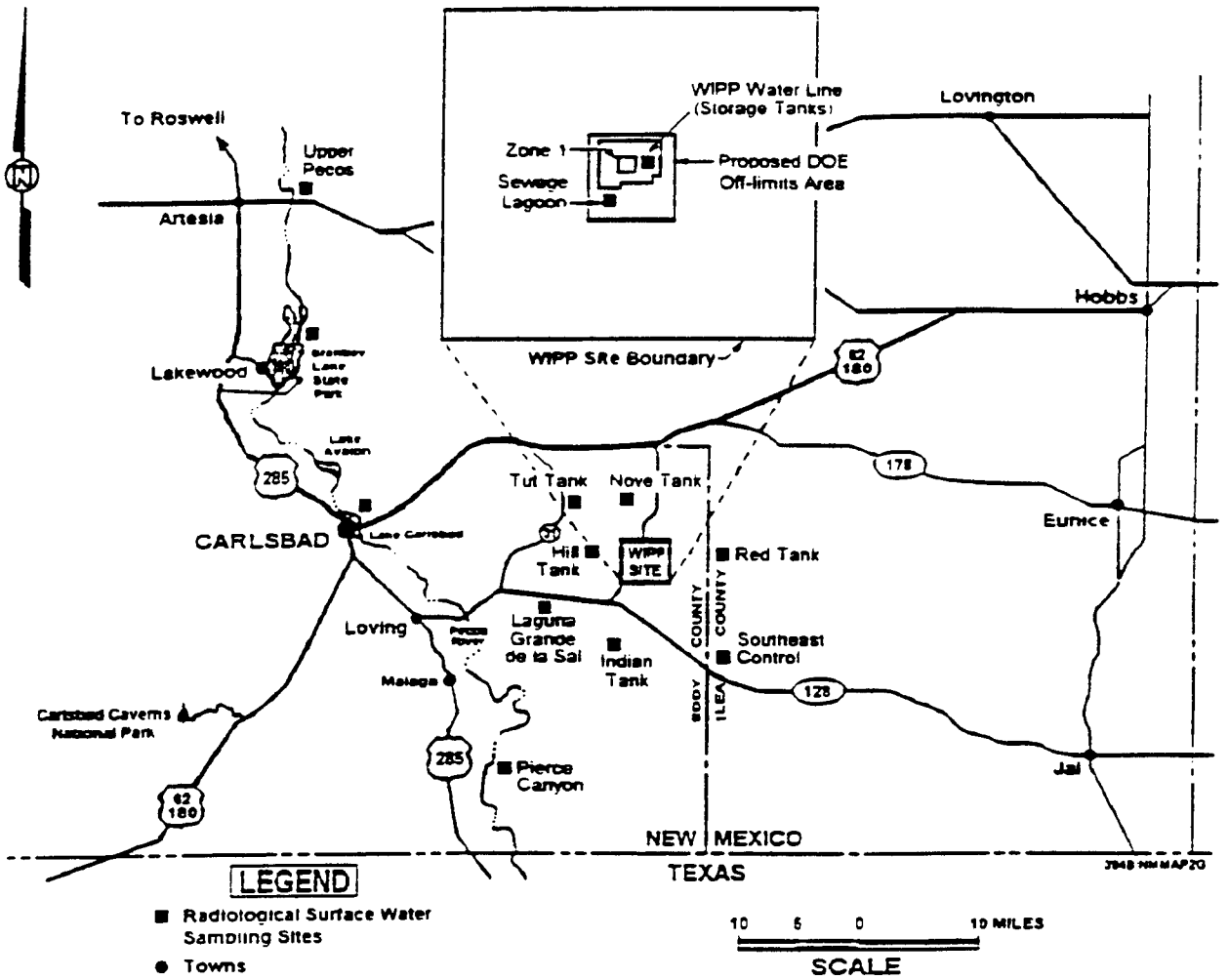

Figure 5-5 EMP Radiological Surface Water Sampling Sites

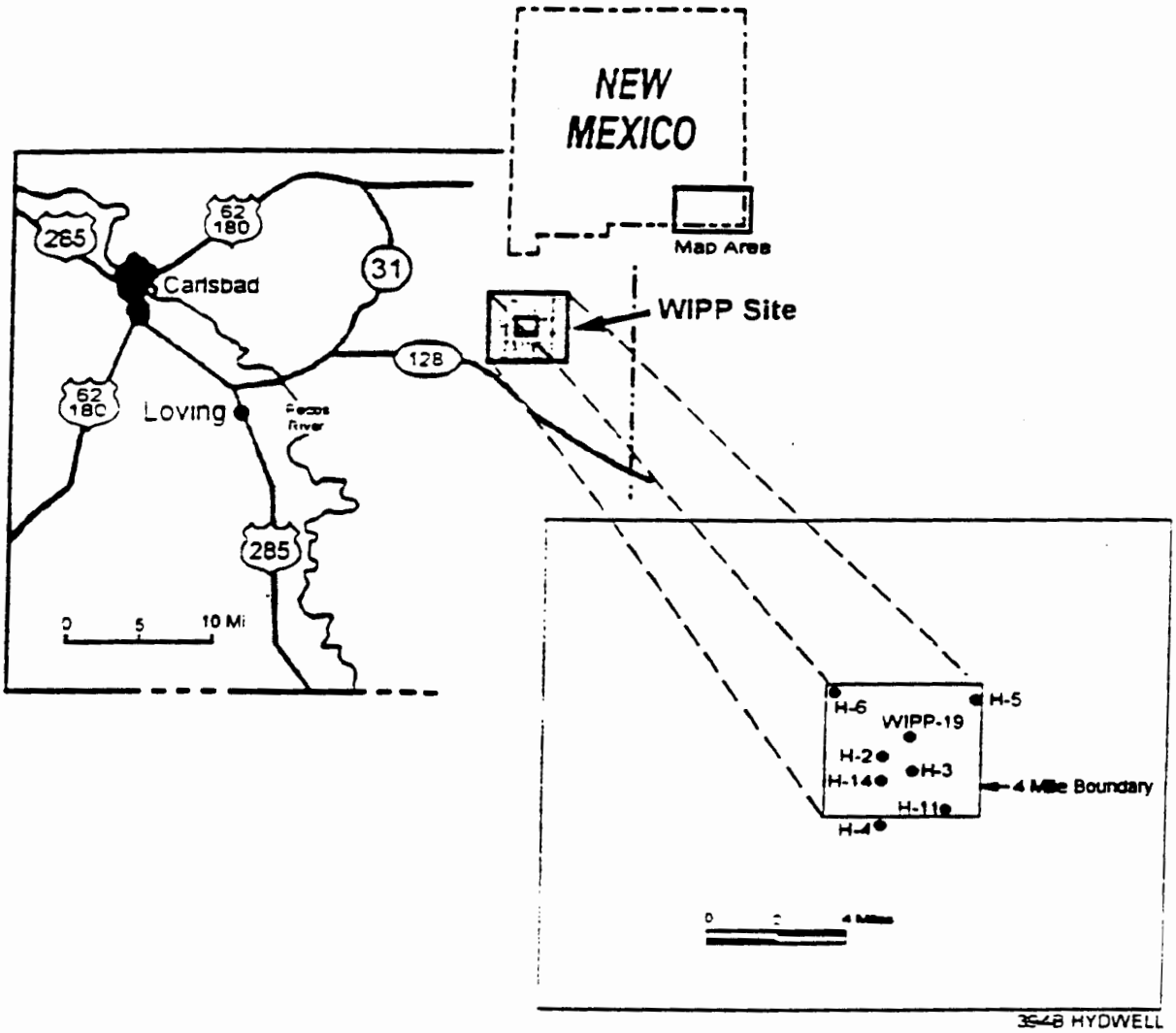

Figure 5-6 EMP Groundwater Sampling Sites

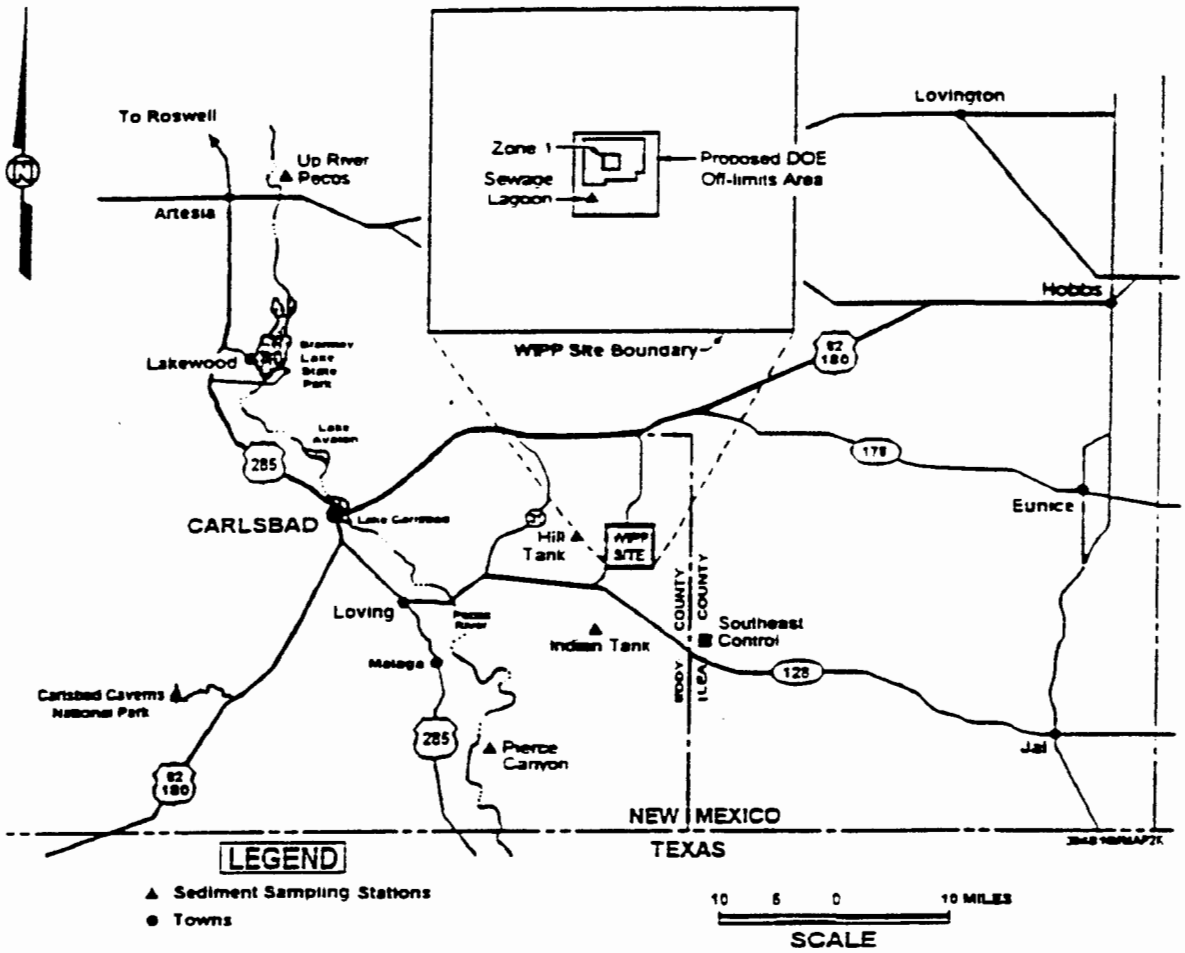

Figure 5-7 EMP Sediment Sampling Locations

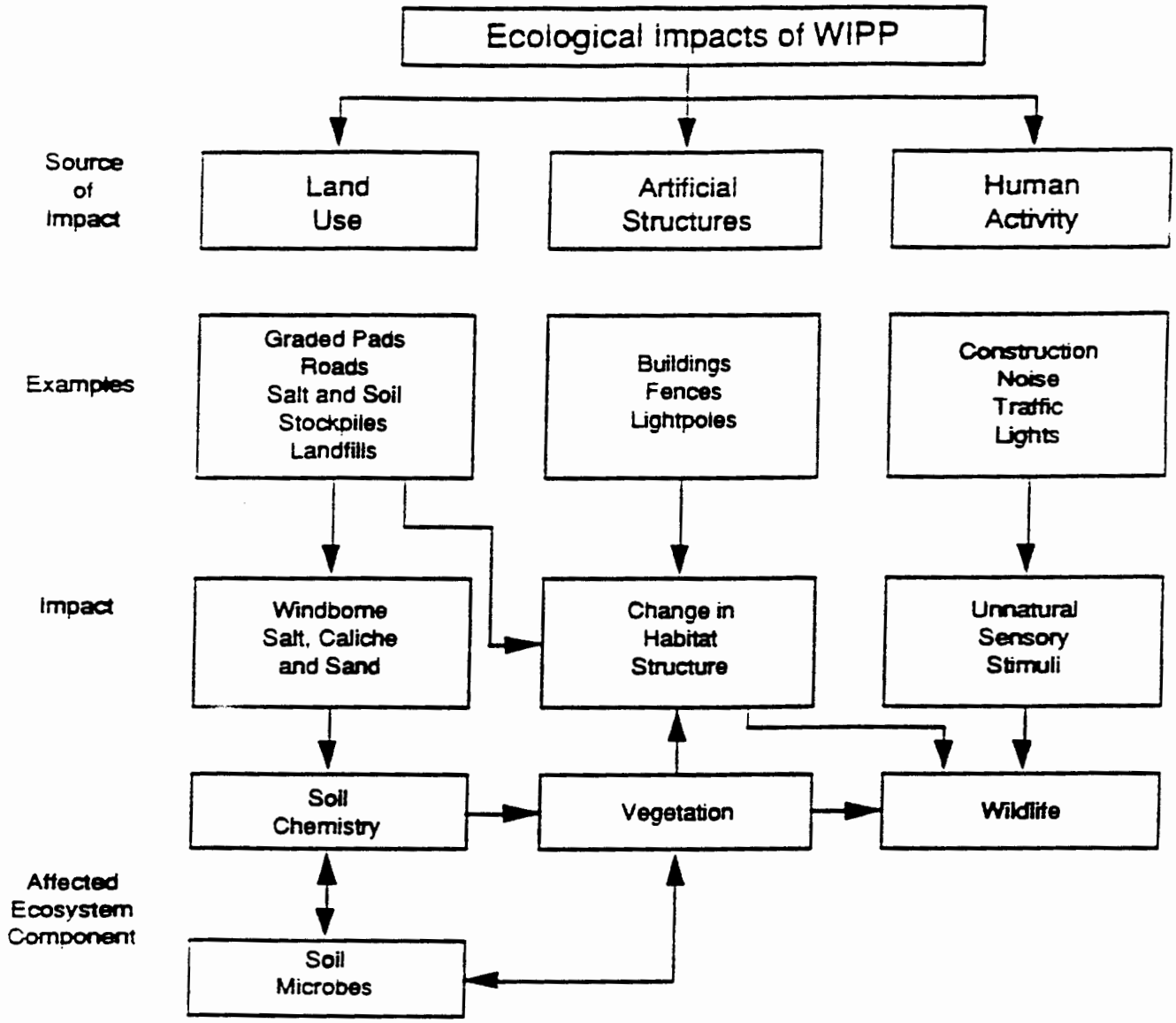

Figure 5-8 Ecological Impacts of WIPP

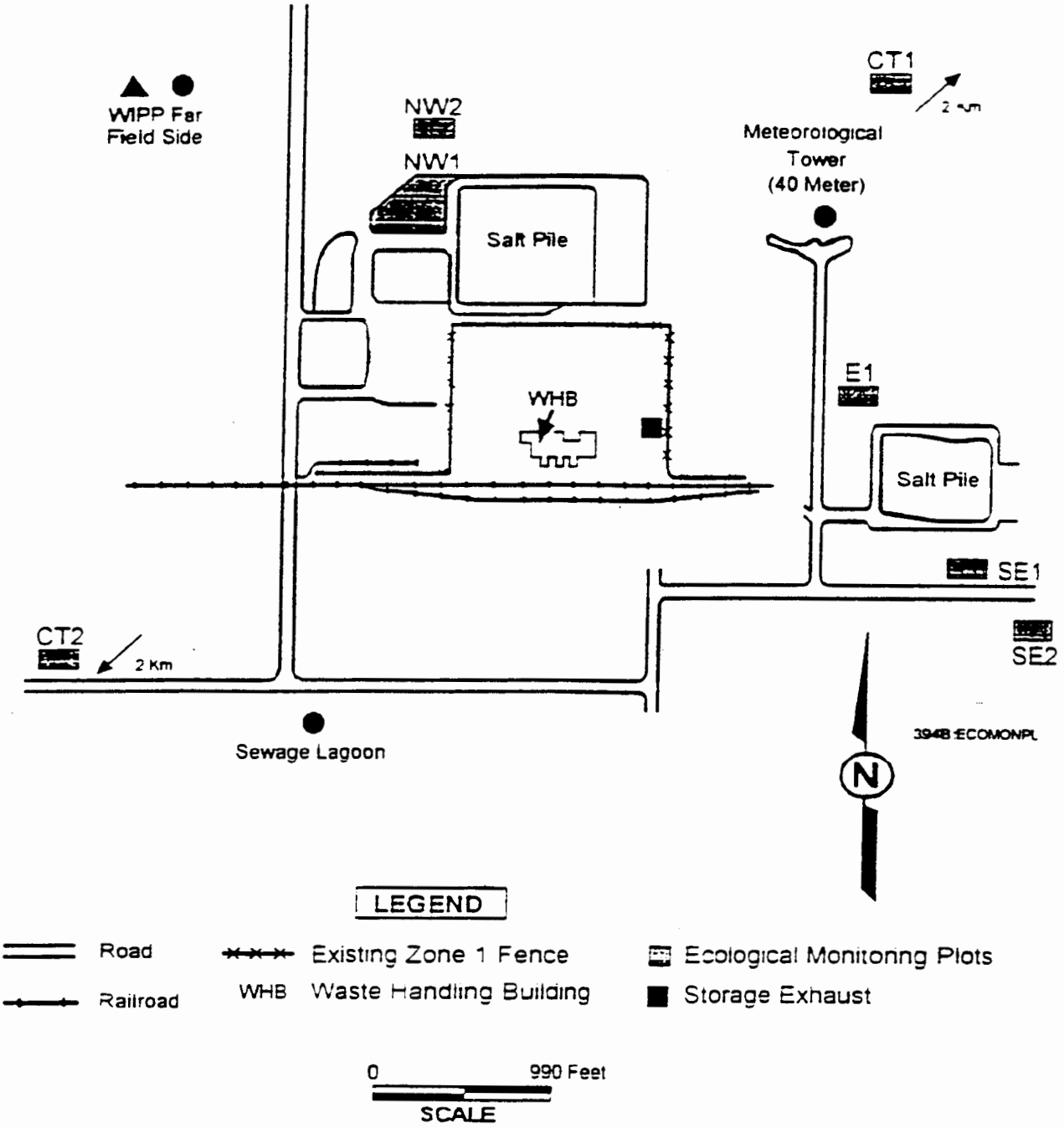

Figure 5-9 EMP Locations of Ecological Monitoring Plots

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6.0 SAMPLE HANDLING AND LABORATORY PROCEDURES

Environmental sampling and analytical laboratory procedures used to obtain quality results for the WIPP are contained and/or described in the following documents:

- Environmental Procedures Manual (WP 02-3)
- Groundwater Monitoring Program Plan and Procedures Manual (WP 02-1)
- Radiation Safety Manual (WP 12-5)
- WID Quality Assurance Program Description (WP 13-1)

The WIPP has field analytical capabilities as well as subcontracted analytical support. Each laboratory is responsible for maintaining an approved quality assurance program.

6.1 SAMPLE HANDLING

Sample Identification

The sample identity codes used in the EMP Radiological Environmental Surveillance (RES) and the NES are unique to each sample collected. A four-tiered hierarchy of sample-specific information is used to accurately identify sample type, sample location, date, and sequence of sampling event. A detailed description of the sample identification for radiological and nonradiological samples, including sample identification, calculations, computer inputs, and other applicable reviews are described in the Environmental Procedures Manual (WP 02-3). Radioactive source control and calibration of equipment are discussed in the Low Level Counting Laboratory Manual (WP 12-LL).

Environmental Activity Levels

During operations, all TRU wastes will remain in sealed containers. Therefore, radionuclide levels in environmental samples are expected to remain minute during operations. All environmental samples are collected in accordance with accepted practices and widely recognized methodologies and criteria for environmental monitoring (WP 02-3).

Packaging and Shipping of Samples Off-Site

Environmental samples sent off-site for analysis are packaged according to the specific sampling procedures (i.e., soil, water, vegetation, etc.) listed in the Environmental Procedures Manual (WP 02-3). The NES/RES Sample Tracking Procedure (WP 02-304) outlines the chain-of-custody requirements that insure the integrity of samples. The WIPP does not handle high-activity samples in the environmental monitoring programs. Contract laboratories are required to follow Quality Assurance/Quality Control (QA/QC) procedures to ensure cross-contamination of high and low activity samples does not occur. The quality of the data from analytical contract laboratories is verified by 1) participation in interlaboratory cross-checks, 2) duplicate, spike, and blank sample analysis, and 3) occasional comparison of results from sample splits that are provided to the NMED and the EEG.

Quality Assurance

A comprehensive QA program has been implemented to assure that the data collected are representative of actual concentrations in the environment. Each contract laboratory is responsible for maintaining an approved quality assurance program detailing the following:

1) routine calibration of instruments;

2) frequent source and background checks (as appropriate);
3) routine yield determinations of radiochemical procedures;

4) replicate/ duplicate analyses to check precision;

5) standard and spike analyses to check accuracy; and

6) analyses of reagents to ensure chemical purity that could affect the results of the analytical process.

The accuracy of radionuclide determination is ensured through the use of standards traceable to the National Institute of Standards and Testing, participation in the Environmental Protection Agency Cross-check Interlaboratory Comparison Program, and other interlaboratory analytical assessment programs, when available.

6.2 RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE

A detailed explanation and justification of all radiological and non-radiological Environmental Surveillance is in accordance with Chapter 5 of this document.

External Radiation

The Environmental Radiation Monitoring Procedure (WP 02-313) provides instructions for obtaining measurements of ambient gamma radiation using the Reuter-Stokes RSS-1012, Environmental Monitoring System. This instrument is located at the WIPP Far Field station and records continuous data that is printed hourly in 15 minute averages with the peak value noted for the 15 minute intervals. This data is summarized in the ASER.

Airborne Particulates

Continuous Low Volume air samplers are used at WIPP for particulate collection. These samplers have a regulated flow rate of 950 ml per second (two cubic feet per minute) of air through a 47-mm (1.9 inch) glass fiber filter. Filters are collected weekly and sent to the analytical laboratory in accordance with the Low-Volume Airborne Particulate Sampling Procedures (WP 02-312). A gross alpha and gross beta count of each weekly filter is completed prior to compositing filters from each location for each sampling quarter. This analyses is conducted by the WIPP low-level counting lab in accordance with operation and calibration of the Canberra Model 2400 2, B counting system (WP 12-516). The quarterly composite is then analyzed using gamma spectrometry for representative gamma-emitting radionuclides typically present in the environment and those expected to occur in the waste received at WIPP. Finally, the composite sample undergoes destructive chemical analysis for the specific alpha and beta activity.

Biological Materials

Samples of native mammals, birds, fish, locally-produced beef and vegetation are collected and prepared for radionuclide analyses as described in the Biotic Sampling Procedures (WP 02-310).

Methods of analyses of all samples are performed in accordance with appropriate EPA approved methods or the U.S. Department of Energy, Environmental Measurements Laboratory Procedure Manual, HASL-300.

Soil Sampling

Soil sampling procedures used at the WIPP are given in the RES Soil Sampling Procedures (WP 02-307). Methods of analyses of all samples are performed in accordance with appropriate EPA approved methods or the U.S. Department of Energy, Environmental Measurements Laboratory procedure manual, HASL-300.

Surface Water and Sediments

Surface water and sediment samples for radionuclides are collected and handled according to the RES Surface Water and Sediment Sampling Procedures (WP 02-309). This procedure describes methods for collecting, preserving, and packaging representative water and sediment samples. Laboratory methods for analyses of all samples are performed in accordance with appropriate EPA approved methods or the U.S. Department of Energy, Environmental Measurements Laboratory Procedure Manual, HASL-300.

Groundwater

Groundwater sampling for radiological analyses is conducted according to the Groundwater Monitoring Program Plan and procedures manual (WP 02-1). This sampling plan includes detailed procedures on collecting a representative sample by measurement of field parameters to determine a chemical steady-state with respect to those constituents. Included in this plan are the procedures associated with the pumping of groundwater, the serial sampling and analysis program, and the final sample collection and preparation for shipment to contract laboratories. Samples are analyzed in accordance with appropriate EPA approved methods, or the U.S. Department of Energy Environmental Measurements Laboratory Procedure Manual, HASL-300.

6.3 NONRADIOLOGICAL ENVIRONMENTAL MONITORING

Soil Sampling

Soil sampling and handling procedures are given in the NES Soil Sampling Procedures (WP 02-336). Samples are collected annually at random locations from each ecological study plot. The methods of analyses of all samples are performed in accordance with appropriate EPA methods.

Surface Water and Sediments

Surface water and sediment sampling and handling procedures for nonradionuclide analyses are conducted according to the NES Surface Water and Sediment Sampling Procedure (WP 02-345) and the Guidance Manual: "Surface Water and Sediment Sampling for the Environmental Monitoring Program at WIPP" (Prill and Buckle, 1986). The methods of analysis of all samples are performed in accordance with appropriate EPA methods.

Groundwater

Groundwater sampling and handling procedures for nonradionuclide analyses are conducted in accordance with the Groundwater Monitoring Program Plan and Procedures manual (WP 02-1). Field parameters for nonradiological analyses include pH, EC, specific gravity, specific conductance, temperature, flow volumes and rates, chloride, calcium, magnesium, total sulfide as H_2S, alkalinity, and dissolved iron. Samples are also collected and sent to a contract laboratory for more extensive analyses performed in accordance with appropriate EPA methods.

VOC Monitoring

VOC sampling and analysis are performed at the WIPP using guidance in the EPA Compendium Method TO-14, "Determination of Volatile Organic Compounds in Ambient Air Using Summa® Passivated Canister Sampling and Gas Chromatographic Analysis." Presently, there are five VOC sampling stations installed at the WIPP facility. Existing instrumentation at stations VOC-1 (exhaust shaft), VOC-2 (air intake shaft), and VOC-8 (underground) will be used for this baseline monitoring. Samples collected at VOC-1 will be used to define baseline concentrations at the top of the exhaust shaft. Data obtained at VOC-2 will be used to define ambient VOC concentrations. Operation of the VOC-8 station will provide baseline data for the underground. These three stations are designated to be air monitoring stations which use commercially available portable VOC sampling equipment. The other two monitoring stations (VOC-9 and VOC-10) will not be activated.

The VOC samplers are operated by the WIPP facility personnel, and sample analyses are performed by a contract laboratory. Laboratory analyses are designed to routinely quantify five VOC target compounds: Carbon tetrachloride, Methylene chloride, Trichloroethylene, 1,1,1-Trichloroethane, and 1,1,2-Trichloro-1,2,2-trifluoroethane. Sample results are compared to the health-based standards established by the EPA in the NMD.

Airborne Gases

The Atmospheric Monitoring Station is used to continuously monitor potential pollutant gas concentrations. The station is composed of seven analyzers which monitor SO_2, H_2S, O_3, CO, NO, NO_2, and NO_x gases. The station is operated in accordance with the draft Ambient Air Quality Monitoring Procedure (WP 02-341). Calibration and maintenance of monitoring equipment are performed in accordance with their respective operation and maintenance manual.

7.0 DATA ANALYSES

This section describes the criteria and methods used for statistically analyzing data collected in the EMP. The goal of statistical data analyses is to provide an objective and reliable means for interpreting data in relation to the objectives of the data collection program. For the EMP the principal goal of data analyses is the comparison of a data point or data set to equivalent data collected at another location and time (such as preoperational baseline data or data collected at a control location), or to a fixed standard.

For the data results of the sample media, each data point will be correlated to the "Statistical Summary of the Radiological Baseline for the WIPP", (DOE/WIPP 92-037). During this review should a discrepancy be noted, an in depth evaluation will be performed to identify the source of the deviation, (i.e. statistical outlier or analytical technique).

Several levels of analyses are required for each parameter before statistically valid interpretation can be achieved. The type of analysis used at each level varies among parameters due to the particular characteristics of parameters and the specific objectives of monitoring. Five general levels of data analyses are described here. Analyses at each of these levels is considered for each parameter. The levels are:

(1) Determination of accuracy for each point measurement by quantification and control of precision and bias;

(2) Evaluation of the effects of auto-correlation on the expected value of the point measurement due to location and time of sampling;

(3) Identification of the appropriate model of variability (i.e., a probability density distribution) for each point measurement and the calculation of descriptive statistics based on the chosen model;

(4) Treatment of data anomalies; and

(5) Interpretation of data through statistically valid comparisons (tests) and trend analysis.

Each of these levels of data analyses are described below and with the requirements for application to the EMP.

7.1 ACCURACY

Accuracy is the closeness of a measurement to its actual, or true, value. Since the true value cannot be determined independently, accuracy cannot be absolutely determined. However, accuracy is controlled by two basic elements: bias (consistent over or underestimation of the true value) and precision, [concentration of repeated measurements around a central (expected) value]. Accuracy is maximized when bias is minimized and precision is maximized.

To some extent precision and bias are controlled by strict adherence to sample collection, handling, and measurement protocols. EMP procedures specify the protocols for those functions performed at the WIPP (WP 02-3) and quality control procedures establish control on precision and bias for contractors (see Section 8.0).

The remaining element of precision and bias is quantitatively estimated through periodic performance of the following measurements:

- measurement of replicate samples;
- measurement of duplicate samples or the repeated measurement of the same sample;
- measurement of blank samples; and
- measurement of standard pseudo-samples (samples of an equivalent medium containing a known amount of the target species).

The measurement of replicate samples is used for estimation of the amount of imprecision incurred through the entire process of sample collection, handling, and measurement. The measurement of duplicates and repeated measurements are used to determine the amount of imprecision attributable to measurement. Blanks and pseudo-samples are used to evaluate bias incurred through measurement processes. Measurements of replicate samples and repeated measurements have been made in the RBP, particularly in the low volume air sampling program. Results of the EPA cross-check Interlaboratory Comparison Program indicate that laboratories supporting the WIPP environmental monitoring program are within specified control limits. As required by DOE Order 5400.1, contract laboratories performing radiological analysis on WIPP samples, and the WIPP low-level counting lab will participate in the DOE interlaboratory QA program coordinated by the DOE Environmental Measurements Laboratory of New York, New York.

The methods for satisfying these requirements will be dependent upon the sampling and measurement characteristics of each parameter. Generally, the following specifications will be followed:

- one replicate sample is collected for each ten samples collected;
- at least one duplicate or one repeated measurement is made for each discrete set of samples analyzed, or for each tenth sample analyzed, whichever is more frequent;
- one blank sample is analyzed for each discrete set of samples analyzed (for radioactivity counts, the background count is not considered a blank); and
- measurements of pseudo-samples is performed once per year.

Variations from these specifications may be required due to peculiarities of the individual parameters, and is stated in the procedure for that parameter.

7.2 TEMPORAL AND SPATIAL ANALYSIS

Environmental parameters vary with space and time. The effect of one or both of these two factors on the expected value of a point measurement is statistically evaluated through spatial analysis and time series analysis; however, these methods often require extensive sampling efforts which are in excess of the practical requirements of the WIPP EMP. The application of these methods to a particular parameter must, therefore, be limited by consideration of its significance in the final interpretation of the data.

In particular, spatial analysis has limited use in this program, although the effect of spatial auto-correlation on the interpretation of the data is considered for each parameter. Spatial variability is accounted for by the use of predetermined key sampling locations. Data analysis is performed on a location-specific basis, or data from different locations is combined only when the data have been determined to be statistically homogeneous.

Time series analysis plays a more important role in data analysis for the EMP. Parameters are reported as time series, either in tabular form or as time plots. For key time series parameters, these plots are in the form of control charts on which control levels will be identified based on preoperational data base, fixed standards, control location data bases, or other standards for comparison (*Statistical Summary of the Radiological Baseline for the WIPP* (DOE/WIPP 92-037)). Where significant seasonal changes in the expected value of the parameter are identified in the preoperational data base or in the control locations, corrections in the control levels which reflect the seasonal change are made.

7.3 DISTRIBUTIONS AND DESCRIPTIVE STATISTICS

For data sets which include more than ten data points that are homogeneous in space and time (including seasonal homogeneity), and have less than ten percent missing data, a test for conformance to the normal distribution is performed. A probability plot is an accepted method for performing this test; however, more powerful tests of normality, such as the W Test, or D'Agostino's Test (Gilbert, 1987) are more accurate. Any standard best fit test is acceptable, provided the assumptions of the test are met.

If normality is not met, the data will be log-transformed and retested for normality. If the transformed data fit a normal distribution, the original data will be accepted as having log-normal distribution. If normality is still not found, two courses may be taken. One is to continue to test the fit to standard families of distributions, such as the gamma, beta, and Weibull, with proper modifications to subsequent analyses based on the these results. The other course is to use nonparametric methods of data analysis.

For data sets smaller than ten, but homogeneous and complete, the log-normal distribution is assumed. Data sets with more than ten percent missing data are analyzed using nonparametric methods. Nonhomogeneous data sets are subdivided into homogeneous sets and each of these analyzed individually.

Descriptive statistics are calculated for each homogeneous data set. At a minimum, these include a central value and a range of variation. The central value is the arithmetic mean of the untransformed data if the data are not censored at either end. If the data are censored, either a trimmed mean or the median is used as the central value (which may be within the censored range). If the data set is greater than ten and is uncensored, the standard deviation is calculated and used as a basis for the reported range in variation. If these criteria are not met, the range between the 0.25 and 0.75 quartiles is used.

7.4 DATA ANOMALIES

Data anomalies include data points reported as being below the limit of detection (LD) or otherwise censored over a specific range of values, missing data points occurring randomly in the data set, and outliers which cannot be ascribed to a known source of variation.

Whenever possible, values which are below detection limits are obtained and incorporated into the data base for statistical analysis. When values are not available, alternative methods of analysis, as described in previous sections, are used. In particular, the use of nonparametric statistics is required.

Missing data points comprising less than 10 percent of the data set do not affect data analyses. Results based on data in which more than 10 percent is missing are identified as such at the time of reporting. Consideration of the potential effect of missing data must be made when the majority of the data are missing from a discrete time span.

An outlier is defined as any data point occurring in either extreme upper or lower range of the data distribution for which there is less than 0.01 probability of occurrence. For normally distributed data, this is roughly 2.3 or more standard deviations above or below the mean. When no probability model is identified, outliers may only be found through visual inspection of the data.

If outside source of variation are not identified to account for outliers in a data set, it is included in the data set and all subsequent analyses. If the inclusion of such outliers is found to affect the final results of the analyses significantly, both results (with and without outliers) are reported.

7.5 COMPARISONS AND REPORTING

Comparisons between data sets are performed using standard statistical tests. The selection of the specific test is dependent upon the relative power of the test and the degree to which the underlying requirements of the test are met. In addition to tests comparing data from distinct locations and times, trend analyses are performed on time series where sufficient data exist. A 95 percent confidence level will be used for the final interpretation of results.

Citation of the source of the test method or the software used to perform the tests will be made when results are reported. Data and subsequent calculated values are reported in the annual site environmental report in accordance with standard rules for significant figures.

Note: There has been no attempt in this section to define standard statistical terminology nor to reference common statistical formulae and derivations. Many satisfactory statistical texts and handbooks, in addition to those given in the reference, are available for this purpose.

8.0 QUALITY ASSURANCE

8.1 INTRODUCTION

This section defines the policies and procedures that have been implemented at the WIPP to provide confidence in the quality of the environmental data that are generated. Quality assurance (QA) practices that cover monitoring activities at the WIPP are consistent with applicable elements of the 18-element format in ANSI/ASME NQA-I, which are as follows:

- Organization of participants
- Quality assurance program
- Design control and analysis
- Procurement document control
- Instructions procedures and drawings
- Document control
- Control of purchased items and services
- Identification and control of materials and samples
- Control of process
- Inspections
- Test control
- Control of measuring and test equipment
- Handling, packaging, storage, and shipping
- Inspection, test, and operating status
- Control of nonconformances
- Corrective actions
- Quality assurance records
- Audits

The WID Quality Assurance Program Description (QAPD), WP 13-1, defines QA requirements and responsibilities that apply to WID work. The format of Revision 14 of WP 13-1 is based on the eighteen QA criteria of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities". Both the requirements of NQA-1 and the ten criteria of DOE Order 5700.6C are addressed. Because QA requirements of data collection for compliance with environmental regulations are less detailed than those usually applied to nuclear facilities, the WID QAPD also addresses EPA QA requirements extracted from the EPA's QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans". For the WIPP project, these EPA QA requirements apply to Environmental Data Operations (EDOs); that is, compliance activities associated with collection and analysis of environmental samples, including data reduction, handling, reporting, and records management. Examples of EDOs at the WIPP include the monitoring programs for compliance with the No-Migration Variance, NESHAPS, and RCRA hazardous waste characterization. Table 8-1 demonstrates the relationship between QA requirements from DOE Order 5700.6C, ASME NQA-1, and EPA QAMS-005/80.

8.2 GOAL

The Westinghouse Waste Isolation Division (WID) quality assurance policy sets a goal to perform all work in such manner that the required quality is attained or exceeded. To attain this goal the WID has developed and implemented a formal QA program that is tailored for activities associated with receipt of TRU waste, including operational safety, environmental compliance, and performance assessment.

TABLE 8-1

DOE 5700.6C CROSS REFERENCE TO ASME NQA-1 AND EPA QAMS-005/80

	DOE ORDER 5700.6C CRITERION	ASME NQA-1 BASIC REQUIREMENT	EPA QAMS-005/80 ELEMENT
MANAGEMENT	1. Program	1. Organization 2. Quality Assurance Program	3. Project Description 4. Project Organization & Responsibility 16. Quality Assurance Reports to Management
	2. Personnel Training and Qualification	2. Quality Assurance Program	3. Project Description 16. Quality Assurance Reports to Management
	3. Quality Improvement	15. Control of Nonconforming Items 16. Corrective Action	15. Corrective Action
	4. Documents and Records	6. Document Control 17. Quality Assurance Records	1. Title Page 2. Table of Contents
PERFORMANCE	5. Work Processes	5. Instructions, Procedures and Drawings 8. Identification and Control of Items 9. Control of Processes 12. Control of Measuring and Test Equipment 13. Handling, Storage and Shipping	6. Sampling Procedures 7. Sample Custody 8. Calibration 9. Analytical Procedures 13. Preventive Maintenance
	6. Design	3. Design Control	5. Data Quality Objectives 6. Sampling Procedures 10. Data Reduction 11. Internal Quality Control 14. Routine Procedures to Assess Data Quality
	7. Procurement	4. Procurement Document Control 7. Control of Purchased Items and Services	N/A
	8. Inspection and Acceptance Testing	10. Inspection 11. Test Control 12. Control of Measuring and Test Equipment 14. Inspection, Test and Operating Status	8. Calibration 13. Preventive Maintenance
ASSESS	9. Management Assessment	2. Quality Assurance Program	3. Project Description 14. Routine Procedures to Assess Data Quality 16. Quality Assurance Reports to Management
	10. Independent Assessment	18. Audits	12. Audits 14. Routine Procedures to Assess Data Quality

8.3 PROGRAM ELEMENTS/CRITERIA

The specific WIPP QA program elements/criteria that are applicable to the performance of the EMP are listed below by DOE Order 5700.6C criterion. These elements establish the applicable QA requirements that are required for compliance activities associated with the collection and analysis of environmental samples, including data reduction, handling, reporting, and records management.

8.3.1 Program

This element includes programmatic practices and procedures that include QA project plans for EDOs that consider and address the 16 essential elements described in Section 5 of the EPA QAMS-005/80. Project descriptions for specific EDOs are provided in project-specific QA project plans (QAPjPs). These project-specific QA project plans include explanations for exclusion of any of the 16 elements that would not be relevant to a specific project. The project descriptions include an experiment design description in sufficient detail for stand-alone review and approval of the plan. EDO project descriptions incorporate the following elements, as appropriate:

- Flow diagrams, tables, and charts;
- Dates anticipated for start and completion; and
- Intended end use of acquired data.

Each WIPP organization involved with activities and operations affecting environmental data quality will specify QA/QC responsibilities in departmental or project-specific QA project plans. The QA project plans include tables or charts showing the project organization and line authority. Key individuals, including the designated QA officer, who are responsible for ensuring the collection of valid data and the routine assessment of measurement systems for precision and accuracy, are listed.

Precision and accuracy of all environmental monitoring data are routinely assessed and reported. Project-specific QA project plans associated with EDOs provide the mechanism for periodic reports to the DOE WIPP project management on the performance of measurement systems and data quality. These reports include:

- Periodic assessment of measurement data accuracy, precision, and completeness;
- Results of performance audits;
- Results of system audits;
- Significant QA problems which if uncorrected could have a serious effect on the health and safety of WIPP workers and the public, seriously impact the operation of the WIPP, or have a noticeable adverse impact on the environment;
- Recommended corrective actions;
- Identification of individuals responsible for report preparation; and
- Provisions in the final report for a separate QA section that summarizes data quality information contained in the periodic reports.

8.3.2 Personnel Training and Qualification

The WIPP training program has been designed to ensure that personnel performing work are capable of performing their assigned task in a proficient manner. Personnel who perform work that requires special skills or abilities are required to meet the qualification requirements for that specific task unless directly supervised by a qualified perso-

8.3.3 Quality Improvement

The quality improvement process has been established and implemented to improve quality and provide corrective action procedures. Corrective action procedures for activities associated with environmental data collection are identified in project-specific QA project plans. At a minimum, the following elements are addressed:

- Predetermined limits for data acceptability beyond which corrective action is required;
- Procedures for corrective action; and
- Identification of individuals responsible for initiating corrective action and individuals responsible for verifying and approving implementation of the corrective action.

Corrective action may be initiated through routine operations, performance audits, system audits, inter/intralaboratory comparison studies, or performance demonstrations conducted by DOE-WSB.

8.3.4 Documents and Records

Procedures are established that control the preparation, review, approval, issuance, use, and revision of documents that establish policies, prescribe work, specify requirements, establish design, or that are being used for the performance of quality-related activities. Each project-specific QA implementation plan for EDOs includes documentation of approval, in the for of a title page.

Procedures are also in place to ensure that records are specified, prepared, reviewed, approved, and maintained to accurately reflect completed work. This process is described in DOE/WIPP 89-013, "WIPP Project Records Management Handbook". The WIPP record management program provides a project-wide records management system that coordinates the collection, maintenance, identification, and preservation of WIPP project records, in accordance with standards mandated by DOE Order 1324.5 "Records Management Program".

8.3.5 Work Processes

Work is performed to established technical standards and administrative controls. For each major measurement parameter, the design of sampling methodology, equipment, and procedures are documented and approved. The following requirements for sample design are addressed in project-specific technical and/or QA plans, as applicable:

- Description of techniques or guidelines used to select sampling sites;
- Inclusion of specific sampling procedures to be used, either by reference in the case of approved standard operating procedures (SOPs), or in entirety if the procedures are nonstandard;

- Charts, flow diagrams, or tables delineating sampling program operations;
- A description of containers, procedures, reagents, etc., used for sample collection, preservation, transportation, and storage;
- Special conditions for the preparation of sampling equipment and containers to avoid sample contamination;
- Sample preservation methods and holding times;
- Time considerations for shipment of samples to the laboratory;
- Sample custody or chain-of-custody procedures; and
- Forms, notebooks, databases, and procedures to be used to document sample history, sampling conditions, and required analyses.

Samples collected for environmental compliance activities or for site validation are controlled by approved chain-of-custody procedures. The actual practices used are documented in project-specific QA implementation plans. The following sample custody procedures are specified in the QA project plan:

- For field sampling operations:
  - Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample;
  - Procedures and forms for recording the exact location and specific considerations associated with sample acquisition;
  - Documentation of specific sample preservation methods; and
  - Sample labels containing all information necessary for effective sample tracking.
- For laboratory operations:
  - Identification of responsible party to act as sample custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment, and verify the data entered onto the same custody records;
  - A laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets; and
  - Specification of laboratory sample custody procedures for sample handling, storage, and dispersement for analysis.

Custody records are treated as permanent QA records by the recipient upon final transmission of the analytical data.

Calibration procedures and frequency for EDO activities are specified in project specific QA implementation plans. The plans include:

- A reference to the applicable SOP, or written description of the calibration procedures used for each major measurement parameter;

- Frequency of calibration; and
- Calibration standards to be used, as well as their sources and traceability.

Preventive maintenance of equipment used for collection and measurement of environmental data are identified in project specific QA implementation plans. The following types of preventive maintenance items are addressed:

- A schedule for preventive maintenance tasks; and
- A list of critical spare parts that should be available.

Procedures used for controlling the analysis of samples collected for EDO activities are specified in project-specific QA implementation or technical plans. For each measurement parameter the applicable procedure is either described in writing, or referenced as an SOP.

8.3.6 Design

Each major measurement parameter, the design of sampling methodology, equipment and procedures are documented and approved. The following requirements for sample design are addressed in project-specific plans and/or QA plans:

- Description of techniques or guidelines used to select sampling sites;
- Inclusion of specific sampling procedures to be used, either by reference in the case of approved SOPs, or in entirety if the procedures are nonstandard;
- Charts, flow diagrams, or tables delineating sampling program operations;
- Description of containers, procedures, reagents, etc., used for sample collection, preservation, transport, and storage;
- Special conditions for the preparation of sampling equipment and containers to avoid sample contamination;
- Sample preservation methods and holding times;
- Time considerations for shipment of samples to the laboratory;
- Sample custody or chain-of-custody procedures; and
- Forms, notebooks, databases, and procedures to be used to document sample history, sampling conditions, and required analyses.

8.3.7 Procurement

The control of procurement documents ensures that procured items and services meet established requirements and specifications. Basic procurement requirements include:

- Applicable design specifications and other order requirements are \or referenced in documents for procurement of items and services;
- That the supplier have a QA program consistent with applicable requirements; and

- That all procurement actions be performed in accordance with written procedures that describe the actions involved in the preparation, review, approval, control and changes of procurement documents.

8.3.8 Inspection and Acceptance Testing

Inspection and acceptance testing of specified items and processes are conducted using established acceptance and performance criteria.

Equipment used for inspections and tests are calibrated and maintained. Calibration procedures and frequency for EDO activities are specified in project specified QA implementation plans. These plans will include:

- A reference to the applicable SOP, or written descriptions of the calibration procedures used for each major measurement parameter;
- Frequency of calibration; and
- Calibration standards to be used, as well as their sources and traceability.

8.3.9 Management Assessment

Senior management assembles input from the following sources to form the basis of management assessment:

- Line management's self-assessment reports;
- Independent assessment reports; and
- Corrective action reports including conditions adverse to quality, nonconformance reports (NCRs), program deficiency reports (PDRs), audit reports, and requests for corrective action (RCAs).

Following the assessment, the effectiveness of the QA program is documented. Further, areas for quality improvement root cause analysis (for severe nonconformances or high-risk items/activities), preventive or corrective actions, milestones for completion, responsibility assignments, trend analysis, and lessons learned are documented and transmitted to the DOE.

8.3.10 Independent Assessment

Independent Assessment is performed to verify procedure compliance. Independent assessment is also used to prove independent oversight of the self-assessment process performed by line management. Independent assessment focuses on improving items and processes by emphasizing line organization's achievement of quality. Results from independent assessments are transmitted to senior management as input for determination of the effectiveness of the integrated QA program. In this regard, personnel performing independent assessments act in a management advisory function.

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9.0 REQUIRED RECORDS AND REPORTS

The record-keeping and reporting requirements applicable to the radiological and nonradiological environmental surveillance programs at the WIPP are identified in the WIPP Environmental Procedures Manual (WP 02-3), and the Groundwater Monitoring Program Plan and Procedure Manual (WP 02-1). These program plans define and delineate the responsibilities for compliance with DOE Orders 1324.2A (DOE, 1988), 5400.1 (DOE, 1990), 5484.1 (DOE, 1981a), and 5700.6C (DOE, 1991c). The final due dates and distribution of routine reports are also indicated in WP 02-3. The following sections identify the WIPP record-keeping and reporting procedures for compliance with applicable DOE orders.

9.1 RECORD KEEPING

Records generated by operational effluent and environmental surveillance activities are controlled and maintained in accordance with DOE Order 1324.2A (DOE, 1988), WIPP Records Management Procedures (WP 15-030), and WIPP Document Control Procedures (WP 15-006). All original records are maintained in a fire retardant file cabinets at the WIPP until transmitted to the WIPP Project Records Services for permanent filing. All records, including raw data, calculations, computer programs or other data manipulation, are subject to review and verification under the WIPP Quality Assurance Program.

Records (such as analyses reports and sample receipt forms transmitted by contract analytical laboratories) are dated upon receipt and a copy made for QC review as specified in NES/RES QA/QC Implementation Procedures (WP 02-302). Specific record and data management procedures including the recording and referencing of data manipulations are implemented according to the WP 02-1, RES Data Management Procedure (WP 02-305), and NES Data Management Procedure (WP 02-334).

Interpretive rule 10 CFR Part 962 Radioactive Waste, By-product Material (DOE, 1987), states that the hazardous component of radioactive mixed waste is subject to regulation under the RCRA. In accordance with 10 CFR Part 962, the WIPP must comply with all applicable regulations specified in 40 CFR Parts 260-268 and 270 (EPA 1980a-f, 1985d, 1981, 1986a, 1983a). The WIPP complies with applicable hazardous waste regulations regarding operating records, reporting, and availability and retention of records as determined by DOE and EPA.

The WIPP voluntarily complies with record-keeping requirements as promulgated under 40 CFR Part 61, Subpart H (EPA, 1985b), which pertain to atmospheric radionuclide emissions (WP 02-301). In addition, unless regulations are amended in the future, records development pursuant to these criteria are maintained at least 30 years, as specified in DOE 1324.2A (DOE, 1988), Chapter V, Attachment 1, Schedule 25 (Medical, Health and Safety Records).

9.2 REPORTING

The WIPP Environmental Monitoring Plan is reviewed annually and updated at least every three years in accordance with DOE Order 5400.1 (DOE, 1988d). Changes are made as new regulations are promulgated which specify record-keeping and reporting requirements applicable to the environmental monitoring program at the WIPP.

The WIPP Annual Site Environmental Report is prepared according to DOE Order 5400.1 (DOE, 1988d). This report summarizes the facility's compliance with applicable environmental regulations and informs the public as to the impact of the operations at WIPP on the surrounding environment.

The Environmental Protection Implementation Plan (EPIP) is revised annually in accordance with DOE Order 5400.1 (DOE, 1988d). This document delineates how the WIPP implements the provisions of DOE Order 5400.1. The EPIP identifies compliance strategies and manpower allocations, and describes the WIPP organizational structure.

The Annual Mitigation Report (AMR), required by DOE Order 5440.1E, is issued each July. This document describes the progress made in implementing the commitments made in the FEIS and SEIS Records of Decision. Several of the commitments that are being tracked pertain to environmental monitoring and environmental compliance.

The No-Migration Determination Annual Report is submitted annually to the EPA in November. This document meets the requirements of the "Conditional No-Migration Determination for the Department of Energy Waste Isolation Plant" (55 FR 47700). This report contains summaries of air monitoring and waste characterization data, as well as VOC monitoring results.

When WIPP begins to receive TRU waste, Radioactive Effluent and On-site Discharge Data Reports will be prepared and submitted to the Waste Information System Branch of EG&G Idaho, Inc., by April 1 of each year. DOE Order 5480.14 specifies instructions for implementing a DOE Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program (DOE, 1985c). No inactive hazardous-waste disposal sites requiring remedial action under CERCLA exist at WIPP. WIPP notifies the National Response Center in the case of a release of "reportable quantities" of radionuclides or other hazardous substances at the WIPP as required by CERCLA §102(a) (DOE, 1985c).

The EPA has promulgated environmental standards for the management and disposal of transuranic radioactive wastes under the authority of the EPA and the Nuclear Waste Policy Act (NWPA). The EPA has not specified reporting requirements applicable to the WIPP under this regulation.

The Office of Management and Budget Circular A-106, "Reporting Requirements in Connection with the Prevention, Control, and Abatement of Environmental Pollution at Existing Federal Facilities" (OMB, 1975), has established a semiannual reporting requirement for implementing Sections 1 through 4 of Presidential Executive Order 12088 and Presidential Executive Order 11752 pertaining to the control of environmental pollution from existing federal facilities. The plans, to be submitted on December 31 and June 30, identify projects necessary to bring federal facilities into compliance with applicable environmental standards.

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WP 12-12, "Low Level Counting Laboratory Manual"

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WP 13-003, "Nonconformance Control"

WP 13-004, "Auditor Training and Lead Auditor Certification"

WP 13-005, "Internal and supplier Quality Assurance Audits"

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APPENDIX D9

EXPOSURE ASSESSMENT FOR PROTECTION OF THE ATMOSPHERE

D9-1 Introduction

The purpose of this analysis is for the assessment of potential human exposure to waste emissions in the atmosphere, and a comparison of that potential exposure to acceptable regulatory levels. 20 NMAC 4.1, Subpart V, §264.601 requires such an assessment for disposal of hazardous waste in a miscellaneous unit.

This assessment applies only to potential air emissions from waste containers during normal operations and the closure time period of the Waste Isolation Pilot Plan (WIPP) facility. In response to a request from the NMED, a calculation of releases during an offnormal event is also included. After final facility closure of the repository, no credible pathway will exist for air emissions. Once sealed, the waste is confined by engineered and natural barriers, which prevent the release of waste constituents in the atmosphere. In this assessment, only gaseous emissions will be considered as a source, because any particulate matter will be contained in the waste containers or panel closures and no liquid waste will be accepted for disposal. Of the gaseous constituents, the assessment is limited to volatile organic compounds (VOC), which comprise approximately 99 percent of the risk.

This appendix provides calculation details and summaries of risk assessments and worker exposures for the operational phase of the WIPP facility. The analyses included here are the

- risk to a hypothetical member of the public at the boundary of the site
- risk to potential members of the public within the boundary of the site
- assessments of worker exposure on the surface within the site
- assessments of worker exposure in the underground portion of the facility

The exhaust shaft concentration of VOCs, which are used in the exposure and risk assessments included in this appendix, are given in Section D9-2. The exposure scenarios are described in Section D9-3. The air dispersion modeling factors for the assessments are given in Section D9-4. Section D9-5 details the calculations for each risk and worker exposure assessment, and Section D9-6 summarizes the assessment results.

D9-2 Exhaust Shaft Concentrations of VOCs

During waste disposal at the WIPP facility, closure systems will be used to isolate waste in a filled panel and to eliminate ventilation through these filled panels. Similarly, as individual rooms within a panel are filled, ventilation barriers will be placed on the filled rooms to prevent the flow of ventilation air through these filled rooms and to isolate the rooms. Exhaust shaft concentrations of VOCs will thus vary with the number of filled, closed panels, the number of filled rooms with ventilation barriers within an open panel, and the number of drums in an open room.

D9-2.1 Exhaust Shaft Concentrations of VOCs from a Closed Panel

Exhaust shaft concentrations of VOCs from a single closed panel are calculated as follows:

$$SCPE = \frac{X \times GR \times HS \times \left(\frac{1\ mole\ fraction}{1\times10^6\ ppmv}\right) \times MW \times (1 \times 10^6\ \mu g/g) \times P_c}{V \times 0.0283\ m^3/ft^3 \times (525{,}600\ min/year)} \quad \text{(D9-1)}$$

where,

$SCPE$	=	exhaust shaft concentration of the VOC from a single closed panel, $\mu g/m^3$
X	=	number of drums in a closed panel, 81,000 drums/panel
GR	=	effective gas generation rate, 0.5 moles/drum/year
HS	=	weighted average headspace concentration of the VOC, ppmv
MW	=	molecular weight of the VOC, g/mole
P_c	=	number of closed panel equivalents, 1 panel
V	=	mine ventilation exhaust rate, 425,000 ft^3/min

Weighted average headspace concentrations are based on sampling and analysis of wastes from the Idaho National Engineering Laboratory (INEL) and the Rocky Flats Environmental Technology Site (RFETS). The weighted average headspace concentrations are derived in Appendix D13.

During the placement of waste at WIPP, closure systems will be used to isolate wastes in a full panel and to eliminate ventilation through these filled panels. Assuming a continuous fresh air flow across the filters, VOCs will diffuse from the drums at a rate that is dependent on the concentration gradient across the filters and the diffusion properties of the VOCs, as described in Appendix D12. After a panel is filled and the ventilation barrier is installed, which is the first step in the closure process, fresh air will no longer flow across the waste drums, and VOC concentrations in the dead air space above the filter will begin to buildup and approach the concentrations in the drum headspace. Therefore, the maximum concentration of VOCs that would be present in the panel atmosphere would be equivalent to the average drum headspace concentration. For the risk assessments, it is conservatively assumed that the average drum headspace concentrations serve as a constant source of VOCs.

The ventilation barrier design includes the use of low-permeability materials that restrict the diffusion of VOCs from the panel; therefore, gas pressurization is assumed to be the only process that would cause VOCs to migrate beyond a panel with a ventilation barrier installed (Appendix I1). Pressurization within a panel will be caused by gas generation and volume reduction due to creep closure of the repository. The panel closure systems will be designed to withstand some pressure buildup; however, for this evaluation, the leakage rate from the panel closure system is conservatively assumed to be equivalent to the effective gas generation rate.

Appendix D11 includes information on gas generation by WIPP waste. Of the gas-generating mechanisms described in Appendix D11, microbial degradation will contribute the most to the generation rate during the time periods of interest. The best estimate for gas generation from microbial degradation under humid conditions is 0.1 moles of gas per drum per year (see Appendix D11 and D16-5). The recommendation in D16-5 is for a rate of 0.02 moles/kg/year. This results in 0.2 moles/drum/year, based on 10kg of cellulosics per drum. However, the memo in D11 states that mocrobial degradation only occurs half of the time. This time results in a 0.1 mole/drum/year rate. For the period of time in this analysis, there is not expected to be enough brine flow into panels to create an inundated environment, which would be necessary to produce these and higher gas generation rates. This analysis conservatively assumes that a humid condition will exist to produce gas at a rate of 0.1 moles per drum per year.

Although Appendix D11 states that the maximum expected value for any one drum of waste is 0.4 moles per drum per year, the lowest expected value for any one drum is 0 moles per drum per year. A discussion of the relationship between gas generation, brine inflow, and creep closure can be found in Section I-1e(4). In reality, under the conditions that will initially exist in a closed panel, the predominant degradation mechanisms may consume gas at a rate faster than it is produced. This outcome is a function of the availability of nutrients to sustain microbial activities. Indications of gas consumption activities are in Francis and Gillow (1994), where they reported 200-day experiments (see Appendix D11).

The average creep closure rate, as discussed in Appendix I1, will result in a reduction of the panel void volume of 812 m^3 per year for each panel. Converting this volumetric reduction rate to a molar (gas) displacement rate, using the Ideal Gas Law:

$$GDR = \frac{812\ m^3}{panel/year} \times \frac{P}{RT} \qquad \text{(D9-2)}$$

Since one full panel contains 81,000 drums of waste, this rate expressed on a drum basis is:

$$GDR = \frac{812\ m^3}{panel/year} \times \frac{1\ atm}{\left(\frac{0.082\ L \bullet atm}{mole \bullet K}\right) \times (298K)} \times \left(\frac{1\times10^3\ L}{m^3}\right) \times (panel/81{,}000 drum)$$

$$GDR = 0.4\ mole/drum/year$$

$$GDR = (4.74\ x\ 10^3\ mole/panel/year) \times (panel/81{,}000 drum)$$

An effective gas generation rate (gas generation rate plus gas displacement rate) can be calculated as follows:

$$GR = GGR + GDR \qquad \text{(D9-3)}$$

where,

GR	=	effective gas generation rate, mole/drum/year
GGR	=	gas generation rate due to microbial degradation in a humid environment, 0.1 mole/drum/year
GDR	=	gas displacement rate due to salt creep (creep closure), 0.4 mole/drum/year

$$GR = (0.1\ mole/drum/year) + (0.4\ mole/drum/year)$$

$$GR = 0.5\ mole/drum/year$$

D9-2.2 Exhaust Shaft Concentrations of VOCs from an Open Panel without Ventilation Barriers

Exhaust shaft concentrations of VOCs from an open panel without ventilation barriers on the filled rooms are calculated using the equation

$$SOPE = \frac{X \times ADE_{VOC} \times MW \times (1 \times 10^6\ \mu g/g) \times P_o}{V \times 0.0283\ m^3/ft^3 \times \left(\frac{1}{60\ s/min}\right)} \qquad \text{(D9-4)}$$

where,

$SOPE$	=	exhaust shaft concentration of the VOC from a full open panel without ventilation barriers on the filled rooms, $\mu g/m^3$
X	=	number of drums in a full panel, 81,000 drums/panel
ADE_{VOC}	=	the average drum VOC emission rate, mole/s/drum
MW	=	molecular weight of the VOC, g/mole
P_o	=	number of open panel equivalents, 1 panel
V	=	mine ventilation exhaust rate, 425,000 ft^3/min

The average drum emission rate for each VOC is calculated from the diffusion rate using the following equation:

$$ADE_{VOC} = D_{VOC} \times MF_{VOC} \times 31{,}536{,}000\ s/year \qquad \text{(D9-5)}$$

where,

ADE_{VOC} = average drum VOC emission rate, mole/drum/year
D_{VOC} = the VOC diffusion characteristic through a model NFT-013 carbon composite filter, mole/s/mole fraction/drum
MF_{VOC} = mole fraction of the VOC, mole/mole

The mole fraction of each VOC is calculated from its weighted average headspace concentration by:

$$MF_{VOC} = (HS_{VOC}) \times (10^{-6}\ mole\ fraction/ppmv) \qquad \text{(D9-6)}$$

where,

MF_{VOC} = mole fraction of the VOC, mole/mole
HS_{VOC} = average headspace concentration for VOC, ppmv.

For filter-specific diffusion characteristics, the ratio of VOC-to-H_2 diffusivities in air are calculated as follows:

$$\frac{D_{VOC\text{ - }air}}{D_{H_2\text{ - }air}} = \left(\frac{P_{c,VOC}}{P_{c,H_2}}\right)^{1/3} \times \left(\frac{T_{c,VOC}}{T_{c,H_2}}\right)^{-1/2} \times \left[\frac{\left(\frac{1}{MW_{air}} + \frac{1}{MW_{VOC}}\right)}{\left(\frac{1}{MW_{air}} + \frac{1}{MW_{H_2}}\right)}\right]^{1/2} \qquad \text{(D9-7)}$$

where,

$D_{VOC\text{-}air}$ = diffusivity of the VOC in air, mole/s/mole fraction/drum
$D_{H2\text{-}air}$ = diffusivity of hydrogen in air, mole/s/mole fraction/drum
$P_{c,\,VOC}$ = critical pressure of the VOC, atm
$P_{c,H2}$ = critical pressure of hydrogen, 12.8 atm
$T_{c,VOC}$ = critical temperature of the VOC, K
$T_{c,air}$ = critical temperature of hydrogen, 33.2K
MW_{VOC} = molecular weight of the VOC, g/mole
MW_{H2} = molecular weight of hydrogen, 2.016 g/mole
MW_{air} = molecular weight of air, 28.946 g/mole

The filter-specific VOC diffusion characteristics from the ratio of VOC-to-H_2 diffusivities in air are calculated using the following equation:

$$D_{VOC} = \left(\frac{D_{VOC\text{ - }air}}{D_{H_2\text{- }air}} \right) \times D_{H_2} \qquad \text{(D9-8)}$$

where,

D_{VOC} = the VOC diffusion characteristic through a model NFT-013 carbon composite filter, mole/s/mole fraction/drum

D_{H2} = the diffusion characteristic for hydrogen through a model NFT-013 carbon composite filter, 1.17E-5 mole/s/mole fraction/drum.

VOC-specific properties for calculating diffusion rates, the SOPE, and the SCPE are given in Table D9-1.

VOCs considered in all calculations are indicator VOCs selected using the screening technique in EPA (1989, p 5-23). These indicator VOCs represent approximately 99 percent of the risk due to air emissions. This screening methodology is described in detail in Appendix D13.

TABLE D9-1

PROPERTIES USED IN CALCULATING DIFFUSION RATES AND EMISSION CONCENTRATIONS

Constituent	*Pc* Critical Pressure (atm)	*Tc* Critical Temperature (K)	*MW* Molecular Weight (g/mole)	*Dvoc* Diffusivity (mole/s/mole fraction/ drum)	*HS* Weighted Average Concentration (ppmv)
Carbon Tetrachloride	45	556.4	153.84	1.21E-06	375.5
Chlorobenzene	44.6	632.4	112.56	1.16E-06	12.5
Chloroform	54	536.4	119.39	1.34E-06	25.3
1,1-Dichloroethylene	51.3	495	96.95	1.40E-06	11.5
1,2-Dichloroethane	53	561.6	98.97	1.32E-06	9.1
Methylene Chloride	60	510	84.94	1.47E-06	368.5
1,1,2,2-Tetrachloroethane	57.6	644.5	167.86	1.21E-06	9.4
Toluene	40.6	591.7	92.13	1.19E-06	19.4
1,1,1-Trichloroethane	42.4	545	133.42	1.21E-06	317.1

ppmv = parts per million by volume

D9-2.3 Public Exposure Concentrations of VOCs

As the waste disposal operations proceed, an increasing number of drums are emplaced in the open panel contributing to the exhaust shaft concentration. In addition, an increasing number of closed panels contribute to the exhaust shaft concentration over time.

The exhaust shaft concentrations for 9 closed and one open panel are conservative for any exposure prior to filling the last panel. From the full open panel, maximum VOC emissions will depend on the presence of ventilation barriers outside the filled rooms. Two levels of conservatism are possible: (1) assuming that rooms in the full panel do not have ventilation barriers installed and VOC emissions are from all drums (i.e., 81,000) in the panel and (2) assuming that the filled rooms within the open panel have ventilation barriers installed and only the drums (i.e., 11,571) in the last room are freely contributing to VOC emissions. The average exhaust shaft VOC concentration over the operational period of the facility will be lower than the maximum for 9 closed panels and 1 full open panel.

The maximum exhaust shaft concentrations of VOCs from 9 closed panels and one open panel without ventilation barriers outside the filled rooms is calculated as EC_{max} using the equation

$$EC_{max} = \left(P_c \times SCPE \right) + \left(P_o \times SOPE \right) \qquad \text{(D9-9)}$$

where,

EC_{max} = exhaust shaft concentration of the VOC from 9 closed panels and 1 full open panel without ventilation barriers outside the filled rooms, $\mu g/m^3$

P_c = number of closed panel equivalents, 9 panels

P_o = number of open panel equivalents, 1 panel

D9-2.4 Surface Worker Exposure Concentration

The maximum exposure concentration for the worker on the surface of the facility is based on emissions from 9 closed and 1 full open panel with ventilation barriers on 6 of the seven rooms. The surface worker exposure concentration is calculated from the exhaust shaft concentration multiplied by the ADF. The exhaust shaft concentration is calculated:

$$ECS_{MAX} = \frac{(AOPE_{VOC}) + (P_C \times R_C \times ACRE) \times MW \times 1 \times 10^6 \ \mu g/g}{Q \times 0.0283 \ m^3/f^3 \times 525{,}600 \ min/yr} \qquad \text{(D9-11)}$$

where,

ECS_{MAX} = exhaust shaft concentration of the VOC from 9 closed panels and 1 full open panel with ventilation barriers, $\mu g/m^3$

$AOPE_{VOC}$ = average open panel VOC emission rate, mole/panel/year

P_c = number of closed panel equivalents, 9 panels
R_c = number of closed rooms in the open panel, 7 rooms/panel
$ACRE_{VOC}$ = average closed room VOC emission rate, mole/room/year
MW = molecular weight of the VOC, g/mole
Q = ventilation rate through the mine, 425,000 ft^3 /minute

The average open panel yearly emission rate (AOPE) for each VOC is based on the number of full rooms, the number of drums in the open room, and the emission rates from each type of room. AOPE for 1 open and 6 closed rooms is calculated as:

$$AOPE_{VOC} = (R_o \times AORE_{VOC}) + (R_c \times ACRE_{VOC}) \qquad \text{(D9-12)}$$

where,

$AOPE_{VOC}$ = average open panel VOC emission rate, mole/panel/year
$AORE_{VOC}$ = average open room VOC emission rate, mole/room/year
$ACRE_{VOC}$ = average closed room VOC emission rate, mole/room/year
R_o = number of open rooms in the open panel, 1 room/panel
R_c = number of closed rooms in the open panel, 6 room/panel

The open room emission rate (AORE) is dependent on the number of drums that have been emplaced in the room and the diffusion of VOCs across the drum vent filters. Assuming a continuous fresh air flow across the filters, VOCs will diffuse from the drums at a rate that is dependent on the concentration gradient across the filters and the diffusion properties of the VOCs, as described in Appendix D12. The AORE is calculated using the equation

$$AORE_{VOC} = ADE_{VOC} \times D \qquad \text{(D9-13)}$$

where,

$AORE_{VOC}$ = average open room VOC emission rate, mole/room/year
ADE_{VOC} = average drum VOC emission rate, mole/drum/year
D = number of drums in the room, drum/room.

The average yearly closed room emission rate (ACRE) for each VOC is calculated as:

$$ACRE_{VOC} = (GR) \times (11{,}571\ drum/room) \times MF_{VOC} \qquad \text{(D9-14)}$$

where,

$ACRE_{VOC}$ = average yearly closed room VOC emission rate, mole/room/year
GR = effective gas generation rate, mole/drum/year
MF_{VOC} = VOC mole fraction, mole/mole

GR is defined as above for gas generation through closed panels. Similar to panel closures, ventilation barriers will be used to isolate wastes in a full room and to eliminate ventilation through these filled rooms. As for panels (Section D9-2.1), gas pressurization is assumed to be the only process that would cause VOCs to migrate beyond a closed room. The effective gas generation rate used for calculating ACRE, then, is 0.5 moles/drum/year.

D9-2.5 Underground Worker Exposure Concentration

The maximum exposure concentrations of VOCs to workers is the hazardous waste worker who is emplacing waste at the beginning of the next open room, which will place the worker downstream in the ventilation air of previously filled rooms with ventilation barriers, but always upstream of the open room waste. This concentration is calculated as folows:

$$ECU_{max} = \frac{(R_C \times ACRE_{VOC}) \times MW \times 10^6\ \mu g/g \times P_o}{Q \times 0.0283\ m^3/ft^3 \times 525{,}600\ \text{min}/year} \qquad \text{(D9-10)}$$

where,

ECU_{max}	=	exposure concentration of the VOC from 1 full open panel with ventilation barriers on the filled rooms, $\mu g/m^3$
R_c	=	number of closed rooms in the open panel, 6 room/panel
$ACRE_{VOC}$	=	average closed room VOC emission rate, mole/room/year
MW	=	molecular weight of the VOC, g/mole
P_o	=	number of open panel equivalents, 1 panel
Q	=	ventilation rate through the open room, 35,000 ft^3 /minute

D9-3 Exposure Assessment

In order to assess the potential public exposure to hazardous constituents in the air, first the probable public activities both outside and inside the WIPP site boundary during the 35-year operational/closure time frame are evaluated. Exposure scenarios for potential receptors both outside and inside the WIPP site boundary are then described.

D9-3.1 Public Activity Outside the WIPP Site Boundary

The most prevalent public activity currently outside the WIPP site boundary is oil and gas production. Several wells are located along the boundary, and drilling activities may require oil workers to be present continuously, but not for several years at a time. Oil activities could be ongoing 24 hours-a-day, 7 days-a-week, up to six months at a time, but the same oil workers are not likely to be present for several years.

Since the land immediately adjacent to the WIPP site boundary is federal or state land, a family could not theoretically build a house or dwelling at the boundary; however, one could

potentially occupy that space for long periods of time. Currently, there are only 27 residents within a 10-mile radius of the WIPP facility, and the closest dwelling is the Mills ranch house approximately 3/4 miles south of the southwest corner of the WIPP site boundary (Figure D9-1).

D9-3.2 Public Activity Inside the WIPP Site Boundary

As shown in Figure D9-1, the area of land that lies within the WIPP site boundary contains approximately 10,240 acres including Sections 15-22 and 27-34 in Township 22 South and Range 31 East. This area contains three other distinct boundaries that limit public access. The innermost boundary, which contains most of the WIPP facility structures, is surrounded by a chain link fence and covers approximately 35 acres in Sections 20 and 21. This fenced area is known as the Property Protection Area. Only persons on official business are allowed within this area. Access is controlled by a 24-hour per day security force. The next area is surrounded by a barbed-wire fence, covers approximately 424 acres, and is posted "No Trespassing." This area is known as the Exclusive Use Area. The public may access this area for short periods of time for limited purposes. This area is patrolled frequently by the security force. The third area covers approximately 1,450 acres, is posted "No Trespassing," and is known as the Off Limits Area. Within this area, certain activities, such as hunting, are prohibited. Other forms of public access are allowed with permission of the DOE. The fourth area covers approximately 10,240 acres and is leased for cattle grazing.

Public access is allowed inside the WIPP site boundary for various activities and for various periods of time. Activities that take place inside the WIPP site boundary are described in detail in DOE (1993).

D9-3.2.1 Agricultural Uses

All the land within the WIPP site boundary outside the Exclusive Use Area has been leased for grazing, which is the only significant agricultural activity in the vicinity. There are two leaseholders as shown in Figure D9-1. The Livingston Ridge Allotment, currently leased by Kenneth Smith, Inc., of Carlsbad, New Mexico, includes 2,880 acres within the northern portion of the WIPP Site. J.C. Mills of Abernathy, Texas, current lessee of the Antelope Ridge Allotment, has lease rights to 7,360 acres within the southern portion of the WIPP Site.

D9-3.2.3 Recreational Activities

Hunting, camping, horseback riding, hiking, wildlife watching, and sightseeing are all activities that may be permitted inside the WIPP site boundary up to the boundaries marked "No Trespassing". Campers are required to check in with WIPP Security personnel before establishing camp. Although all of these activities are allowed and managed (DOE 1993), no member of the public is expected to perform any of these activities on WIPP property for long periods of time. Hunting durations are short and are established and enforced by the State of New Mexico. The other activities mentioned above are not likely to occur, because the WIPP facility is in a hot, arid environment, and much more scenic areas are in the vicinity for these activities (e.g., Guadalupe Mountains).

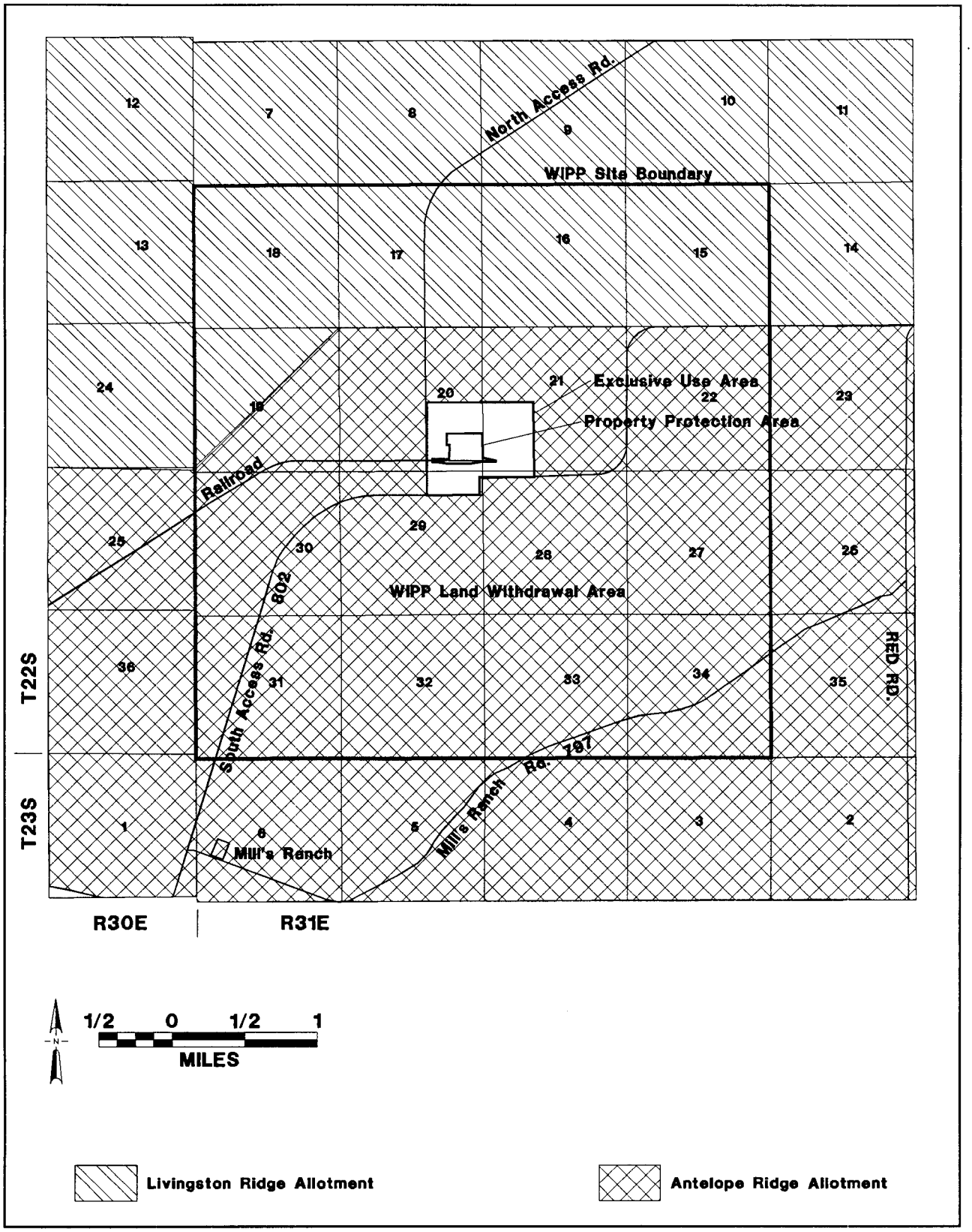

Figure D9-1
Grazing Allotments in the Vicinity of the WIPP Land Withdrawal Area

RCRAD9-2

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D9-3.2.4 Scientific Research

Some scientific research is conduced for WIPP-related activities (i.e., archaeological and geological studies), but public research inside the WIPP site boundary does not typically occur. If such studies were to occur in the future, the time frame for such studies would be short-term (hours, days, or weeks at most) and would not pose significant exposure concerns for the public.

D9-3.3 Public Exposure Outside the WIPP Site Boundary

The worst-case exposure just outside the WIPP site boundary is conservatively assumed to occur to the hypothetical member of the public who could occupy space on the boundary up to 24 hours-a-day, 365 days-a-year, for 35 years (EF = 8760 hours/year, ED = 35 years, AT = 613,200 hours). This exposure scenario is referred to in following sections as the ***Boundary Public Receptor***. The Boundary Public Receptor exposure scenario is not considered a realistic scenario because residents around the facility live some distance away from the site boundary. More realistic exposure scenarios are those relating to ranching activities within the site boundary as discussed below.

D9-3.4 Public Exposure Inside the WIPP Site Boundary

The worst-case exposure of a member of the public to hazardous constituents released into the air around the WIPP facility is assumed to occur to the rancher who may be on land leased for cattle grazing. The exposure is assumed to be equally likely for any point within the area. The assumption is conservative, because the ranch hand is typically inspecting fences and watering facilities, which takes him to isolated locations either on the periphery of the grazing area or to locations which are not principle downwind locations. DOE is responsible for inspecting the fence on the boundary of the grazing allotment adjacent to WIPP. Because no actual statistics exist regarding the amount of time a ranch hand may spend at any field location on a ranch, the DOE had to make several assumptions in order to prepare the exposure analysis. The exposure time assumptions have been made in a manner that tends to overestimate exposures. First, it is assumed that a ranch hand spends 8 hours per day, 5 days per week (EF = 2080 hours/year) for 35 years (ED = 35 years, AT = 613,200 hours)working the ranch. This is conservative, because ranchers rotate pastures to protect them from overgrazing. As a result, there will be extended periods of time when there will be no activity in the grazing areas within the WIPP site boundary. Second, it is assumed that a single ranch hand from each ranch works only on the portions of the leases within the WIPP site boundary. This is conservative, because the lease covers a much larger area than what lies within the WIPP site boundary. Third, the exposure assessment is based on the average ground-level, rather than inhalation level, concentrations of hazardous constituents for each area of grazing-leased land between the WIPP site boundary and the Exclusive Use Area.

For the exposure assessment, two hypothetical receptors are evaluated, corresponding to ranchers working on each of the two grazing allotments within the WIPP site boundary. The exposure scenarios are referred to in following sections as ***Livingston Ridge Rancher*** and ***Antelope Ridge Rancher***.

D9-3.5 Occupational Exposure Inside the WIPP Site Boundary

Two additional exposure scenarios that hypothetically occur within the WIPP site boundary are also evaluated in this appendix. One additional scenario is that of a worker who works on site 1,920 hours/year (EF = 1,920 hours/year), for 10 years (ED = 10 years, AT = 613,200 hours) on the surface near the exhaust shaft. The 1920 hours are the hours for an employee after removing vacations and holidays. This is conservative since workers spend approximately ten percent of their time off site at training, travel, and meetings. The ten year exposure duration represents normal turnover in employees. Turnover, in this case includes new employment, new positions and new locations at the facility. The exposure location chosen corresponds to the maximum VOC exposure at the surface within the site boundary and is located in the property protection area. The scenario is referred to in following sections as ***Surface Worker***.

The second scenario is that of an underground worker who works "downwind" of a full, but closed room. This worker performs hazardous waste duties and is estimated to be working downstream of a closed room while beginning to fill each subsequent room 33 hours/year for 10 years. The underground worker exposure scenario is a worst-case exposure scenario, and is referred to in the following sections as ***Underground Worker***. The exposure frequency was developed based on the expected operational throughput times in Figure D-36 and the number of waste locations in the area of a room (130) that is downwind from a room exhaust. The 130 positions represents stacks that are 3 high, so 390 waste units (7-pack, SWB, 4-pack, or TDOP) are involved. These configurations represent approximately 100 pallets of waste, which take 30 minutes per pallet to emplace or 50 hours per room. Backfill requires 30 minutes every time a row of 5 stacks is complete. Since there are 26 rows in this area (130 ÷ 5), 13 hours for emplacing backfill is needed. This results in a total of 63 hours per room that are spent downwind from full rooms. Finally, a waste worker will be downwind for Rooms 6 through 1; however, the amount of waste in the Room 1 entry is 32 positions (1/4 of Rooms 2-6) so that the total exposure time in a panel is 63 × 5.25 = 330 hours. This exposure occurs over the 2.5 years required to fill the panel and is shared equally by four waste workers resulting in an annual exposure of 330 ÷ 2.5 ÷ 4 = 33 hours/year.

D9-4 Air Dispersion Modeling

This section presents the results of specific air dispersion modeling performed inside and outside the WIPP site boundary that are used in assessing the scenarios described in Section D9-3 for exposures at the surface, that is, for the Boundary Public, Livingston Ridge Rancher, Antelope Ridge Rancher, and Surface Worker. The Long-Term Version of the Industrial Source Complex (ISCLT3) model, EPA (1995), was used for the air dispersion modeling. Concentrations were modeled in accordance with EPA (1992). Details of the modeling is described in Appendix D10.

To determine areas where the maximum concentrations may occur, the air dispersion model was run with a coarse receptor grid of 400 meters (see Figure D9-2). To model the boundary public exposures, the air dispersion model was run with a fine receptor grid of 10 meters around the point of highest concentration predicted on the boundary during the coarse grid

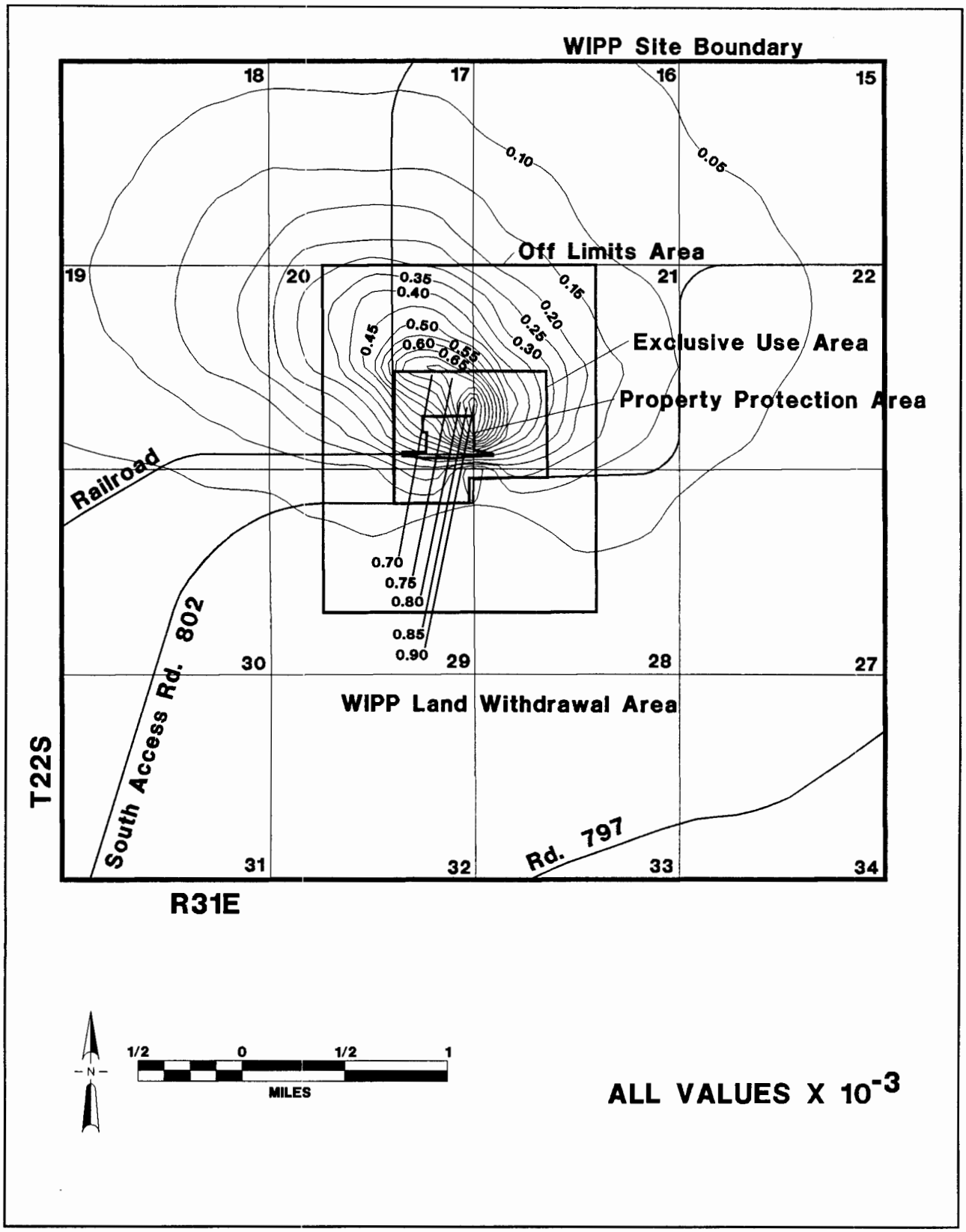

Figure D9-2
Air Dispersion Factors at WIPP

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run. To determine the exposure concentrations at the WIPP site boundary, the annual average concentration anywhere on the boundary is used to determine the ADF for the boundary public receptor. That average concentration, which was modeled from an arbitrary 1,000 $\mu g/m^3$ source, is divided by 1,000 $\mu g/m^3$ to arrive at the air dispersion factor (ADF) used in the risk calculations presented in Section D9-5. The ADF for the boundary public receptor is 1.2×10^{-4} (Table D9-2).

For the rancher exposure assessments, the coarse grid run mentioned above was used. This grid covers all of the leased land within the WIPP site boundary as shown in Figure D9-1. All concentrations derived in the model run were then averaged for each lease, representing an average exposure concentration throughout the leased land inside the boundary. The resulting ADF for the Livingston Ridge Allotment is 9.8×10^{-5} and the ADF for the Antelope Ridge Allotment is 6.7×10^{-5}.

For determining the exposure concentrations to the surface worker, the model was run with a fine receptor grid of 10 meters around the area with the highest concentration inside the WIPP site boundary predicted during the coarse grid run (see Figure D9-3). This area was near the exhaust fans. The ADF for the surface worker is 1.23×10^{-2}.

TABLE D9-2
AIR DISPERSION FACTORS FOR WIPP SITE AREAS

Area	Averaged/Modeled Concentration ($\mu g/m^3$)	Air Dispersion Factor (ADF)
WIPP Site Boundary	1.2E-01	1.2E-04
Livingston Ridge Allotment	9.8E-02	9.8E-05
Antelope Ridge Allotment	6.7E-02	6.7E-05
WIPP Property Protection Area	1.23E+01	1.23E-02

D9-5 Receptor Concentrations and Risk Calculations

Risks and hazards for the public exposure scenarios described in Section D9-3 are described in this section. Also presented are evaluations of VOC concentration levels to worker receptors. The equations used in assessing excess risk from carcinogens and hazard from noncarcinogens are derived and given. The calculations use exposure factors as appropriate for the exposure scenarios. ADFs are used for the Boundary Public, Livingston Ridge Rancher, Antelope Ridge Rancher, and Surface Worker scenarios. The calculations assume the receptors are subjected to concentrations based on maximum exhaust shaft VOC concentrations, which are those concentrations that result from emissions from 9 closed and

1 full open panels. The full open panel is conservatively assumed to contain no room closures for assessing impacts to the public at the surface, that is, the Boundary Public, Livingston Ridge Rancher, Antelope Ridge Rancher, and Surface Worker scenarios. These scenarios also include model estimates of concentrations from air dispersion. For assessing impact to an underground worker, only one full open panel is used and is assumed to contain room closures. Since this worker is exposed to underground concentrations, no air dispersion takes place before exposure.

D9-5.1 Public Risk Outside the WIPP Site Boundary

The Boundary Public exposure scenario is evaluated in this section. An ADF of 1.2×10^{-4} is used in assessing risk from emissions from 9 closed and 1 open panel equivalents, with no credit taken for room closures within the open panel.

D9-5.1.1 Carcinogens

For carcinogens, risk is calculated as follows:

$$Risk = \frac{EC \times ADF \times URF \times EF \times ED}{AT} \qquad \text{(D9-15)}$$

where,

- $Risk$ = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
- EC = maximum exhaust shaft concentration for the VOC, $\mu g/m^3$, EC_{max}
- ADF = air dispersion factor, unitless, 1.2×10^{-4}
- URF = unit risk factor for VOC, $(\mu g/m^3)^{-1}$
- EF = exposure frequency, 8,760 hours/year (24 hours/day × 365 days/year)
- ED = exposure duration, 35 years
- AT = averaging time, 613,200 hours (24 hours/day × 365 days/year × 70 years)

Equation D9-15 was derived from equations in EPA (1989); the derivation is shown below.

EPA (1989), page 6-44, provides the calculation of residential exposure from inhalation of airborne (vapor phase) chemicals as:

$$Intake = \frac{CA \times IR \times EF \times ED}{BW \times AT} \times \left(\frac{mg}{1 \times 10^3\ \mu g} \right) \qquad \text{(D9-16)}$$

where,

- $Intake$ = receptor intake, mg/kg-day
- CA = contaminant concentration in air, $\mu g/m^3$
- IR = inhalation rate, 20 m^3/day

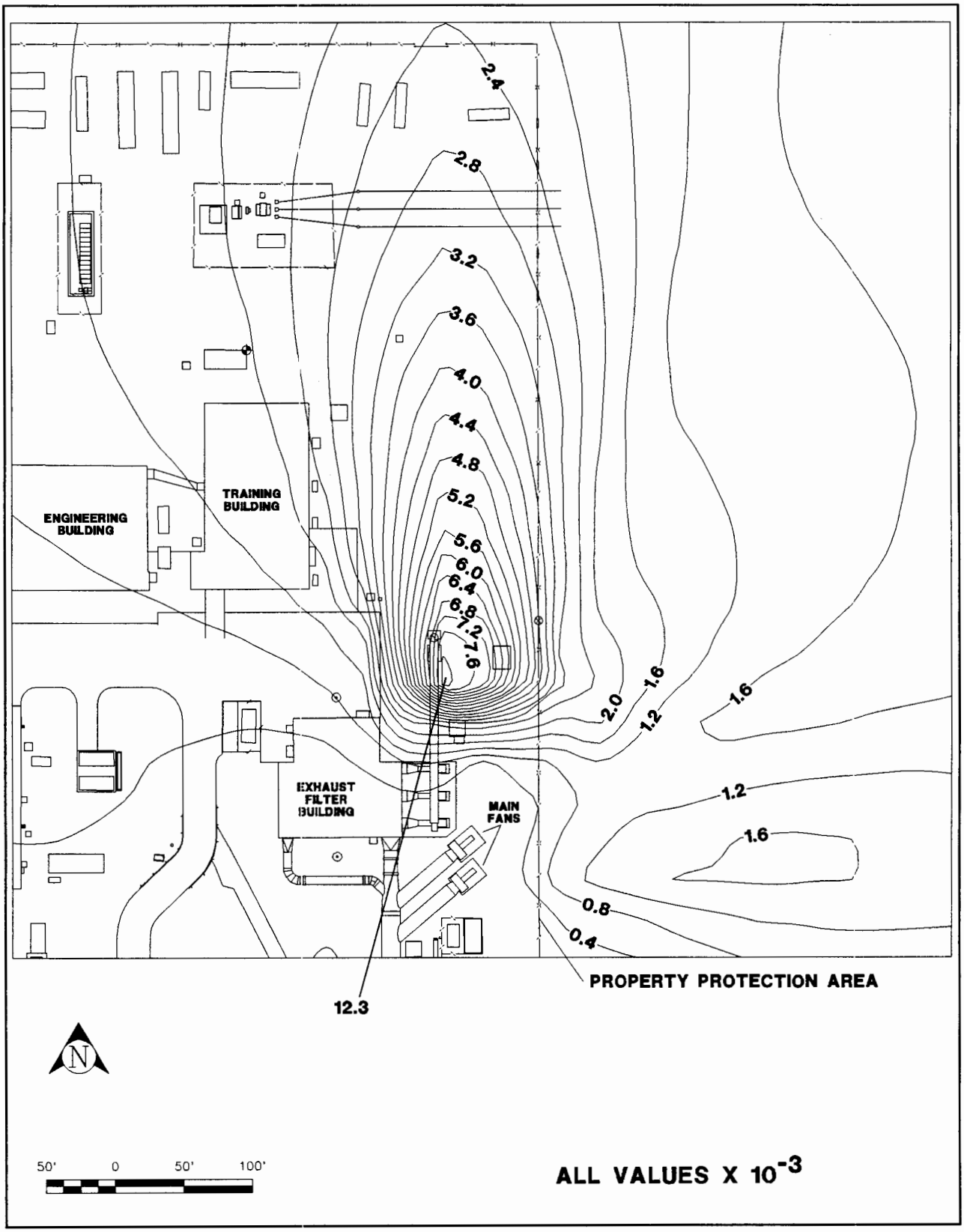

Figure D9-3
Air Dispersion Factors Inside the Property Protection Area

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EF = exposure frequency, hours/year
ED = exposure duration, years
BW = body weight, 70 kg
AT = averaging time, days

EPA (1989), page 8-6, also describes chronic intake as:

$$Intake = \frac{Risk}{SF} \qquad \text{(D9-17)}$$

where,
Intake = receptor intake, mg/kg-day
Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
SF = cancer slope factor, $(mg/kg\text{-}day)^{-1}$

To express the carcinogenic effect in terms of unit risk factor, as provided in EPA (1989), page 7-13, the following equation is used:

$$URF = \frac{SF \times IR}{BW} \times \left(\frac{mg}{1 \times 10^3\ \mu g} \right) \qquad \text{(D9-18)}$$

where,
URF = unit risk factor, unitless
IR = inhalation rate, 20 m^3/day
BW = body weight, 70 kg
SF = cancer slope factor, $(mg/kg\text{-}day)^{-1}$

Solving for slope factor in equation D9-18:

$$SF = \frac{URF \times BW}{IR} \times \left(\frac{1 \times 10^3\ \mu g}{mg} \right) \qquad \text{(D9-19)}$$

where,
SF = cancer slope factor, $(mg/kg\text{-}day)^{-1}$
URF = unit risk factor, unitless
BW = body weight, 70 kg
IR = inhalation rate, 20 m^3/day

Combining equation D9-17 and D9-19:

$$Intake = \frac{Risk \times IR}{URF \times BW} \times \left(\frac{mg}{1 \times 10^3\ \mu g}\right) \qquad \text{(D9-20)}$$

where,

Intake	=	receptor intake, mg/kg-day
Risk	=	a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
IR	=	inhalation rate, 20 m^3/day
URF	=	unit risk factor, unitless
BW	=	body weight, 70 kg

Setting equations D9-16 and D9-20 equal to each other:

$$\frac{Risk \times IR}{URF \times BW} \times \left(\frac{mg}{1 \times 10^3\ \mu g}\right) = \frac{CA \times IR \times EF \times ED}{BW \times AT} \times \left(\frac{mg}{1 \times 10^3\ \mu g}\right)$$

and solving for risk yields equation D9-21:

$$Risk = \frac{CA \times URF \times EF \times ED}{AT} \qquad \text{(D9-21)}$$

where,

Risk	=	a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CA	=	contaminant concentration in air, $\mu g/m^3$
URF	=	unit risk factor, unitless
EF	=	exposure frequency, hours/year
ED	=	exposure duration, years
AT	=	averaging time, days

For this assessment, the contaminant concentration in air is the exhaust shaft concentration in air (EC) multiplied by the ADF as follows:

$$CA = EC \times ADF \qquad \text{(D9-22)}$$

where,

CA	=	contaminant concentration in air, $\mu g/m^3$
EC	=	exhaust shaft concentration for the VOC, $\mu g/m^3$
ADF	=	air dispersion factor, unitless

Combining equations D9-21 and D9-22 yields equation D9-15:

$$Risk = \frac{EC \times ADF \times URF \times EF \times ED}{AT}$$

Excess cancer risks to the Boundary Public Receptor are calculated using Equation D9-15 with an ADF of 1.2×10^{-4} and are presented in Table D9-3. For this assessment, excess cancer risk to the public ranges from one and one-half to three and one-half orders-of-magnitude below acceptable risk levels. All risks given in Table D9-3 are for a receptor being subjected to concentrations based on maximum exhaust shaft VOC concentrations, that is, those resulting from emissions from 9 closed and 1 full open panels, over the entire exposure period. Room closures within the open panel are not considered.

D9-5.1.2 Noncarcinogens

For noncarcinogens, excess health effects are quantified in terms of a hazard quotient. The hazard quotient is computed as:

$$Hazard\ Quotient = \frac{EC \times ADF \times EF \times ED}{AT \times RfC} \times \left(\frac{1\ mg}{1 \times 10^3 \mu g}\right) \qquad \text{(D9-23)}$$

where,

Hazard Quotient = receptor hazard quotient, unitless
EC = exhaust shaft concentration for the VOC, $\mu g/m^3$
ADF = air dispersion factor, unitless
ED = exposure duration, years
RfC = reference concentration, mg/m^3
AT = averaging time, 306,600 hours (24 hours/day × 365 days/year × 35 years)

Note that the averaging time for noncarcinogens is one-half that for carcinogens. If the hazard quotient is below 1.0, no excess health effects to the receptor is expected. Equation D9-23 was derived from equations in EPA (1989); the derivation is shown below.

EPA (1989), page 8-11 provides the calculation for intake as:

$$Intake = Hazard\ Quotient \times RfD \qquad \text{(D9-24)}$$

where,

Intake = receptor intake, mg/kg-day
Hazard Quotient = receptor hazard quotient, unitless
RfD = reference dose, mg/kg-day

TABLE D9-3
EXCESS CANCER RISKS OUTSIDE THE WIPP SITE BOUNDARY

Compound	*Receptor Concentration (EC x ADF)* Boundary Public Receptor (μg/m³)	*URF* Unit Risk Factor	Carcinogen Class	*Risk* Boundary Public Receptor	Acceptable Risk Level
Carbon Tetrachloride	3.79E-03	1.50E-05[a]	B2	3E-08	1E-06
Chloroform	2.17E-04	2.30E-05[a]	B2	2E-09	1E-06
1,1,-Dichloroethylene	8.34E-05	5.00E-05[a]	C	2E-09	1E-05
1,2-Dichloroethane	6.38E-05	2.60E-05[a]	B2	8E-10	1E-06
Methylene Chloride	2.45E-03	4.70E-07[a]	B2	6E-10	1E-06
1,1,2,2-Tetrachloroethane	1.03E-04	5.80E-05[b]	C	3E-09	1E-05
1,1,1-Trichloroethane	2.77E-03	1.60E-05[b]	C	2E-08	1E-05

a. Data from EPA (1994a)
b. Data from Superfund Technical Support Center

EPA (1989), page 8-5 provides the calculation for the reference dose as:

$$RfD = \frac{RfC \times IR}{BW} \qquad \text{(D9-25)}$$

where,

RfD = reference dose, mg/kg-day
RfC = reference concentration, mg/m³
IR = inhalation rate, 20 m³/day
BW = body weight, 70 kg

Combining equations D9-24 and D9-25:

$$Intake = \frac{Hazard\ Quotient \times RfC \times IR}{BW} \qquad \text{(D9-26)}$$

where,

Intake	=	receptor intake, mg/kg-day
Hazard Quotient	=	receptor hazard quotient, unitless
RfC	=	reference concentration, mg/m^3
IR	=	inhalation rate, 20 m^3/day
BW	=	body weight, 70 kg

Setting equations D9-15 and D9-26 equal to each other:

$$\frac{Hazard\ Quotient \times RfC \times IR}{BW} = \frac{CA \times IR \times EF \times ED}{BW \times AT} \times \left(\frac{1\ mg}{1 \times 10^3\ \mu g}\right)$$

and solving for Hazard Quotient:

$$Hazard\ Quotient = \frac{CA \times EF \times ED}{AT \times RfC} \times \left(\frac{1\ mg}{1 \times 10^3\ \mu g}\right) \qquad \text{(D9-27)}$$

where,

Hazard Quotient	=	receptor hazard quotient, unitless
CA	=	contaminant concentration in air, µg/m^3
EF	=	exposure frequency, hours/year
ED	=	exposure duration, years
AT	=	averaging time, 306,600 hours (24 hours/day × 365 days/year × 35 years)
RfC	=	reference concentration, mg/m^3

Combining equations D9-22 and D9-27 yields equation D9-23:

$$Hazard\ Quotient = \frac{EC \times ADF \times EF \times ED}{AT \times RfC} \times \left(\frac{1\ mg}{1 \times 10^3\ \mu g}\right)$$

Excess non-cancer health effects to a Boundary Public Receptor are calculated using Equation D9-23 with an ADF of 1.2×10^{-4} and are presented in Table D9-4. Non-cancer health effects range from five and one-half to six and one-half orders-of-magnitude below acceptable levels for a hypothetical Boundary Public Receptor. All hazard quotients given in Table D9-4 are a receptor being subjected to concentrations based on maximum exhaust shaft VOC concentrations, that is, those resulting from emissions from 9 closed and 1 full open panels, over the entire exposure period.

TABLE D9-4
EXCESS NON-CANCER HEALTH EFFECTS OUTSIDE THE WIPP SITE BOUNDARY

	Receptor Concentration (EC x ADF)	*RfC*	*Hazard Quotient*	
Compound	**Boundary Public Receptor ($\mu g/m^3$)**	**Reference Concentration (mg/m^3)**	**Boundary Public Receptor**	**Acceptable Hazard Level**
Chlorobenzene	8.88E-05	2.00E-02[a]	4E-06	1E+00
Toluene	1.15E-04	4.00E-01[b]	3E-07	1E+00

a. Data from EPA (1994b)
b. Data from EPA (1994a)

D9-5.2 Receptor Concentrations and Risk Inside the WIPP Site Boundary

The Livingston Ridge Rancher, Antelope Ridge Rancher, Surface Worker, and Underground Worker exposure scenarios are evaluated in this section. ADFs of 9.8×10^{-5}, 6.7×10^{-5}, and 1.23×10^{-2} are used for the Livingston Ridge Rancher, Antelope Ridge Rancher, and Surface Worker exposure scenarios, respectively. For all public exposure scenarios, the maximum exhaust concentration from emissions from 9 closed and 1 open panel equivalents is used in assessing risk, with no credit taken for room closures within the open panel. Room closures are used in evaluating the Underground Worker exposure scenario.

D9-5.2.1 Carcinogens

The excess cancer risks calculated for each VOC inside the WIPP site boundary for the Livingston Ridge Rancher and the Antelope Ridge Rancher are presented in Table D9-5. The excess cancer risks to the Livingston Ridge Rancher and the Antelope Ridge Rancher range from two and one-half to four and one-half orders of magnitude below acceptable levels. Acceptable levels for these receptors are 1×10^{-6} for Class B carcinogens and 1×10^{-5} for Class C carcinogens.

Risks given in Table D9-5 are for receptors being subjected to concentrations based on maximum exhaust shaft VOC concentrations, that is, those resulting from emissions from 9 closed and 1 full open panels, over the entire period of exposure.

TABLE D9-5
EXCESS CANCER RISKS INSIDE THE WIPP SITE BOUNDARY FOR LIVINGSTON RIDGE RANCHER AND ANTELOPE RIDGE RANCHER SCENARIOS

	Receptor Concentration (EC x ADF)		*URF*		*Risk*		
Compound	Livingston Ridge Rancher (μg/m³)	Antelope Ridge Rancher (μg/m³)	Unit Risk Factor	Carcinogen Class	Livingston Ridge Rancher Risk	Antelope Ridge Rancher Risk	Acceptable Risk Level
Carbon Tetrachloride	3.09E-03	2.11E-03	1.50E-05	B2	6E-09	4E-09	1E-06
Chloroform	1.77E-04	1.21E-04	2.30E-05	B2	5E-10	3E-10	1E-06
1,1,-Dichloroethylene	6.81E-05	4.65E-05	5.00E-05	C	4E-10	3E-10	1E-05
1,2-Dichloroethane	5.21E-05	3.56E-05	2.60E-05	B2	2E-10	1E-10	1E-06
Methylene Chloride	2.00E-03	1.37E-03	4.70E-07	B2	1E-10	8E-11	1E-06
1,1,2,2-Tetrachloroethane	8.45E-05	5.78E-05	5.80E-05	C	6E-10	4E-10	1E-05
1,1,1-Trichloroethane	2.27E-03	1.55E-03	1.60E-05	C	4E-09	3E-09	1E-05

TABLE D9-6
EXCESS NON-CANCER HEALTH EFFECTS INSIDE THE WIPP SITE BOUNDARY FOR LIVINGSTON RIDGE RANCHER AND ANTELOPE RIDGE RANCHER SCENARIOS

	Receptor Concentration (EC x ADF)		*RfC*	*Calculated Hazard Quotient*		
Compound	**Livingston Ridge Rancher (µg/m³)**	**Antelope Ridge Rancher (µg/m³)**	**Reference Concentration (mg/m³)**	**Livingston Ridge Rancher**	**Antelope Ridge Rancher**	**Acceptable Hazard Level**
Chlorobenzene	7.25E-05	4.96E-05	2.00E-02	9E-07	6E-07	1E+00
Toluene	9.43E-05	6.45E-05	4.00E-01	6E-08	4E-08	1E+00

D9-5.2.2 Noncarcinogens

The excess non-cancer health effect calculation results for each VOC inside the WIPP site boundary are presented in Table D9-6. The ADFs used are the same as those described in Section D9-5.2.1. Excess non-cancer health effects range from six to seven and one-half orders-of-magnitude below a hazard quotient of one; this implies that there will be no adverse health effects from noncarcinogens to any of the evaluated receptors inside the WIPP site boundary. All hazard quotients given in Table D9-6 are for receptors being subjected to concentrations based on exhaust shaft VOC concentrations for emissions from 9 closed panels and 1 full open panel over the entire period of exposure.

D9-5.3 Worker Concentrations and Risk on the Surface and Underground

Worker Concentrations are calculated using the maximum allowable average VOC headspace concentration as established in Table C-5 of Chapter C. The Table C-5 limits are the highest average concentrations that can exist in any waste room. This assumption is very conservative, since the average headspace concentration clearly shows that concentrations are much lower on average. The Table C-5 limits are listed in Table D9-7.

As described in Section D-9b(4)(a) of Chapter D, occupational and public risk measures are different. For example, occupational exposure is calculated by assessing the effects on healthy adults of working age and public risk includes effects on children, adults, the elderly and the infirm. See D-9b(4)(a) for more information.

TABLE D9-7
MAXIMUM AVERAGE HEADSPACE CONCENTRATION LIMITS

Compound	Table C-5 Limit (ppmv)
Carbon Tetrachloride	7,510
Chlorobenzene	17,660
Chloroform	6,325
1,1,-Dichloroethylene	28,750
1,2-Dichloroethane	9,100
Methylene Chloride	100,000
1,1,2,2-Tetrachloroethane	7,924
Toluene	41,135
1,1,1-Trichloroethane	100,000

D9-5.3.1 Carcinogens

VOC contaminant concentrations in air for the Surface Worker and the Underground Worker are given in Table D9-8 along with Occupational Safety and Health Administration (OSHA) 8 hour time-weighted averages (TWAs). This information provides a mechanism for evaluating occupational exposures. The receptor concentrations for the Surface Worker range from four to nearly seven orders of magnitude below the TWAs. The receptor concentrations for the Underground Worker range from two to nearly six orders of magnitude below the TWAs.

Human health risk from carcinogens can be calculated using equation D9-15 with EF = 1920 hours/year for the surface worker and 33 hours per year for the underground worker, ED = 10 years, EC = ECS in Table 9-8, and ADF = 1.2×10^{-2}. The calculated risk from Carbon Tetrachloride is 9E-07 for the surface worker and 6E-07 for the underground worker. The risk from Chloroform is 9E-07 for the surface worker and 6E-07 for the underground worker. The risk from 1,1-Dichloroethene is 8E-06 for the surface worker and 5E-06 for the underground worker. The risk from 1,2-Dichloroethane is 1E-06 for the surface worker and 8E-07 for the underground worker. The risk from Methylene Chloride is 2E-07 for the surface worker and 1E-07 for the underground worker. The risk from 1,1,2,2-Tetrachloroethane is 4E-06 for the surface worker and 3E-06 for the underground worker. The risk from 1,1,1-Trichloroethane is 1E-05 for the surface worker and 8E-06 for the underground worker.

D9-5.3.2 Non-Carcinogens

As for carcinogens, noncarcinogen VOC contaminant concentrations in air for the Surface Worker and the Underground Worker and OSHA 8 hour TWAs are presented (Table D9-9). This information provides a mechanism for evaluating occupational exposures in addition to the risk assessment approach. The receptor concentrations for the Surface Worker are seven orders of magnitude below the TWAs and those for the Underground Worker are more than six orders of magnitude below the TWAs.

Human health risk from non-carcinogens can be calculated using equation D9-23 with EF = 1920 hours/year for the surface worker and 33 hours per year for the underground worker, ED = 10 years, and EC = ECS in Table 9-9. The calculated hazard quotient from Chlorobenzene is 4E-01 for the surface worker and 3E-02 for the underground worker. The risk from Toluene, the hazard quotient is 3E-02 for the surface worker and 3E-03 for the underground worker.

TABLE D9-8
VOC CONTAMINANT CONCENTRATIONS IN AIR FOR THE SURFACE WORKER AND THE UNDERGROUND WORKER

	ECS_{max}	ECU_{max}	*Receptor Concentration*		
Compound	**Exhaust Shaft Concentration for Surface Worker (µg/m³)**	**Exposure Concentration for Underground Worker (µg/m³)**	**(ECS x ADF) Surface Worker (ppmv)**	**Underground Worker (ppmv)**	**OSHA TWA[a] (ppmv)**
Carbon Tetrachloride	1.54E+02	7.70E+01	3.00E-04	1.22E-02	10
Chloroform	1.06E+02	5.03E+01	2.67E-04	1.03E-02	50
1,1,-Dichloroethylene	4.01E+02	1.86E+02	1.24E-03	4.68E-02	5[b]
1,2-Dichloroethane	1.25E+02	6.00E+01	3.81E-04	1.48E-01	100
Methylene Chloride	1.26e+02	5.66E+02	4.45E-03	1.63E-02	500
1,1,2,2-Tetrachloroethane	1.77E+02	8.86E+01	3.17E-04	1.29E-02	5
1,1,1-Trichloroethane	1.77E+03	8.89E+02	4.00E-03	1.63E-01	350

a. 8 hour TWAs except chloroform TWA for up to a 10 hour day in a 40 hour work week.
b. TWA from ACGIH

TABLE D9-9
VOC CONTAMINANT CONCENTRATIONS IN AIR FOR THE SURFACE WORKER AND THE UNDERGROUND WORKER

	ECS_{max}	ECU_{max}	Receptor Concentration		
Compound	Exhaust Shaft Concentration for Surface Worker (µg/m³)	Exposure Concentration for Underground Worker (µg/m³)	Surface Worker (ppmv)	Underground Worker (ppmv)	OSHA TWA (ppmv)
Chlorobenzene	2.58E+02	1.32E+02	6.91E-04	2.88E-02	75
Toluene	4.99E+02	2.53E+02	1.63E-03	6.70E-02	200

D9-6 Summary

Based on estimated maximum VOC emissions from emplaced waste, there are no significant exposures expected to occur to the public or workers. Risks and hazards to members of the public range from one and one-half to seven and one-half orders-of-magnitude below acceptable levels. Worker exposure VOC concentrations are approximately two to over five orders-of-magnitude below 8 hour OSHA TWAs.

The worker exposure and public risk assessment used the following conservative assumptions:

- Table C-5 limits for headspace concentrations of VOCs represent the average container concentration
- All drums are fitted with the model NFT-013 carbon composite filter
- The effective gas generation rate is constant in closed panels
- The actual source of VOCs will exist throughout the operational/closure phase and will maintain the average concentrations in drum and panel headspaces (i.e., no depletion of the source over time)
- VOC concentrations in the closed panel atmosphere are instantaneously equivalent to the drum average headspace concentrations
- There is no decrease in closure system permeability due to creep closure over time
- The hypothetical Boundary Public receptor is exposed every hour of every day during the span of facility operations
- Public risk to developing excess cancer does not include the probability that the receptor is one of the 27 residents within 10 miles (16 kilometers) of WIPP

WIPP

- Enough moisture will exist to create humid environmental conditions for gas generation
- A full repository of waste exists for the duration of the operational/closure
- There will be 81,000 drums disposed of in each panel. The actual configuration may include 60% Standard Waste Boxes (2 vents, 7-drum equivalent) and 40% drums (1 vent), meaning less than 81,000 filter vents will be venting in a panel (approximately 58,000).
- The assessments for the public and surface worker assume that no room ventilation barriers are installed, and emissions from 9 closed and 1 open panel full of waste exists for 35 years

Other assumptions that may contribute to the overall uncertainty of the receptor concentration and risk estimates are as follows:

- The mine ventilation flow rate will remain constant throughout the operational/closure phase
- Weighted average drum headspace concentrations of VOCs are representative of all waste to be disposed of at the WIPP

Although the uncertainties in the receptor concentration and risk estimates that result from these assumptions are not quantifiable, it is believed that they are far outweighed by the conservative assumptions used in the estimates.

D9-7 REFERENCES

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ATTACHMENT 1
EXAMINATION OF ROOF COLLAPSE SCENARIO

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ATTACHMENT 1
EXAMINATION OF ROOF COLLAPSE SCENARIO

D9-ATT 1-1.0 Background Information from WIPP SAR

An unexpected roof collapse in panels two through eight is considered to be an incredible ($\leq 10^{-6}$) accident because the panels will be mined, filled with waste, and closed before a roof fall in these panels becomes a concern (WIPP 1995). However, Panel 1, having a longer life span, has been addressed for this scenario as a special case. The WIPP safety analysis report (SAR) (WIPP 1995) determined that the unexpected roof collapse event in Panel 1 during emplacement operations in the underground bounds all other roof collapses due to the total number of waste containers in the area during these operations. Even in Panel 1, such a roof fall would require the failure of preventive and mitigative systems and controls identified in the SAR for this scenario, and is considered unlikely (frequency of occurrence of 10^{-2} to 10^{-4}).

The number of drums that can be placed under this hypothetical room collapse, stacked 3 layers high in seven pack configurations, is 3,843 (WIPP). The maximum drum weight allowed by the WIPP WAC is 1,000 pounds. Assuming the top two layers of drums in the waste stack are loaded to the maximum weight of 1,000 lb (454 kg), a loading of 2,000 pounds (907 kg) would be applied to a drum in the bottom layer. Based on the roof collapse in room 1 in the Site Preliminary Design Validation (SPDV), the section that collapsed was irregularly shaped and approximately 33 ft (10 m) wide by 7 ft (2.1 m) thick by 180 ft (54.9 m) long and weighed 700 tons (636 metric tons). With the added weight of the 7 ft (2.1 m) high collapsed roof material, the load on a drum on the bottom layer is 3,100 lb (1407 kg) (WIPP 1995). Backfill added to the top of the drum stack contributes 4200 lb (1907 kg) to each seven pack or 600 lb (272 kg) to each drum. Thus, the total load on a drum on the bottom layer is 3,700 lb (1680 kg). Conservatively assuming this entire mass as dynamic loading, the maximum load on a drum from 3,700 lb (1680 kg) of material falling a distance 1.5 ft (0.4572 m) is approximately 5,550 ft-lb (7,540 N-m).

Sandia National Laboratories, in report SAND80-2157, *Analysis, Scale Modeling, and Full-Scale Tests of Low-Level Nuclear Waste Drum Response to Accident Environments* (Sandia 1980), concluded that the energy required to crush an empty drum 10 inches in the axial direction requires a dynamic load of greater than 16,947 N-m . The lid did not separate from the drum and the drum did not breach during the dynamic tests. Therefore, the roof fall scenario, when conservatively considering the dynamic effects of falling roof material on drums, is not expected to result in any breached drums.

Even if some of the drums are breached, the material falling is expected to encapsulate the waste and the material available to be released will be minimal. Therefore, no release of radioactive or nonradioactive hazardous materials is expected from the loading of drums due to the added weight of the collapsed roof material. However, for conservatism the SAR assumed that an underground roof collapse causes 21 drums to fall from the top of the stack resulting in a breach of those drums.

D9-ATT 1- 2.0 Methodology

Two scenarios were evaluated: (1) a roof collapse in an open room that is being filled with drums, and (2) a roof collapse in a closed room with ventilation barriers in place. In addition two cases are evaluated for each scenario based on the concentrations of VOCs in the headspace of the drums. These cases are: (1) drum headspace VOC concentrations corresponding to the values given in Table C-5, representing the maximum average headspace concentrations for a container of waste, and; (2) concentrations of VOCs in the drum headspace corresponding to the weighted average concentrations as calculated in Appendix C2. Assumptions used to quantify exposure levels associated with the scenarios and cases examined are presented in the following sections.

D9-ATT 1- 2.1 Open Room Scenario

D9-ATT 1- 2.1.1 Assumptions

1) The underground roof (back) collapse may occur during waste emplacement causing 21 drums to fall from the top of the stack resulting in a breach of the drums, although the roof life has been extended by a supplementary roof support system (WIPP 1995). Two cases are examined one based on the Table C-5 limits of VOCs in the containers and the second based on the Appendix C2 headspace concentrations.

2) The room is backfilled to 1.5 ft from the ceiling (i.e., no credit is taken for the air between the drums).

3) Room dimensions are 300 ft x 33 ft x 13 ft.

4) The void space in each drum is 5.2 ft^3 (WIPP 1995).

5) The room headspace air volume and the void space gas volume in the breached containers, mix completely and instantaneously.

6) Dilution of the contaminated air from the collapsed room with the air flowing by the workers is negligible because
   a) the rate of displacement of the contaminated air is much greater than the rate of fresh air flow by the workers.
   b) the collapse of the room will preclude fresh air ventilation.

7) The contaminated air is cleared from the vicinity of the workers based on the rate of the fresh air flowing by them (i.e., 35,000 ft^3/min) (WID 1996).

8) Duration of exposure is dependent on the rate at which the contaminated air is cleared from the vicinity of the worker. Averaging time for calculation of risk and hazard quotient is 70 yrs and 0.014 hrs, respectively.

9) A worker is assumed to be downstream of this event. In reality, for as low as reasonable achievable (ALARA) reasons, few workers spend time downstream of the emplaced radioactive waste.

D9-ATT 1- 2.1.2 Calculations

1) Volume of clean air in the room headspace (RHV)

300 ft (length) x 33 ft (width) x 1.5 ft (headspace) = 14,850 ft^3

2) Volume of contaminated air released from the containers (CAC)

(number of drums) x 5.2 ft^3/drum = 109.2 ft^3 (for 21 drums)

3) Concentration of the contaminant in the room air (CCR) (NOTE - the room air is hereafter referred to as the cloud)

(VOC concentration) x (CAC/(RHV+CAC)) = ppmv

4) Duration of worker exposure (DWE)

(RHV + CAC)/35,000 ft^3/min = (14,850 ft^3 + 109.2 ft^3)/35,000 ft^3 = 0.43 min

5) 8-hour time weighted average

(CCR x DWE x hr/60 min)/8 hrs

D9-ATT 1- 2.2 Closed Room Scenario

The time dependent VOC concentration expressed as mole fraction VOC in a closed room may be evaluated by solving the following differential equation describing the accumulation of VOC in the sealed room due to the diffusion of VOC through the drum filter from the drum headspace into the room.

$$\frac{dX_R}{dt} = NR_f\,(X_H - X_R)$$

subject to the initial condition that no VOC is present in the closed room initially, i.e.

$X_R(t = 0) = 0$

where,

$$R_f = \frac{D_{VOC} \times R \times T}{V_{air} \times P}$$

R_f	VOC filter release coefficient (1/day mol fraction)
D_{VOC}	VOC diffusivity through filter on drum, mol s^{-1} mol $fraction^{-1}$
R	Gas law constant, 8.2057 x 10^{-5} atm m^3 mol^{-1} K^{-1}
T	Absolute temperature, 298 K
V_R	Room headspace volume, 14,850 ft^3
P	Absolute pressure, 1 atm
X_R	Mole fraction VOC in the closed room, dimensionless
N	Number of drums in closed room, 11,571 drums
X_H	Mole fraction VOC in drum headspace, dimensionless
t	Time, yr.

The solution to the differential equation yields the time dependent VOC concentration in a closed room as:

$$X_R(t) = X_H(1-e^{-NRt})$$

The time dependent concentrations of VOCs in the closed room are presented in Figure D9-ATT 1-1. After 0.1 years, the concentrations in all regions of the room have equilibrated and the concentrations are equal to the concentrations inside the drum headspace.

D9-ATT 1- 2.2.1 Assumptions

1) The underground roof collapse occurs in a closed room (i.e. a room with ventilation barriers). Six rooms are closed and each room contains 11, 751 drums. The last room is open and is about to be closed with 11,751 drums inside.

2) The room is backfilled to 1.5 ft from the ceiling.

3) Room dimensions are 300 ft x 33 ft x 13 ft.

4) Based on the previous analyses to predict VOC concentrations in a closed room as a function of time, the concentrations of the VOCs in the air gap have equilibrated with the VOC concentrations in the headspace of the containers (i.e, the VOC concentration in the room is equal to the VOC concentration in the drum headspace).

5) Based on the Sandia experiments, the collapse of the roof material onto the drum stacks does not provide sufficient energy to breach the drums. Thus, only the contaminated air gap is available for release. Based on examination of the material that collapsed in room 1 in the SPDV, the collapse of the roof material cannot be simply described as a piston system that expels the contaminated air gap into the panel access drifts. The majority (90%) of the contaminated air will escape into the overlying void space created by the collapsed section and will not be available for release into the fresh air flowing through the panel. Ten percent of the room air is released with 5% escaping through each side of the room. Thus a worker is exposed to 5% of the room air.

6) In calculating the 8 hr TWA, the contaminated air is cleared from the vicinity of the worker based on the rate of the fresh air flowing by them (i.e., 35,000 ft^3/min) (WID 1996).

7) In calculating the 8 hr TWA, the duration of exposure is dependent on the rate at which the contaminated air is cleared from the vicinity of the worker based on 5% of the contaminated air being released into the fresh air flowing through the access drift in the panel.

8) A worker is assumed to be downstream of this event. In reality, for as low as reasonable achievable (ALARA) reasons, few workers spend time downstream of the emplaced radioactive waste.

D9-ATT 1- 2.2.2 Calculations

1) Duration of worker exposure (DWE) is calculated as

$$(f \times RHV)/(35{,}000\ ft^3/min)$$

where,

f Fraction of room headspace volume that is released to an access drift and available for worker exposure, 0.05 dimensionless

RHV Room headspace volume, 14,850 ft^3

2) The 8-hour time weighted average (TWA) assuming one closed room with a roof collapse is calculated as:

(CCR x DWE x hr/60 min)/8 hr

where,

CCR Concentration of the contaminant in the room air, ppmv

3) The maximum 1-minute concentration that the worker is exposed to is calculated as:

$MAXC = CCR \times f \times RHV/(35{,}000\ ft^3 + f \times RHV)$

D9-ATT 1- 3.0 Discussion

The VOC concentrations to which the workers would be exposed in the scenarios examined were compared to various exposure limits, including threshold limit values (TLVs), permissible exposure limits (PELs), and recommended exposure limits (RELs). These exposure limits were compiled from various sources and are presented in Table D9-ATT 1-1.

D9-ATT 1- 3.1 Open Room Scenario

The calculated worker exposures, given as the contaminant concentration in the cloud (CCR), were then compared to the most restrictive exposure limits; this comparison is presented in Table D9-ATT 1-2 and Table D9-ATT 1-3 for each of the two cases examined. Based on the analyses, the immediate VOC concentrations in air (i.e., in the CCRs) are below the respective IDLH exposure limits for both of the scenarios. The 8-Hr TWA concentrations are below the respective TWA exposure limits for both of the scenarios.

D9-ATT 1- 3.2 Closed Room Scenario

The calculated worker exposures, in terms of 8 hr TWA concentrations were then compared to the most restrictive exposure limits. This comparison is presented in Table D9-ATT 1-4 andTable D9-ATT 1-5 for each of the two cases examined. Based on the Table C-5 limits for VOCs in the drum headspace, the 1 minute maximum VOC concentrations are below the IDLH limits for all VOCs. Using the Table C-5 VOC concentrations in the drum headspace, the 8 Hr TWA are below the 8 Hr TWA limits. Based on the Appendix C2 concentrations for VOCs in the drum headspace, the 1 minute maximum concentrations are well below the IDLH values in all cases and the calculated worker exposure 8 hr TWA concentrations are well below the 8 hr TWA limits.

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TABLES

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Table D9-ATT 1-1. Exposure Limits[a]

Substance	OSHA PEL[b]	ACGIH TLV	NIOSH REL[c]
Carbon tetrachloride (Tetrachloromethane)	10 ppm TWA (C) 25 ppm 200 ppm peak for 5 min in any 4 hrs	5 ppm TWA, 31 mg/m^3 10 ppm STEL, 63 mg/m^3 Animal carcinogen	2 ppm STEL (60 min), 12.6 mg/m^3 Carcinogen 200 ppm IDLH
Chlorobenzene	75 ppm TWA, 350 mg/m^3	10 ppm TWA, 46 mg/m^3	NL[d] 1,000 ppm IDLH
Chloroform (Trichloromethane)	(C) 50 ppm, (C) 240 mg/m^3	10 ppm TWA, 49 mg/m^3 Suspected human carcinogen	NL[e] 2 ppm STEL (60 min), 9.78 mg/m^3 Carcinogen 500 ppm IDLH
1,1-Dichloroethylene (Vinylidene chloride)	NL	5 ppm TWA, 20 mg/m^3 20 ppm STEL, 79 mg/m^3	NL[e] Carcinogen IDLH not determined
1,2-Dichloroethane (Ethylene dichloride)	100 ppm TWA (C) 200 ppm 300 ppm peak for 5 min in any 3 hrs	10 ppm TWA, 40 mg/m^3	NL[e,f] 1 ppm TWA, 4 mg/m^3 2 ppm STEL, 8 mg/m^3 Carcinogen 50 ppm IDLH
Methylene chloride (Dichloromethane)	500 ppm TWA (C) 1,000 ppm 2,000 ppm peak for 5 min in any 2 hrs	50 ppm TWA, 174 mg/m^3 Suspected human carcinogen	NL[e] Carcinogen 2,300 ppm IDLH
1,1,2,2-Tetrachloroethane	5 ppm TWA, 35 mg/m^3 Skin designation	1 ppm TWA, 6.9 mg/m^3 Skin designation	NL[e,f] 1 ppm TWA, 7 mg/m^3 Carcinogen, skin designation 100 ppm IDLH
Toluene	200 ppm TWA (C) 300 ppm 500 ppm peak for 10 min	50 ppm TWA, 188 mg/m^3 Skin designation	100 ppm TWA, 375 mg/m^3 150 ppm STEL, 560 mg/m^3 500 ppm IDLH
1,1,1-Trichloroethane (Methyl chloroform)	350 ppm TWA, 1,900 mg/m^3	350 ppm TWA, 1,910 mg/m^3 450 ppm STEL, 2,460 mg/m^3	(C) 350 ppm (15 min), (C) 1,900 mg/m^3 700 ppm IDLH

Table D9-ATT 1-1. Exposure Limits[a]

(continued)

Substance	OSHA PEL[b]	ACGIH TLV	NIOSH REL[c]

[a]SOURCE: 29 CFR 1910.1000; ACGIH 1995; NIOSH 1994.
[b]8 hr TWA unless noted otherwise, (C) denotes ceiling limit

[c]Up to a 10 hr day in a 40 hr workweek TWA, STEL is a 15 min TWA unless noted otherwise
[d]NIOSH questions whether the OSHA PEL TWA of 75 ppm is adequate to protect workers from recognized health hazards but does not offer an alternative.
[e]NIOSH usually recommends that occupational exposures to carcinogens be limited to the lowest feasible level
[f]NIOSH considers the substance to be a potential occupational carcinogen

Acronyms and Units for Table D9-ATT 1-1

OSHA	Occupational Safety and Health Act
PEL	permissible exposure limit
ACGIH	American Conference of Governmental Industrial Hygienists
TLV	threshold limit value
NIOSH	National Institute for Occupational Safety and Health
REL	recommended exposure limit
ppm	parts of vapor or gas per million parts of contaminated air by volume at 25C and 760 torr
TWA	time-weighted average
(C)	ceiling limit
STEL	short-term exposure limit
IDLH	immediately dangerous to life or health concentration
mg/m^3	milligrams per cubic meter
NL	not listed

Table D9-ATT 1-2. Open Room Scenario: Comparison of Calculated Cloud Concentrations from 21 Drum Source and Table C-5 VOC Concentrations to Most Restrictive Exposure Limits

Chemical	Headspace Table C-5 Limit VOC Concentration (ppm)	Concentration in Air (ppm)		Exposure Limit (ppm)	Source
		Immediate	8-Hr TWA		
Carbon tetrachloride	7,510	27.51	0.05	2 (STEL) 5 (TWA) 200 (IDLH)	NIOSH ACGIH NIOSH
Chlorobenzene	-	–[a]	–	10 (TWA) 1000 (IDLH)	ACGIH NIOSH
Chloroform	6,325	23.17	0.04	2 (STEL) 10 (TWA) 500 (IDLH)	NIOSH ACGIH NIOSH
1,1-Dichloroethylene	28,750	105.3	0.19	20 (STEL) 5 (TWA)	ACGIH ACGIH
1,2-Dichloroethane	9,100	33.34	0.06	2 (STEL) 1 (TWA) 50 (IDLH)	NIOSH NIOSH NIOSH
Methylene chloride	100,000	366.3	0.65	50 (TWA) 2,300 (IDLH)	ACGIH NIOSH
1,1,2,2-Tetrachloroethane	-	–	–	1 (TWA) 100 (IDLH)	NIOSH NIOSH
Toluene	-	–	–	150 (STEL) 50 (TWA) 500 (IDLH)	NIOSH ACGIH NIOSH
1,1,1-Trichloroethane	-	–	–	450 (STEL) 350 (TWA) 700 (IDLH)	ACGIH ACGIH NIOSH

a No Table C-5 limit assigned.

Table D9-ATT 1-3. Open Room Scenario Comparison of Calculated Cloud Concentrations from 21 Drum Source and Appendix C2 VOC Concentrations to Most Restrictive Exposure Limits

Chemical	Appendix C2 Headspace VOC Concentration (ppm)	Concentration in Air (ppm)		Exposure Limit (ppm)	Source
		Immediate	8-Hr TWA		
Carbon tetrachloride	375.5	1.38	2.44×10^{-3}	2 (STEL) 5 (TWA) 200 (IDLH)	NIOSH ACGIH NIOSH
Chlorobenzene	12.5	0.05	8.13×10^{-5}	10 (TWA) 1000 (IDLH)	ACGIH NIOSH
Chloroform	25.3	0.09	1.64×10^{-4}	2 (STEL) 10 (TWA) 500 (IDLH)	NIOSH ACGIH NIOSH
1,1-Dichloroethylene	11.5	0.04	7.48×10^{-5}	20 (STEL) 5 (TWA)	ACGIH ACGIH
1,2-Dichloroethane	9.1	0.03	5.92×10^{-5}	2 (STEL) 1 (TWA) 50 (IDLH)	NIOSH NIOSH NIOSH
Methylene chloride	368.5	1.35	2.40×10^{-3}	50 (TWA) 2,300 (IDLH)	ACGIH NIOSH
1,1,2,2-Tetrachloroethane	9.4	0.03	6.11×10^{-5}	1 (TWA) 100 (IDLH)	NIOSH NIOSH
Toluene	19.4	0.07	1.26×10^{-4}	150 (STEL) 50 (TWA) 500 (IDLH)	NIOSH ACGIH NIOSH
1,1,1-Trichloroethane	317.1	1.16	2.06×10^{-3}	450 (STEL) 350 (TWA) 700 (IDLH)	ACGIH ACGIH NIOSH

Table D9-ATT 1-4. Closed Room Scenario Comparisons of Concentrations Based on Table C-5 VOC Concentration Limits to the Most Restrictive Exposure Limits

VOC	Table C-5 VOC Concentration Limit (ppmv)	Calculated 8 Hr TWA (ppmv)	Maximum 1 min Concentration (ppmv)	IDLH	8 Hr TWA Limits (ppmv)
Carbon tetrachloride	7,510	0.33	156	200	5
Chlorobenzene	-	-	-	-	10
Chloroform	6,325	0.28	131	500	10
1,1-Dichloroethylene	28,750	1.27	597	-	5
1,2-Dichloroethane	9,100	0.40	189	50	1
Methylene chloride	100,000	4.42	2,080	2,300	50
1,1,2,2-Tetrachloroethane	-	-	-	100	1
Toluene	-	-	-	500	50
1,1,1,1-Trichloroethane	-	-	-	700	350

Table D9-ATT 1-5. Closed Room Scenario Comparisons of Concentrations Based on Appendix C2 Weighted Average Headspace Concentrations to the Most Restrictive Exposure Limits

VOC	Appendix C2 VOC Concentration (ppmv)	Calculated 8 Hr TWA (ppmv)	Maximum 1 min Conc. (ppmv)	IDLH	8 Hr TWA Limits (ppmv)
Carbon tetrachloride	376	0.0166	7.80	200	5
Chlorobenzene	13	0.0006	0.26	-	10
Chloroform	25	0.0011	0.53	500	10
1,1-Dichloroethylene	12	0.0005	0.24	-	5
1,2-Dichloroethane	9	0.0004	0.19	50	1
Methylene chloride	369	0.0163	7.66	2,300	50
1,1,2,2-Tetrachloroethane	9	0.0004	0.20	100	1
Toluene	19	0.0009	0.40	500	50
1,1,1,1-Trichloroethane	317	0.0140	6.59	700	350

FIGURES

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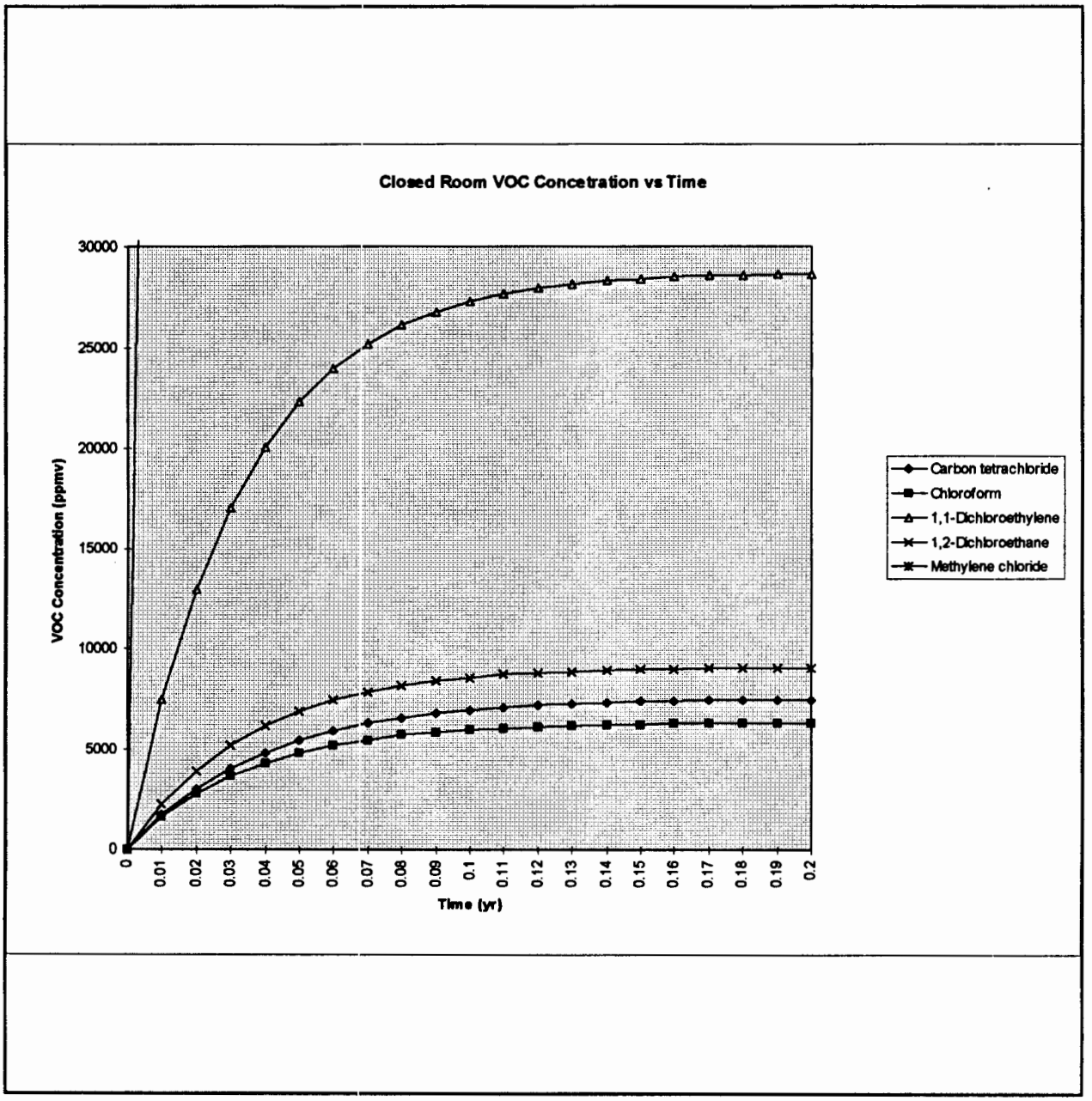

Figure D9-ATT 1-1 Closed Room VOC Concentration Versus Time

APPENDIX D20

AIR PATHWAY CONFIRMATORY MONITORING PLAN

Air Pathway Confirmatory Monitoring Plan for Volatile Organic Compounds During Waste Disposal at the Waste Isolation Pilot Plant

Westinghouse Electric Corporation
Waste Isolation Division
Waste Isolation Pilot Plant
Carlsbad, New Mexico

April 3, 1996

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1.0 INTRODUCTION

This document describes the confirmatory monitoring plan for volatile organic compounds (VOC) which may be entrained in the exhaust air from the Waste Isolation Pilot Plant (WIPP), Carlsbad, New Mexico, during the disposal phase at the facility. This Monitoring Plan is designed to confirm the demonstration contained in the No-Migration Variance Petition (NMVP) that there will be no migration of VOCs from WIPP exceeding concentrations that pose unacceptable risks to human health and the environment. This Monitoring Plan includes the monitoring design, a description of sampling and analysis procedures, and quality assurance (QA) objectives and reporting activities.

1.1 BACKGROUND

The WIPP project was authorized by the U.S. Congress to provide a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from national defense activities and programs. The WIPP facility is constructed in a massive underground salt bed formation, with its design characterized as a "room and pillar" arrangement, allowing containerized solids or solidified waste to be placed in the excavations. Waste, equipment, and personnel enter the underground facility through designated shafts.

The hazardous waste management units, defined as waste panels, are located 2150 feet (ft)(655 meters(m)) below ground surface, in the WIPP underground. The waste panels consist of seven rooms and two access drifts each. Each room is approximately 300 ft (91 m) long, 33 ft (10 m) wide, and 13 f (4 m) high. Access drifts connect the

rooms and have the same cross section. The U.S. Department of Energy (DOE) intends to operate the facility in a manner that minimizes the number of panels that are open at any one time.

The panels provide room for 6.2 million cubic feet (ft^3) (175,600 cubic meters (m^3)) of transuranic (TRU) waste, of which 250,000 ft^3 (7080 m^3) may be remote handled (RH) TRU waste. The remainder will be contact handled (CH) TRU waste. The CH TRU waste package assemblies will be stacked up to three containers high across the width of the room in an interlocking triangular pitch. The RH TRU waste canisters will be inserted into predrilled horizontal holes bored into the room wall of the disposal area. The facility performance objectives are derived from 40 Code of Federal Regulations (CFR) Part 268 and are directed at permanently isolating the waste from the biosphere.

The NMVP (DOE, 1996) demonstrates theoretical compliance with the requirements of 40 CFR Part 268.6, which allows the disposal of wastes prohibited from land disposal only if it can be demonstrated that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the disposal unit for as long as the wastes remain hazardous. This Confirmatory Monitoring Plan describes a sampling and analysis program to confirm the theoretical no-migration calculations contained in the NMVP. The monitoring program will be capable of quantifying VOC concentrations in ambient mine air at WIPP. As demonstrated in the NMVP, other media are not considered viable contaminant transport pathways during the WIPP operational time frame and are therefore not addressed in this program. By the nature of WIPP operations, there is no credible mechanism for direct release of hazardous constituents to water or soil during the operational time frame.

For the disposal phase, the mine ventilation system is the only possible migration pathway.

Accordingly, this Confirmatory Monitoring Plan is designed to confirm that there will be no migration of VOCs from disposed wastes in the WIPP repository via the air pathway during the Disposal Phase. This plan addresses the following information requirements:

1. Rationale for the design of the monitoring program, based on:

   - Possible migration pathways from WIPP during the active life of the facility

   - Operations at WIPP

   - Strength of engineered and natural material components at WIPP

   - Optimum location of the hazardous constituent monitoring stations to confirm the migration calculations contained in the NMVP

2. Descriptions of the specific elements of the monitoring program, including:

   - The type of monitoring conducted

   - The location of the monitoring stations

   - The monitoring interval

- The specific hazardous constituents monitored
- The implementation schedule for the monitoring program
- The equipment used at the monitoring stations
- Sampling and analytical techniques used
- Data recording/reporting procedures

The results of baseline VOC monitoring at WIPP were used, in part, to refine the monitoring program that will be established for the Disposal Phase, during which full-scale waste emplacement activities will occur. The baseline VOC monitoring results are presented in Appendix BAD of the NMVP, and the environmental monitoring currently anticipated during both the operational and post-closure phases are presented in Chapter 6 of the NMVP.

1.2 WASTE DISPOSAL

The DOE will operate and maintain WIPP so that it is free of both chemical and radiological contamination. Therefore, as allowed by New Mexico Administrative Code 4.1, Subpart V §264.13, and consistent with joint U.S. Environmental Protection Agency (EPA) and U.S. Nuclear Regulatory Commission guidance, all waste sampling and analyses are conducted by DOE generator sites in accordance with established procedures. The generator conducts the required waste characterization activities for each container of waste to be sent to WIPP under a QA program. The reports resulting from waste characterization activities are then reviewed for completeness and acceptability at WIPP prior to transport of the wastes.

Waste will be disposed of in the seven rooms of a panel. Each panel will be closed when it is full using a panel closure system installed in each of the two panel access drifts as described in Appendix CLP of the NMVP. The closure system conceptual design consists of concrete block bulkheads and a poured concrete bulkhead. The concrete block bulkheads provide a ventilation barrier while the concrete bulkhead is being installed. The concrete component provides strength and stability for maintenance-free service during the operational period. The DOE's analysis of the bulkhead shows that the structure has sufficient rigidity and compressive strength to remain stable for creep and short-term dynamic loadings. Once a panel has been filled and closed, it will be managed per the requirements of the WIPP RCRA Part B Permit and a No-Migration Determination.

1.3 OBJECTIVES OF THE VOLATILE ORGANIC COMPOUND CONFIRMATORY MONITORING PLAN

As described in the NMVP, minute quantities of VOCs could be released from open and closed panels located at WIPP during the disposal phase of the project. Chapter 5 of the NMVP contains a demonstration that any VOCs released from panels would be below any concentrations of concern (COC). This plan describes how VOCs released from waste panels will be monitored to confirm the VOC concentration estimates contained in the NMVP. This plan is responsive to requirements of 40 CFR Part 268.6 and addresses confirmatory monitoring of waste management activities during the WIPP disposal phase.

2.0 TARGET VOLATILE ORGANIC COMPOUNDS

The wastes proposed for disposal at WIPP are described in Chapter 4 of the NMVP. Approximately 60 percent of the waste proposed to be emplaced at WIPP during the entire lifetime of the facility is classified as TRU mixed waste, which consists of waste that contains both radioactive and Resource Conservation and Recovery Act (RCRA)-regulated hazardous chemical components.

Generator knowledge of the wastes and the processes by which they are generated, as well as available analytical data, indicate that the VOCs most commonly present in the wastes and responsible for approximately 99 percent of the calculated RCRA-constituent posed human health risk (Appendix WAP of the NMVP) are as follows:

- 1,1-Dichloroethylene
- Carbon tetrachloride
- Methylene chloride
- Chloroform
- 1,1,2,2-Tetrachloroethane
- 1,1,1-Trichloroethane
- Chlorobenzene
- 1,2-Dichloroethane

- Toluene

Physical and chemical data for these target VOCs are presented in Table 2.1.

2.1 SOURCES OF VOLATILE ORGANIC COMPOUND EMISSIONS

Figure 2.1 depicts the initial WIPP underground facility configuration. Potential waste-related sources of VOCs include: 1) open panels containing vented waste drums, and 2) closed panels of disposed waste. Any VOC emissions from emplaced waste will pass by a monitoring system as it is directed to the exhaust shaft. Other activities not related to normal waste management activities may also lead to VOC emissions.

Nonwaste-related sources of VOCs at WIPP include background sources and emissions from operational activities in ambient mine air. Background sources of VOCs include any sources that emit VOCs to the ambient air that are drawn into the air intake shaft of the underground WIPP facility. Examples of background sources are oil and gas exploration and petroleum production activities in the WIPP vicinity, potash production, and motor vehicle emissions in the WIPP parking lot and on nearby roads. Sources of VOC emissions also exist below ground surface that are related to WIPP mine operational activities. Fuel combustion, painting activities, cleaning solvents, equipment exhaust, and air conditioners are potential sources of VOCs.

Chapter 5 of the NMVP establishes COCs for the VOCs from waste in open and closed panels. Therefore, the VOC Confirmatory Monitoring

Plan is designed to differentiate VOC concentrations attributed to open and closed panels from other potential sources. Accordingly, VOC monitoring performed to confirm the calculations in the NMVP will begin when waste emplacement commences in the first panel. Potential VOC sources other than open and closed panels will not be directly monitored at WIPP.

2.2 MIGRATION PATHWAY

The only pathway for migration of VOCs to the unit boundary during the operational phase is via airborne transport. Any VOCs released in the underground facility would become entrained in the underground ventilation air and released to the atmosphere through the exhaust shaft (Figure 2.1).

Chapter 5 of the NMVP identifies COCs in the Drift E-300 air pathway for the target VOCs. COCs at the panels have been extrapolated from the levels of concern at the unit boundary using a mathematical dispersion model and facility ventilation design data.

Table 2.1: Target Analytes for VOC Monitoring During the WIPP Disposal Phase

Target Analyte	Common Synonyms and Acronyms	Chemical Formula	Molecular Weight (g/mol)	Boiling Point (°C)*
1,1-Dichloroethylene	1,1-Dichloroethene, Vinylidene chloride, 1,1-DCE	$C_2H_2Cl_2$	96.95	31
Carbon tetrachloride	Tetrachloromethane	CCl_4	153.8	77
Methylene chloride	Dichloromethane	CH_2Cl_2	84.94	40
Chloroform	Trichloromethane	$CHCl_3$	119.4	61
1,1,2,2-Tetrachloroethane	sym-Tetrachloroethane, Tetrachloroethane	$C_2H_2Cl_4$	167.9	147
1,1,1-Trichloroethane	1,1,1-TCA, TCA, Methyl chloroform	$C_2H_3CCl_3$	133.42	74
Chlorobenzene	Monochlorobenzene, Benzene chloride	C_6H_5Cl	112.6	132
1,2-Dichloroethane	1,2-DCA, DCA, Ethylene dichloride, EDC, sym-Dichloroethane	$C_2H_4Cl_2$	98.96	83
Toluene	Methyl benzene	C_7H_8	92.13	111

°C Degrees Celsius
VOC Volatile organic compound
WIPP Waste Isolation Pilot Plant

* Handbook of Chemistry and Physics, 62nd Edition, CRC Press, 1982.

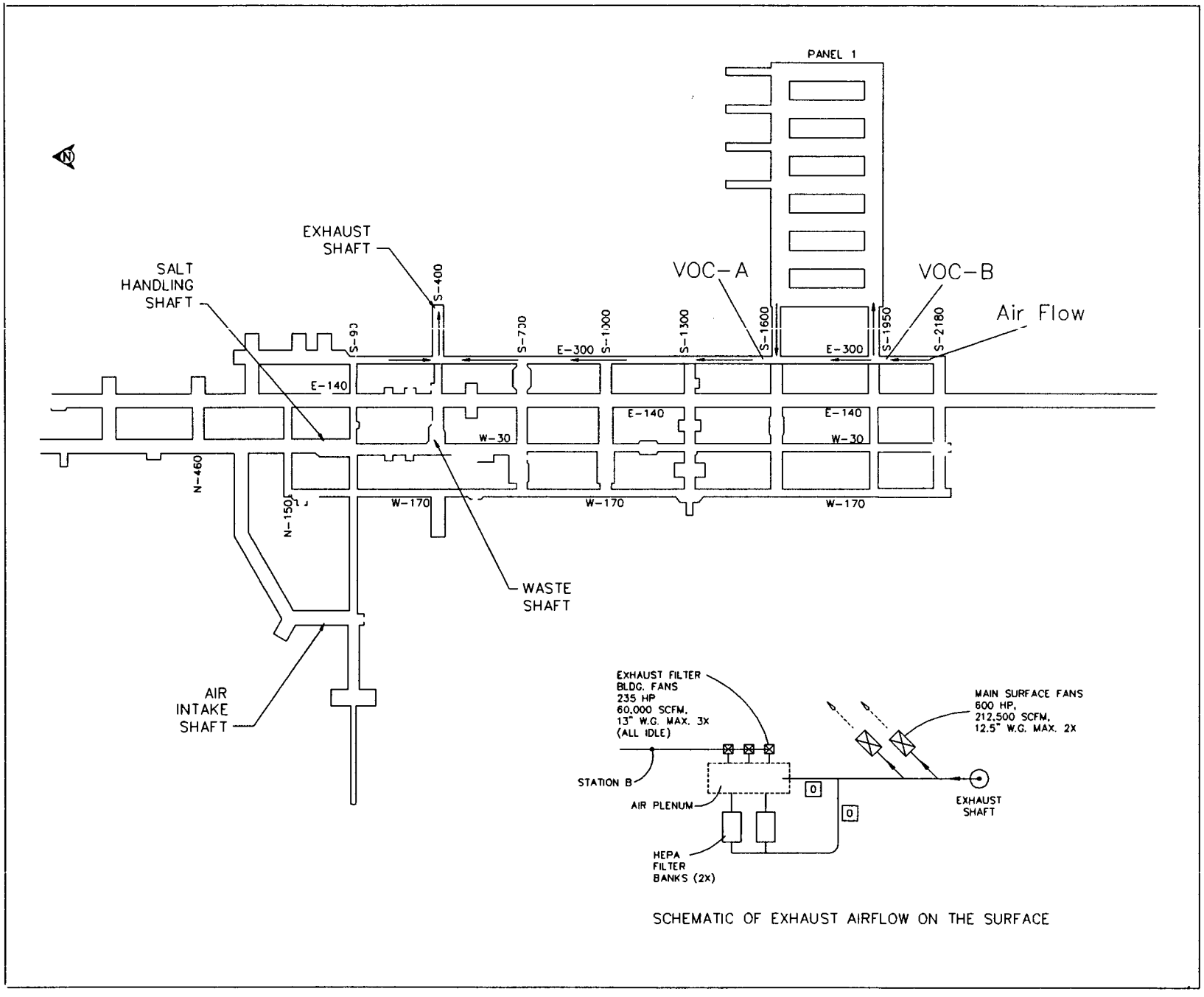

Figure 2.1 – Panel Area Air Flow

3.0 MONITORING DESIGN

Detailed design features of the VOC Confirmatory Monitoring Plan are presented in this section. The purpose of this program is to confirm that there is no migration of specific target VOCs exceeding any COC. This monitoring plan uses available sampling and analysis techniques to measure VOC concentrations. Available sampling equipment includes the standard WIPP VOC canister samplers with minor modifications.

3.1 SAMPLING LOCATIONS

Air samples will be collected at two locations in the facility to quantify airborne VOC concentrations. VOCs emanating from Panel 1 will be measured by placing one VOC monitoring station just downstream from Panel 1 at VOC-A and another station upstream from Panel 1 at VOC-B (Figure 2.1). In this configuration VOC-B will measure VOC releases from the upstream sources (i.e., Panel 2) and other background sources of VOCs, and VOC-A will measure upstream VOC releases plus any additional releases from Panel 1. A sample will be collected from each station on designated sample days. For each quantified target VOC, the concentration measured at VOC-B will be subtracted from the concentration measured at VOC-A to assess any release from Panel 1. Measurements from the first panel will confirm estimates of releases from all panels since the releases will be cyclic from panel-to-panel.

The sampling locations were selected based on operational considerations and the calculations presented in Chapter 5 of the NMVP. As discussed in Section 2.0, there are several different potential

sources of release for VOCs. These sources include incoming air from above ground, facility support operations, open waste panels, and closed waste panels. In addition, because of the ventilation requirements of the underground facility and atmospheric dispersion characteristics, any VOCs that are released from Panel 1 may be difficult to detect and differentiate from other sources of VOCs at any underground or above ground location further downstream of Panel 1. By measuring VOC concentrations close to the potential source of release (i.e., Panel 1), it will be possible to differentiate potential releases from background levels and confirm the theoretical calculations included in the NMVP.

3.1.1 E-300 Panel 1 Air Outlet (Station VOC-A)

Panel 1 will be the first open panel, and it will become the first closed waste panel once it is filled and the panel closure systems are installed and certified. Waste disposal activities will continue in Panel 2 during closure of Panel 1. Because Panel 1 is a potential source of VOC releases to the ventilation air traveling to the exhaust shaft, sampling station VOC-A has been established in the Drift E-300 downstream of the Panel 1 air outlet (Drift S-1600). The purpose of this station is to evaluate whether the concentrations of VOCs measured at this point are sufficiently higher than upstream concentrations to indicate potential migration from Panel 1. Therefore, concentrations of VOCs measured upstream of Panel 1 will be subtracted from those measured at station VOC-A and the resulting differences will be compared to the calculated COCs for Drift E-300.

The COCs for releases from waste panels have been calculated for each of the target VOCs in the Drift E-300 under normal operational conditions (see Chapter 5 of the NMVP). The calculated COC

difference between VOC-A and VOC-B, is presented in Table 3.1 for each of the nine target compounds, in terms of micrograms per cubic meter ($\mu g/m^3$) and parts per billion by volume (ppbv). As presented in Appendix BAD of the NMVP, baseline VOC monitoring has been performed at WIPP for three of the target VOCs (i.e., carbon tetrachloride, methylene chloride, and 1,1,1-trichloroethane). The average measured concentrations of these compounds entrained in the facility exhaust air are less than 2 percent of the COC presented in Table 3.1. These data demonstrate that it will be possible to differentiate between the VOC concentrations measured at VOC-A and VOC-B for comparison to the COCs presented in Table 3.1.

3.1.2 E-300 Panel 2 Air Outlet (Station VOC-B)

To quantify VOC concentrations upstream of Panel 1, another sampling station will be established in Drift E-300 downstream of the Panel 2 air outlet. Results from this monitoring station will allow target VOC concentrations in the ventilation air upstream of Panel 1 to be distinguished from any target VOCs that may be released from Panel 1. VOC concentrations measured at this location will consist of background concentrations entering the facility through the Air Intake Shaft, concentrations attributed to upstream facility operations, and concentrations from waste disposal activities in open Panel 2 after Panel 1 is closed. For each sampling event, target compound concentrations detected at VOC-B will be subtracted from those measured at VOC-A to assess VOC releases from Panel 1.

Table 3.1: Volatile Organic Compound Concentrations of Concern*

Compound	Molecular Weight (g/mol)	Drift E-300 µg/m³	Drift E-300 ppbv
1,1-Dichloroethylene	96.95	106	27
Carbon tetrachloride	153.8	35	6
Methylene chloride	84.94	1,130	326
Chloroform	119.4	23	5
1,1,2,2-Tetrachloroethane	167.9	92	13
1,1,1-Trichloroethane	133.42	3,300	600
Chlorobenzene	112.6	10,000	2,300
1,2,-Dichloroethane	98.96	20	10
Toluene	92.13	212,000	57,000

g/mol Grams per mole
µg/m³ Micrograms per cubic meter
ppbv Parts per billion by volume

* Calculated at 25 degrees Celsius (°C) and 760 millimeters of mercury (mmHg).

3.2 ANALYTES TO BE MONITORED

Based on acceptable knowledge, previous analytical data, and recent risk calculations (Appendix WAP and Chapter 5 of the NVMP), nine VOCs have been initially identified for monitoring. These compounds are listed in Table 2.1. The analysis will focus on routine detection and quantification of these compounds in collected samples. Other compounds may also be present in the samples. As part of the analytical evaluations, the presence of other compounds will be investigated. The analytical method will allow semi-quantitative evaluation of these compounds as tentatively identified compounds (TIC).

3.3 SAMPLING AND ANALYSIS METHODS

A technically sound, reliable, and versatile sampling method is required for the VOC monitoring program. The selected method must be able to definitively identify and quantify the initial nine target compounds. Another consideration is the desire to use EPA approved or recommended methods that provide data of known and documented quality. In addition, the present WIPP program includes a comprehensive VOC monitoring program established at the facility; equipment, training, and documentation for VOC measurements are already in place.

The method selected for VOC sampling is EPA Compendium Method TO-14 (EPA, 1988b; Winberry and others, 1990). The TO-14 sampling technique uses 6-liter SUMMA® passivated stainless-steel canisters to collect integrated air samples at each sample location. This method will be used for guidance in collecting the samples at WIPP. The samples will be analyzed using gas chromatography/mass spectrometry (GC/MS) under an established Quality Assurance/Quality

Control (QA/QC) program (WP 12-7) following guidance from the Draft EPA CLP-SOW for Volatile Organics Analysis of Ambient Air in Canisters (EPA, 1991). The Quality Assurance Project Plan (QAPP), WP 12-7, was prepared for the baseline monitoring program at the WIPP. It will be updated once the confirmatory monitoring plan is finalized.

The TO-14 method is an EPA-recognized sampling procedure for VOC sampling and speciation. It can be used to provide integrated samples, or grab samples, and compound quantitation for a broad range of concentrations. The sampling system can be operated unattended but requires detailed operator training.

As presently designed, the field sampling systems will be operated in the pressurized mode. In this mode, air is drawn through the inlet and sampling system with a pump. The air is pumped into an initially evacuated SUMMA® passivated canister by the sampler, which regulates the rate and duration of sampling. The passivation process forms a pure chrome-nickel oxide on the interior surfaces of the canisters. This type of container has been used routinely at WIPP in the past and has demonstrated sample storage stability for a wide variety of VOCs. At the end of each sampling period, the canisters will be pressurized to about two atmospheres absolute. In the event of shortened sampling periods or other sampling conditions, the final pressure in the canister may be less than two atmospheres absolute. Sampling duration will be approximately six hours, so that a complete sample can be collected during a single work shift.

The canister sampling system and GC/MS analytical method are particularly appropriate for the VOC Confirmatory Monitoring Program because a relatively large sample volume is collected, and

multiple dilutions and reanalyses can occur to ensure identification and quantification of target VOCs within the working range of the method. The contract required quantitation limits (CRQL) proposed by EPA are 5 ppbv or less for the nine target compounds (EPA, 1991), so that low concentrations can be measured. CRQLs are the EPA-specified levels of quantitation for EPA contract laboratories that analyze canister samples by GC/MS. The CLP-SOW expressly states how instrument detection limits are demonstrated. For the purpose of this monitoring plan, the CRQLs are defined as the method reporting limits (MRL). The MRL is a function of instrument performance, sample preparation, sample dilution, and all steps involved in the sample analysis process.

Detailed analytical standard operating procedures (SOP) and a QAPP have been prepared for EPA Method TO-14 canister analysis as part of the baseline VOC monitoring at WIPP. Revisions to these documents will be made as necessary to meet the QA/QC objectives described in Section 5.0. In addition, canister and sampling system cleaning and certification SOPs and QAPPs have been prepared. These procedures and plan will be consistent with the QA/QC objectives defined for the program.

Alternative sampling methods will be considered for deployment. One option will be to use subatmospheric samplers rather than pressurized sampling systems for stations VOC-A and VOC-B. In addition, remote sensing by proposed draft EPA Method TO-16, open-path fourier transform infrared spectroscopy (OP-FTIR) and extractive FTIR, may constitute supplemental or alternative methods for detecting VOCs released from waste panels at WIPP. WIPP personnel will continue to follow the development of emerging FTIR technology, and other potentially applicable technologies for assessing VOCs in the WIPP environment. Real-time monitoring with

a FTIR system may be a feasible future option for the VOC Confirmatory Monitoring Program.

3.4 Sampling Schedule

Many tasks will be completed prior to the initiation of VOC monitoring according to the monitoring plan. For example, power will be run to the monitoring station locations, engineering drawings will be created/revised for the monitoring stations, and program QAPP and SOP documentation will be finalized. Some sampling will be conducted prior to waste emplacement to troubleshoot the monitoring system. The purpose of collecting data during this phase will be to evaluate whether the monitoring systems and analytical methods are properly functioning. The troubleshooting period will be determined by VOC monitoring group personnel.

Confirmatory VOC sampling at Stations VOC-A and VOC-B will begin with initial waste emplacement in Panel 1. Sampling will continue during Panel 1 operations and will end no earlier than 6 months after the certified closure of Panel 1.

The environment within Panel 1 is not expected to vary substantially from day to day. If releases from Panel 1 do occur, concentrations in Drift E-300 may increase gradually over time as the panel is filled. Once the panel is filled and closed, the panel closure systems are designed to minimize air leakage from the relatively static panel environment. For these reasons, routine sampling will be conducted twice a week during the time Panel 1 is filled and for the first 6 months after the closure of Panel 1 has been certified.

VOC concentrations will be evaluated quarterly to assess whether the sampling results represent adequate confirmation of the emission calculations. If the average measured concentrations for the Panel 1 monitoring period confirm the calculations, no additional sampling will be performed. Confirmation will be achieved if the annual average concentration is below the predicted value. Monitoring will be extended for at least 12 months if no emissions are detected. However, the sampling frequency will be decreased to one per week. In addition, if a 12-month average target compound concentration exceeds the concentration of concern, additional sampling will be considered.

4.0 SAMPLING AND ANALYSIS PROCEDURES

This section describes the equipment and procedures that will be implemented during sample collection and analysis activities for VOCs at WIPP.

4.1 SAMPLING EQUIPMENT

The sampling equipment that will be used during the study includes the following: 6-liter (L) stainless-steel SUMMA® canisters, and VOC canister samplers. A discussion of each of these items is presented below.

4.1.1 SUMMA® Canisters

Six-liter, stainless-steel canisters with SUMMA® passivated interior surfaces will be used to collect and store all ambient air and gas samples for VOC analyses collected as part of the monitoring processes. These canisters must be cleaned and certified prior to their use, as described by Compendium Method TO-14 and the draft EPA CLP-SOW for Analysis of Ambient Air in Canisters. A SOP describing this process in detail has been prepared by the analytical laboratory. Compendium Method TO-14 and the CLP-SOW (EPA, 1991) were used as guidance documents in the preparation of this SOP.

4.1.2 Volatile Organic Compound Canister Samplers

A conceptual diagram of a VOC sample collection unit is provided in Figure 4.1. Unless an alternate sampling method is selected, two

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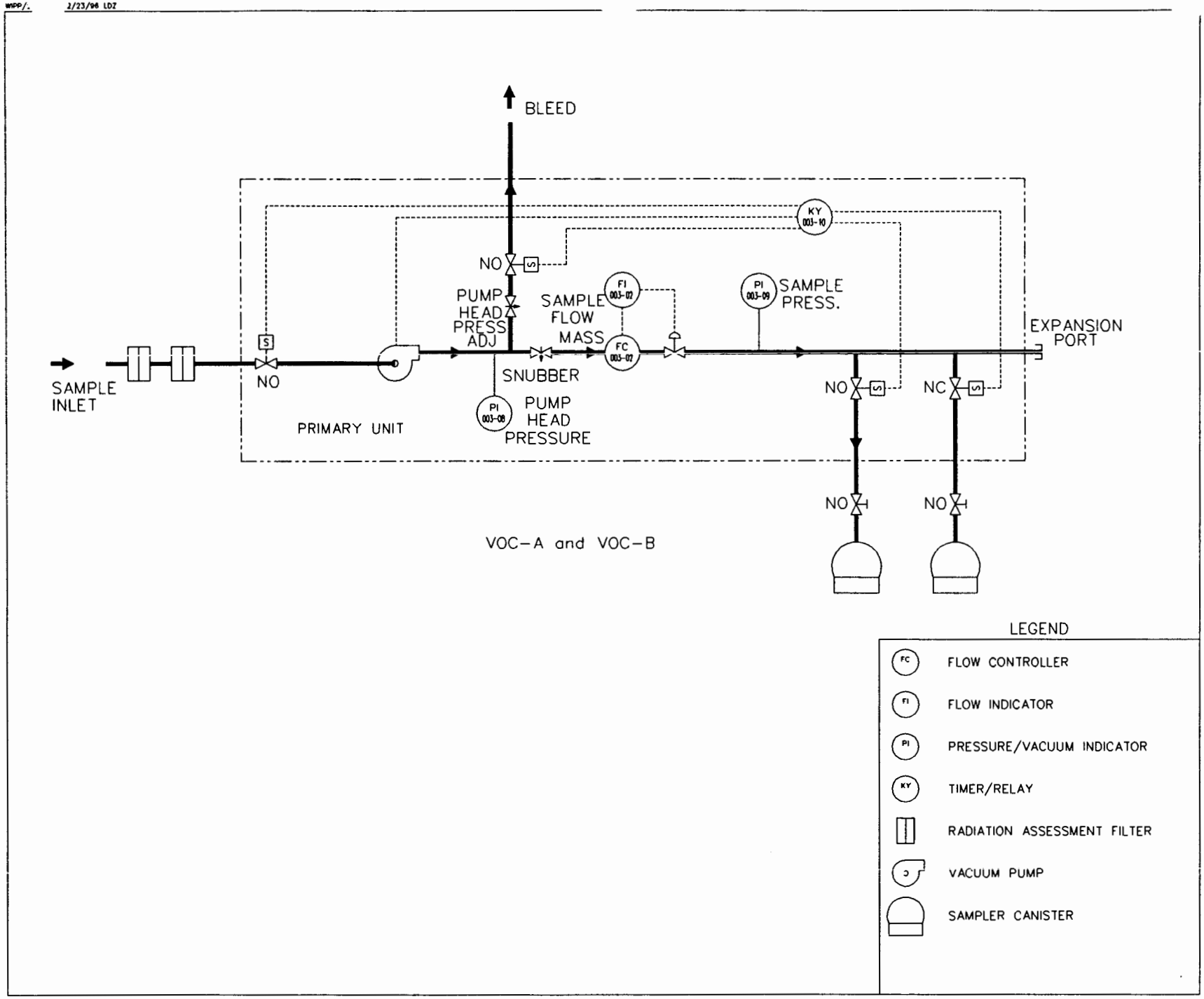

Figure 4.1 – VOC Monitoring System Design

such systems, VOC-A and VOC-B, will be operational at the time waste disposal operations begin in Panel 1. The sampling system consists of a sample pump, flow controller, sample inlet, two inlet filters in series to remove particulate matter, vacuum/pressure gauge, electronic timer, inlet purge vent, two sampling ports, and sufficient collection canisters so that any delays attributed to laboratory turnaround time and canister cleaning and certification will not result in canister shortages. Knowledge of sampler flow rates and duration of sampling will allow calculation of sample volume. The set point flow rate will be verified during sample collection by monitoring the mass flow indication. Prior to use, the sample collection units, including inlet line, will be tested and certified to demonstrate that they are free of contamination above the reporting limits of the VOC analytical method (see Section 5.0). Ultra high purity humidified zero air will be pumped through the sampling unit and collected in previously certified canisters as sampler blanks for analysis, as described in WP 12-7. A SOP describing in detail the cleaning and certification procedure for samplers (including pressure testing and target compound recovery evaluation) has been prepared.

4.2 SAMPLE COLLECTION

Samples collected from the underground facility should be representative of routine operations; therefore, six-hour integrated samples will be collected on each sample day. Alternative sampling durations may be defined for experimental purposes. The VOC canister sampler at each location will sample ambient air on the same programmed schedule. The sample pump will be programmed to sample continuously over a six-hour period during the work day. The units will sample at a nominal flow rate of 33.3 actual milliliters per minute over a six-hour sample period.

This schedule will yield a final sample volume of approximately 12 L. Flow rates and sampling duration may be modified as necessary for experimental purposes and to meet the data quality objectives.

Sample flow will be checked each sample day using the in-line mass flow controller. These flow controllers are initially factory-calibrated and specify a typical accuracy of better than 10 percent full scale. Additionally, each air flow controller is calibrated at a manufacturer-specified frequency using a National Institute of Standards and Testing (NIST) primary flow standard. Existing SOPs have been revised to address the specific calibration requirements of the VOC monitoring equipment.

Upon initiation of waste disposal activities in Panel 1, samples will be collected twice each week (at Stations VOC-A and VOC-B). Samples collected at the panel locations should represent the same matrix type (i.e., elevated levels of salt aerosols). To verify the matrix similarity, duplicate samples will be collected from each sampling station (stations VOC-A and VOC-B) during the first sampling event and at an overall frequency of five percent thereafter (see Section 5.1).

4.3 SAMPLE MANAGEMENT

Field sampling data sheets will be used to document the conditions under which each sample is collected. These data sheets have been developed specifically for VOC monitoring at the WIPP facility. The individuals assigned to collect the specific samples will be required to fill in all of the appropriate sample data and to maintain this record in sample logbooks. The program team leader will review these forms for each sampling event.

All samples will be maintained, and shipped if necessary, at ambient temperatures. Collected samples will be transported in appropriate containers. Prior to leaving the underground for analysis, all sample containers must undergo radiological screening. No potentially contaminated samples or equipment will be transported to surface.

Additional QA requirements for sample management contained in the sitewide Quality Assurance Program Description, WP 13-1, will be followed as appropriate. Chain-of-custody procedures will be followed closely, and additional requirements imposed by the laboratory for sample analysis will be included as necessary.

Individuals collecting samples will be responsible for the initiation of custody procedures. The chain of custody will include documentation as to the canister certification, location of sampling event, time, date, and individual handling the samples. Samples will be collected and handled in accordance with WP 12-7 and approved SOPs. Deviations from procedure will be considered a variance. Variances must be preapproved by the program manager and recorded in the project files. Unintentional deviations, sampler malfunctions, and other problems are nonconformances. Nonconformances must be documented and recorded in the project files. All field logs/data sheets must be incorporated into WIPP's records management program.

More detailed documentation of sample management is presented in WP 12-7, the QAPP for the VOC Monitoring Program (to be updated as described in Section 3.3).

4.4 SAMPLER MAINTENANCE

Routine sampler maintenance will be the responsibility of the sampling personnel. This maintenance will include, but not be limited to, replacement of damaged or malfunctioning parts without compromising the integrity of the sampler, filter changes, leak testing, and minor cleaning. Major cleaning and sampler cleanliness certification will be the responsibility of the sampling and analytical laboratory personnel. Additionally, complete spare units will be maintained onsite to minimize downtime because of sampler malfunction. A sampler preventative maintenance schedule has been developed and is included in WP 12-7. At a minimum, samplers will be certified for cleanliness initially, after any parts that are included in the sample flow path are replaced, or any time analytical results indicate potential contamination. All sample canisters will be certified prior to each usage.

4.5 ANALYTICAL PROCEDURES

Analytical procedures used in the analysis of VOC samples from canisters are based on EPA guidance in Compendium Method TO-14 (EPA, 1988b) and in the Draft CLP-SOW for Analysis of Ambient Air (EPA, 1991). Specific analytical SOPs and method validation data are in place at the program analytical laboratory for the performance of canister sample analyses. The technical approach for canister sample analysis is summarized below.

4.5.1 Sample Preparation

Because canisters will be pressurized during the sampling procedure, laboratory pressurization will not be necessary for analyses. Canister pressures will be verified by the laboratory when they are

received to confirm that significant losses did not take place during shipping and storage.

4.5.2 Analytical System Requirements

The GC/MS analytical system will consist of three major components: the sample introduction system, analyte separation system (GC), and the analyte detector system (MS).

- Sample Introduction System for Canisters: This system will include a drying tube to remove moisture from the gas stream. One or more cryogenic traps may be used to focus and desorb trapped material. Transfer lines within the introduction unit will be heated as necessary so that volatile compounds are not actively absorbed. Valves and solenoids will be heated and be of a low dead volume type. The introduction system will have an in-line mass flow controller. The introduction unit will be capable of introducing internal standards directly into the sample flow path.

- Analyte Separation: Analyte separation will be achieved by GC. The GC will be capable of subambient temperature programming.

- Detection System: Analyte detection will be accomplished by MS. The MS must be capable of scanning from 35 to 300 mass to charge ratio in one second or less, be fitted with a gas jet separator, a data system capable of storing all raw data, and a computer algorithm for analyte quantitation and forward library searching. All raw and processed GC/MS data must be stored on magnetic tape or disk and kept for the duration of this project.

4.5.3 Standard Preparation

Primary analytical standards will be prepared by the laboratory from commercially available, certified calibration gases. Alternatively, primary standards may be generated internally by the laboratory. Primary standards of analytes that are gases at standard temperature and pressure (STP) may be internally prepared in a static gas dilution bottle. For analytes that are liquid or solid at STP, a mixture may be made and loaded directly into a standard preparation cylinder. These internally generated standards will be checked against EPA audit cylinders or other reference materials to verify the accuracy of their concentrations.

Primary standards will be prepared for the nine target compounds as well as the internal standards. Secondary standards used for instrument calibration will be prepared from dilution of the primary standards.

4.5.4 Calibration Procedures

Prior to the analysis of a standard curve, the GC/MS system must undergo a mass calibration check. This check is performed by injecting 50 nanograms (ng) of 4-bromofluorobenzene (BFB) directly onto the capillary column. The requirements (criteria) for relative ion abundances for BFB, listed in Table 4.1, must be met before analyses may proceed. BFB requirements must be met for each 12 hours of operation.

Quantitative standards for the nine target analytes will be analyzed at five concentrations. These concentrations should

define the linear range of the instrument for these nine compounds; however, if some nonlinearity exists, concentrations may be determined by curve fitting or physically plotting the data. One standard concentration shall be at or near a concentration corresponding to the required MRL for each target compound. Relative response factors will be generated for each target compound. These response factors must meet the requirements listed in Section 5.1.3. As discussed above, if low concentration standards do not meet the linearity requirement, then a curve-fitting routine may be used. The method used to quantify the data must be reported with the analytical results.

Table 4.1: 4-Bromofluorobenzene Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	8 to 40 percent of mass 95
75	30 to 60 percent of mass 95
95	Base Peak, 100 percent Relative Abundance
96	5 to 9 percent of mass 95
173	<2 percent of mass 174
174	>50 percent of mass 95
175	4 to 9 percent of mass 174
176	>93 percent but <101 percent of mass 174
177	5 to 9 percent of mass 176

4.5.5 Library Searches

In every sample analyzed, a forward search of the NIST library of mass spectra must be performed for all chromatographic peaks greater than 10 percent of the nearest internal standard.

4.5.6 Data Reporting

Sample target analyte concentrations will be quantified using the mid-range calibration standards and will be reported in ppbv. Non-target sample contaminants identified by NIST library searches will be reported as TICs, and concentration calculations will be based on the response of the nearest internal standard. The relative response factor used for quantitation, as well as copies of spectra with the library search results (purity and fit), will be submitted with the results. A table listing the run sequence with the corresponding internal standard area counts must be reported with the analytical results. A narrative describing any problems with sample analysis must be included. Any nonconformances must be included with the reporting of the data. Data reporting and documentation requirements are discussed in greater detail in WP 12-7.

4.6 LABORATORY SELECTION

Sample analyses will occur at the WIPP onsite analytical laboratory and/or at a suitable contract analytical laboratory. Upon selection of an offsite contract laboratory, measures shall be taken, in accordance with the current Westinghouse Waste Isolation Division procurement policies and procedures, to ensure that procured services conform to specified requirements. These measures

will generally include one or more of the following: 1) evaluation of the supplier's capability to provide services in accordance with requirements, including a history of providing similar services; 2) evaluation of objective evidence of conformance, such as laboratory document submittals; and 3) examination of delivered services.

4.7 LABORATORY PROCEDURES

Analytical laboratories that perform analyses for the VOC Confirmatory Monitoring Plan are required to develop and maintain, at a minimum, the following SOPs:

- Canister cleaning and certification
- Sampler cleaning and certification
- Analysis of VOCs in SUMMA® canisters
- Data QA and reporting

Laboratories are also required to maintain an internal program QA Manual, and to develop and prepare a QAPP covering cleaning and certification of canisters and laboratory analysis of canister samples. In addition, laboratories will be required to review and comply with WP 12-7.

5.0 QUALITY ASSURANCE

Many quality assurance objectives for the VOC Confirmatory Monitoring Plan have been addressed in Sections 3.0 and 4.0. For example, sample collection procedures are discussed, including justification of sampling location selection. Additional topics include discussions of sampling program operations, preparation of sampling equipment and sample containers, redundancy in sampling equipment and sample containers (including canister certification), a general sample management/control scheme, and the selection of analytical procedures. More detailed descriptions of these functions, as well as additional quality-related objectives, are addressed in WP 12-7. WP 12-7 has been prepared in accordance with the document entitled "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations" (EPA, 1994) and the "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (EPA, 1983), and QA criteria listed in Table 5.1. This section addresses the methods to be used to evaluate the components of the measurement system and how this evaluation will be used to assess data quality. In addition, project activities will be performed in conformance with QA requirements described in WP 12-7.

5.1 QUALITY ASSURANCE OBJECTIVES FOR THE MEASUREMENT OF PRECISION, ACCURACY, SENSITIVITY, AND COMPLETENESS

Quality assurance objectives for the VOC Confirmatory Monitoring Plan will be defined in terms of the following data quality parameters:

Table 5.1: Quality Assurance Objectives for Accuracy, Precision, Sensitivity, and Completeness

Compound	Accuracy (Percent Recovery)	Precision (RPD)	Required MRL (ppbv)	Completeness (Percent)
1,1-Dichloroethylene	60 to 140	25	5	≥90
Carbon tetrachloride	60 to 140	25	2	≥90
Methylene chloride	60 to 140	25	5	≥90
Chloroform	60 to 140	25	2	≥90
1,1,2,2-Tetrachloroethane	60 to 140	25	2	≥90
1,1,1-Trichloroethane	60 to 140	25	5	≥90
Chlorobenzene	60 to 140	25	2	≥90
1,2-Dichloroethane	60 to 140	25	2	≥90
Toluene	60 to 140	25	5	≥90

These data quality objectives are based on control criteria proposed by EPA as presented in the Contract Laboratory Program Statement of Work for the Analysis of Ambient Air in Canisters (EPA, 1991).

EPA U.S. Environmental Protection Agency
MRL Method reporting limit
ppbv Parts per billion by volume
RPD Relative percent difference

- **Precision.** For the duration of this project, precision will be defined and evaluated by the relative percent difference (RPD) values calculated between field duplicate samples and between laboratory duplicate samples.

$$RPD = \frac{(A - B)}{[(A + B)/2]} \times 100 \quad (3)$$

where:

A = Original sample result

B = Duplicate sample result

- **Accuracy.** Analytical accuracy will be defined and evaluated through the use of analytical standards. Because recovery standards cannot reliably be added to the sampling stream, overall system accuracy must be based on analytical instrument performance evaluation criteria. These criteria will include performance verification for instrument calibrations, laboratory control samples, and sample internal standard areas. These criteria will constitute the verification of accuracy for target analyte quantitation (i.e., quantitative accuracy). Evaluation of standard ion abundance criteria for BFB will be used to evaluate the accuracy of the analytical system in the identification of targeted analytes, as well as the evaluation of unknown contaminants (i.e., qualitative accuracy).

- **Sensitivity.** Sensitivity will be defined by the required MRLs for the program. Attainment of required MRLs will be verified by the performance of statistical method detection limit (MDL) studies in accordance with 40 CFR Part 136. The MDL represents the minimum concentration that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. An MDL study will be performed by the program analytical laboratory prior to sampling and analysis.

- **Completeness.** Completeness will be defined as the percentage of the ratio of the number of valid sample results received versus the total number of samples collected. Completeness may be affected, for example, by sample loss or destruction during shipping, by laboratory sample handling errors, or by rejection of analytical data during data validation.

5.1.1 Evaluation of Laboratory Precision

Laboratory sample duplicates and blank spike/blank spike duplicates (BS/BSD) will be used to evaluate laboratory precision. Quality assuarance objectives for laboratory precision are listed in Table 5.1, and are based on precision criteria proposed by EPA for canister sampling programs (EPA, 1991). These values will be appropriate for the evaluation of samples with little or no matrix effects. Because of the potentially high level of salt-type aerosols in the WIPP underground environment, the analytical precision achieved for WIPP samples may vary with respect to the

EPA criteria. RPDs for BS/BSD analyses will be tracked through the use of control charts. RPDs obtained for laboratory sample duplicates will be compared to those obtained for BS/BSDs to ascertain any sample matrix effects on analytical precision. BS/BSDs and laboratory sample duplicates will be analyzed at a frequency of 10 percent or one per analytical lot, whichever is more frequent. Precision windows and outlier criteria are addressed in WP 12-7.

5.1.2 Evaluation of Field Precision

Field duplicate samples will be collected at a frequency of five percent for both monitoring locations. Like the laboratory duplicate data, field duplicate data will be compared to the EPA precision criteria presented in Table 5.1, and matrix and sampling effects on precision will be assessed through comparison with internal laboratory precision data.

5.1.3 Evaluation of Laboratory Accuracy

Quantitative Accuracy

Quantitative analytical accuracy will be evaluated through performance criteria on the basis of: 1) relative response factors generated during instrument calibration, 2) analysis of laboratory control samples (LCS), and 3) recovery of internal standard compounds. The criteria for the initial calibration (5-point calibration) is that any single relative response factor for a particular target compound can differ by no more than 30 percent from the average of the five. After the successful completion of the 5-point calibration, it is sufficient to analyze only a midpoint standard for every 12 hours of operation. The midpoint

standard must pass the 30 percent difference acceptance criteria before sample analysis may begin.

A blank spike or LCS is an internal QC sample generated by the analytical laboratory by spiking a standard air matrix (humid zero air) with a known amount of a certified reference gas. The reference gas will contain the target VOCs at known concentrations. Percent recoveries for the target VOCs will be calculated for each LCS relative to the reference concentrations. Objectives for percent recovery are listed in Table 5.1, and are based on accuracy criteria proposed by EPA for canister sampling programs (EPA, 1991). LCSs will be analyzed at a frequency of 10 percent or one per analytical lot, whichever is more frequent. Recovery windows and outlier criteria are addressed in WP 12-7.

Internal standards will be introduced into each sample analyzed, and will be monitored as a verification of stable instrument performance. In the absence of any unusual interferences, areas should not change by more than 40 percent over a 12-hour period. Deviations larger than 40 percent are an indication of a potential instrument malfunction. If an internal standard area in a given sample changes by more than 40 percent, the sample must be reanalyzed. If the 40 percent criterion is not achieved during the reanalysis, the instrument must undergo a performance check and the midpoint standard must be reanalyzed to verify proper operation. Response and recovery of internal standards will also be compared between samples, LCSs, and calibration standards to identify any matrix effects on analytical accuracy.

Qualitative Accuracy

Qualitative accuracy in the identification of target VOCs will be evaluated by the relative ion abundance criteria established for the internal standard compound BFB. For each 12 hours of sample analysis, a 50-nanogram (ng) injection of BFB must be made, and the requirements listed in Table 4.1 must be met before the instrument may be used to analyze samples.

5.1.4 Evaluation of Sensitivity

The presence of aerosol salts in underground locations may affect the MDL of the samples collected in those areas. The intake manifold of the sampling systems will be sufficiently protected from the underground environment to minimize salt aerosol interference.

The MDL for each of the nine target compounds will be evaluated by the analytical laboratories before sampling begins. The initial MDL evaluation will be performed in accordance with 40 CFR Part 136 and with EPA/530-SW-90-021, as revised and retitled, "Quality Assurance and Quality Control" (Chapter 1 of SW-846) (1986).

5.1.5 Completeness

The expected completeness for this project is greater than or equal to 90 percent. Data completeness will be tracked monthly.

5.2 SAMPLE HANDLING AND CUSTODY PROCEDURES

Sample packaging, shipping, and custody procedures are addressed in WP 12-7 (see Sections 7.4 and 8.0).

5.3 CALIBRATION PROCEDURES AND FREQUENCY

Calibration procedures and frequencies for analytical instrumentation are listed in Section 4.5.4.

5.4 ANALYTICAL PROCEDURES

The analytical procedures for the VOC Confirmatory Monitoring Program, which are based on the draft CLP SOW for Analysis of Ambient Air in Canisters (EPA, 1991) and EPA guidance Method TO-14 (EPA, 1988b), are outlined in Section 4.5.

5.5 DATA REDUCTION, VALIDATION, AND REPORTING

Data reduction and validation are addressed in the WP 12-7. A brief description of data reporting is given in Section 4.5; more detail on data reporting is provided in WP 12-7.

A dedicated logbook will be maintained by the operators. This log will contain documentation of all pertinent data for the sampling. Sample collection conditions, maintenance, and calibration activities will be included in this log. Additional data collected by other groups at WIPP, such as ventilation airflow, temperature, pressure, etc., will also be obtained to document the sampling conditions, as necessary.

Data validation procedures will be specified in the monitoring program QA protocols. At a minimum, all field data forms and

sampling logbooks will be checked for completeness and correctness. Sample custody and analysis records will be routinely reviewed by the QA officer and the laboratory supervisor.

Data will be summarized quarterly. Data summaries will include target VOC results for each sample collected as well as overall statistical summaries. Graphical summaries may also be included.

5.6 PERFORMANCE AND SYSTEM AUDITS

System audits will initially address startup functions for each phase of the project. These audits will consist of onsite evaluation of materials and equipment, review of canister and sampler certification, review of laboratory qualification and operation, and may, at the request of the QA officer, include an onsite audit of the laboratory facilities. The function of the system audit is to verify that the requirements in this plan and the QAPP, have been met prior to initiating the program. System audits will be performed prior to the initiation of the monitoring program.

Performance audits will be accomplished as necessary through the evaluation of analytical quality control data, by performing periodic site audits throughout the duration of the project, and through the introduction of third-party audit cylinders (laboratory blinds) into the analytical sampling stream. Performance audits will also include a surveillance/review of all data associated with canister and sampler certification, a project-specific technical audit of field operations, and a laboratory performance audit. Field logs, logbooks, and data sheets will be reviewed weekly. Blind-audit canisters will be introduced once

during the sampling period. Details concerning scheduling, personnel, and data quality evaluation are addressed in WP 12-7.

5.7 PREVENTATIVE MAINTENANCE

A brief description of sampler maintenance is described in Section 4.4. Maintenance of analytical equipment will be addressed in the analytical SOP.

5.8 CORRECTIVE ACTIONS

Nonconformances and corrective actions of noncomformances will be processed as outlined in the Quality Assurance Program Description (DOE 1994).

5.9 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The results of audits will be reported in accordance with sitewide Quality Assurance Plan (QAP) and WP 13-005. Audit reports will include identification of findings and/or observations, as well as an assessment of the effectiveness of the QAP elements review.

6.0 ACRONYMS

BFB	4-Bromofluorobenzene
BS/BSD	Blank spike/blank spike duplicate
CFR	Code of Federal Regulations
CH	Contact handled
CLP	Contract Laboratory Program
COC	Concentration of concern
CRQL	Contract required quantitation limit
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
g/mol	Grams per mole
GC/MS	Gas chromatography/mass spectroscopy
LCS	Laboratory control samples
MDL	Method detection limit
mmHg	Millimeters of mercury

MDL	Method detection limit
MRL	Method reporting limit
m/z	Mass to charge ratio
ng	Nanogram
NIST	National Institute of Standards and Testing
NMAC	New Mexico Administrative Code
NMVP	No-migration variance petition
OP-FTIR	Open-path fourier transform infrared spectroscopy
ppbv	Parts per billion by volume
QA/QC	Quality assurance/quality control
QA	Quality assurance
QAPD	Quality Assurance Program Description
QAPP	Quality Assurance Project Plan
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RH	Remote handled

RPD	Relative percent difference
SOP	Standard operating procedure
SOW	Statement of work
STP	Standard temperature and pressure
TIC	Tentatively identified compound
TRU	Transuranic
UHP	Ultra high purity
VOCs	Volatile organic compounds
WAC	Waste acceptance criteria
WAP	Waste analysis plan
WID	Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
$\mu g/m^3$	Micrograms per cubic meter
°C	Degrees Celsius

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WP 13-QA3003, Corrective Action Program.

WP 13-1, WIPP Sitewide Quality Assurance Program.

App F1, Rev 6.0

WATER TANK LEVEL

(SEE FIRE PUMP)

APPENDIX J1
SOLID WASTE MANAGEMENT UNIT CHARACTERIZATION SHEETS

APPENDIX J1
SOLID WASTE MANAGEMENT UNIT CHARACTERIZATION SHEETS

001 MUD PITS

Unit Type:	Mud Pits
Unit Use:	Storage/Settling
Operational Status:	Decommissioned/In Use
Use Period:	1970s - Present
Materials Managed:	Solid Waste
Hazardous Release:	None
Radioactive Release:	None
Information source(s):	Process Knowledge

Unit Description

Refer to Figure J-1 for location. Thirteen decommissioned mud pits are identified in the WIPP RFA. Additional mud pits associated with seven groundwater monitoring well sites have been created since the RFA. They were used for settling drill cuttings out of the drilling fluids being used in drilling holes to support hydrologic testing and monitoring, potash evaluation, and drilling for hydrocarbons. These mud pits ranged in size from approximately 150 by 150 by 5 feet (ft) (46 by 46 by 1.5 m) to 10 by 30 by 5 ft (3 by 9 by 1.5 m). Diesel fuel, foaming agents and other organic additives were added to the drilling mud to reduce dissolution of the water-soluble rocks, promote hole stability, and to help lubricate the drill rods. It is not known how many of the wells were drilled using diesel in the drilling mud. Each mud pit was lined with a plastic sheet and used for one to two months during drilling, then allowed to dry out. To facilitate drying, holes were cut in the bottom of the liner of some pits. In general, once a pit was dry, it was covered with the soil that had been removed to make the berms and then graded to the original contours. The individual mud pits in SWMU No. 001 are listed on Table J1-1. It is difficult to determine the exact location of most of the mud pits because of the grading and revegetation that has taken place.

Many of these mud pits were the result of exploration activity that was conducted prior to the selection of the area for the WIPP facility and, therefore, were not created by DOE in support of the WIPP Project. All such locations are indicated in Table J1-1.

Waste Description

Materials in the mud pits consisted of sodium- and potassium chloride-saturated brine to which starch, bentonite gel, and diesel fuel were added; drill cuttings; metal cuttings; trace amounts of hydraulic fluid, grease, and motor oil; and the plastic liner.

Release Information

Potential releases from each of the drill sites occurred when the mud pits were drained by cutting holes in the liner. The materials released consisted of saturated brines, which are not considered hazardous under the RCRA. All of the solids confined in the plastic liner of the mud pits were buried when the pits were covered with soil and graded.

TABLE J1-1
SWMU DATA — MUD PITS

SWMU[a]	Location[b]	Hole No.	No. of Pits[c]	Period of Use	Well Status	Size of Drill Pad (Acres/ Hectares)
001-x	NW, NE, SW, 17	WIPP-13	2	8/78 & 10/85	Open	4/1.6
001-p	SW, NE, SW, 34	Cotton Baby	2	1973-1974	Plugged	3/1.2
001-o	NW, NE, SW, 15	Badger Unit	1	1974	Plugged	2/0.8
001-t	SE, SE, SW, 30	IMC-374	1	Unknown (pre-1975)	Plugged	1/0.4
001-q	SE, SE, SE, 28	DOE-1	2	1982	Open	3/1.2
001-n	SW, SW, SW, 31	P-15	1	10/76	Plugged	1/0.4
001-g	SW, SW, SW, 29	H-14 P-1	2	9/86 8/76	Sampled once/3 yrs. Plugged	1/0.4
001-h	NE, NE, NE, 28	H-15 P-2	2	10/86-11/86	Sampled once/3 yrs.	1/0.4
001-s	SE, SE, SE, 20	ERDA-9	1	4/76-6/76	Open	2/0.8
001-j	SE, SE, SW, 20	P-3	1	8/76-9/76	Plugged	0.5/0.2
001-k	SE, SW, SE, 28	P-4	1	8/76-9/76	Plugged	.75/0.3
001-l	SE, SE, SE, 17	P-5 WIPP-12	4	9/76 11/78 & 10/85	Plugged Open	6/2.4
001-m	SW, SW, NW, 30	P-6	1	9/76	Plugged	1/0.4
001-ah	SE, NW, SW, 28	H-19	multiple	1994-present	Open	4.65/1.9
001-ai	NW, NE, NW, 20	WQSP-1	2	1994-present	Open	0.46/0.19
001-aj	SW, NW, SW, 16	WQSP-2	2	1994-present	Open	0.46/0.19
001-ak	SE, SW, SW, 16	WQSP-3	2	1994-present	Open	0.46/0.19
001-al	SE, NW, SW, 28	WQSP-4	2	1994-present	Open	0.46/0.19
001-am	SE, SE, SE, 29	WQSP-5	2	1994-present	Open	0.46/0.19
001-an	SW, NE, SW, 29	WQSP-6 WQSP-6A	4	1994-present	Open	0.46/0.19

[a]SWMU designation in parentheses is the designation used in the WIPP RCRA Facility Assessment.
[b]All of the mud pits are in T22S, R31E. The location column gives the 1/4 of the 1/4 of the 1/4 of the section.
[c]Probable number of mud pits. Many of the drill pads were used to drill several holes, requiring the use of more than one mud pit.
[d]These are wells that were not drilled at the request of DOE; they were drilled for hydrocarbon and potash exploration.

002 LANDFILLS

Unit type:	Landfill
Unit use:	Disposal
Operational status:	Active
Use period:	1976 - Present
Materials managed:	Solid Waste
Hazardous release:	None
Radioactive release:	None
Information source(s):	Process Knowledge Aerial Photos

Unit Description

Refer to Figure J-1 for location. Two areas have been used as landfills at the WIPP facility. The older location, called the Brinderson Landfill (003-a), is located 1 mi (1.6 km) due south of Zone I. Prior to use as a construction landfill, the area was used as a quarry for road-bed materials. It was an active landfill from 1976 to January 1988 and covers about 4 acres (ac) (1.6 hectares [ha]). The closure of the Brinderson Landfill was approved by the U.S. Department of Interior, Bureau of Land Management (BLM). Since it was closed, the Brinderson Landfill has been covered over and reseeded. The new landfill (003-b) is located 1/2 mi (0.8 km) south of Zone I. The new construction landfill was developed in two parts. The first part, to the south of the current one, was excavated on BLM land and operated under a BLM permit until 1989. It was closed at the request of the BLM. The second part of the landfill was opened on land designated by the BLM as part of the DOE Exclusive Use Area in Public Land Order 6403. Ground was first broken for the new landfill area in November 1989; it is still active and covers about 15 ac (6 ha). Permits were obtained from the BLM for both landfills on BLM-administered land.

Waste Description

Both of the landfills have been used to bury construction debris consisting of foundation excavation soils, waste concrete, scrap wood, and metal. In addition, it has been reported that small amounts of nonconstruction debris (most likely office wastes) were dumped in the Brinderson Landfill. No asbestos materials are known to have been disposed of in the landfills. Disposal of RCRA hazardous waste or hazardous constituents in the construction landfill is done in accordance with written procedures.

Release Information

Releases of RCRA hazardous waste or hazardous constituents have not occurred at these sites.

003 STORAGE YARDS

Unit type:	Storage Areas
Unit use:	Storage
Operational status:	Active
Use period:	1976 - Present
Materials managed:	Solid Waste
	Hazardous Waste
	Oils
Hazardous release:	Potential
Radioactive release:	None
Information source(s):	Process Knowledge
	Aerial Photos

Unit Description

Refer to Figure J-1 for location. One area presently used for storage was designated in the RFA. This storage yard, the Portacamp (004-a), is located about 1,000 ft (305 m) southeast of Zone I. The yard is used to store construction and maintenance materials and as temporary storage for wastewater and waste oils awaiting laboratory analysis or recycling. The waste oils are recycled if free of hazardous contamination. The area is approximately 2 ac (0.8 ha) in extent and has been active since 1976.

Waste Description

The wastes stored at the Portacamp are water contaminated with motor oil, hydraulic oil, and diesel fuel from the vehicle wash bays; used hydraulic oil; used motor oil; glycol-based oils; used antifreeze; discontinued oils and empty 55-gallon drums. In 1987 the excess chemical grout from grouting the Exhaust Shaft and the Waste Shaft was stored in this yard prior to being shipped off site for disposal as hazardous waste.

Release Information

There have been no releases of RCRA hazardous waste or hazardous constituents from the area; however, small areas of stained soil under the pallets where excess or used petroleum products are stored indicate there have been minor releases of oil and petroleum products (non-RCRA regulated materials) from the drums. Any releases from the area used for staging wastewater and waste oils are remediated according to the applicable WIPP facility procedure.

APPENDIX L1

NO-MIGRATION DETERMINATION FOR THE PROPOSED TEST PHASE

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LEGI-SLATE Report for the 104th Congress Wed, May 17, 1995 5:00pm (EST)

Q U I C K F E D E R A L R E G I S T E R (T E X T)
55 FR 47721

On 11/14/90
[L-S document 375430, 55 FR 47700, 2403 lines]

ENVIRONMENTAL PROTECTION AGENCY

[FRL-3860-1]

Conditional No-Migration Determination for the Department of Energy Waste Isolation Pilot Plant (WIPP)

Agency: Environmental Protection Agency.

Action: Notice of Final No-Migration Determination.

Summary: In response to a petition from the Department of Energy (DOE), the Environmental Protection Agency (EPA) is today making a determination of no migration for placement of hazardous waste at DOE's Waste Isolation Pilot Plant (WIPP), located near Carlsbad, New Mexico. Today's determination imposes several conditions on such placement and is for a maximum of ten years. As a result of this determination, DOE may place a limited amount of untreated hazardous waste subject to the land disposal restrictions of the Resource Conservation and Recovery Act (RCRA) in the WIPP for the purposes of testing and experimentation. DOE submitted a petition to EPA for a no-migration determination in March 1989; EPA proposed to grant the petition in April 1990. After a careful review of public comments on the proposal, EPA has concluded that DOE has demonstrated, to a reasonable degree of certainty, that hazardous constituents will not migrate from the WIPP disposal unit during the testing period proposed by DOE, and that DOE has otherwise met the requirements of 40 CFR 268.6 for the WIPP. The approved petition requires DOE to remove the hazardous wastes from the underground repository if it cannot demonstrate the long-term acceptability of the disposal site by the end of the test period.

Effective Date: November 14, 1990.

Addresses: The public docket for this determination is available for public inspection in Room M2427, U.S. Environmental Protection Agency, 401 M St. SW., Washington, DC 20460, Monday through Friday, excluding Federal holidays. Members of the public may make an appointment to review docket materials by calling (202) 475-9327. Copies of docket materials may be made at no cost, with a maximum of 100 pages of material from any one regulatory docket. Additional copies are $0.15 per page.

For Further Information Contact: General questions about the regulatory requirements under RCRA should be directed to the RCRA/Superfund Hotline at 800-424-9346 (toll free) or 202-382-3000 (local).

Specific questions about the issues discussed in this notice should be directed to Matthew Hale, Office of Solid Waste (OS-341), U.S. Environmental Protection Agency, 401 M St. SW., Washington, DC 20460, at 202-382-4746.

Supplementary Information:

Preamble Outline

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I. Background

A. RCRA Land Disposal Restrictions

The Hazardous and Solid Waste Amendments (HSWA) of 1984, which amend the Resource Conservation and Recovery Act (RCRA), imposed substantial new requirements on the land disposal of hazardous waste. In particular, the amendments prohibit the continued land disposal of hazardous wastes, unless either (1) the wastes meet treatment standards specified by EPA, or (2) the Administrator determines that the prohibition is not required in order to protect human health and the environment. This latter determination must be based on a demonstration by the owner/operator of the facility receiving the waste "that there will be no migration of hazardous constituents from the disposal unit or injection zone as long as the wastes remain hazardous." (RCRA sections 3004 (d)(1), (e)(1), and (g)(5).) The Department of Energy (DOE) has chosen to comply with the land disposal restrictions for certain

transuranic (TRU) wastes to be shipped for testing and experimentation at its Waste Isolation Pilot Plant (WIPP) by pursuing the second option. Today's notice approves, with conditions, DOE's petition for the WIPP site.

EPA first promulgated standards and procedures for review of no-migration petitions under 40 CFR 268.6 in November 1986. These regulations, which apply to land disposal units other than underground injection wells, codify the statutory standard for no-migration findings, specify the information required in no-migration petitions, and establish EPA's procedures for approving or denying petitions (November 7, 1986, 51 FR 40572). EPA amended these regulations on August 17, 1988 (53 FR 31138) to add further procedural requirements and standards./1/ EPA is now developing additional no-migration standards to clarify or expand on certain parts of the current regulations. The Agency expects to propose these standards in the near future. In conjunction with this proposal, EPA has also developed draft no-migration guidance, a copy of which is available in the docket for this rulemaking.

NOTE /1/ On July 26, 1988, EPA also promulgated standards under 40 CFR part 148 for no-migration determinations for underground injection wells (53 FR 28122).

To date, EPA has received 31 no-migration petitions submitted in accordance with 40 CFR 268.6. Today's notice, which addresses disposal of mixed radioactive and hazardous waste in a mined salt bed, is the Agency's first decision on any of these petitions under Sec. 268.6. The other Sec. 268.6 petitions, which primarily address land treatment operations, are currently under Agency review. In addition, EPA has received approximately 65 no-migration petitions for underground injection wells under 40 CFR part 148. Of these, 30 have been approved, 26 are still under review, and a number of others have been withdrawn.

B. Regulatory Status of Mixed Wastes

The hazardous wastes that are subject to today's notice are "mixed wastes." Mixed wastes are defined as a mixture of hazardous wastes regulated under Subtitle C of RCRA and radioactive wastes regulated under the Atomic Energy Act (AEA). Because section 1004 of RCRA excludes "source," "special nuclear," and "byproduct materials," as defined under the Atomic Energy Act, from the definition of RCRA "solid waste," there has been some confusion in the past as to the scope of EPA's authority over mixed waste under RCRA. EPA clarified this question in a Federal Register notice on July 3, 1986.

EPA's clarification stated that the section 1004 exclusion applies only to the radioactive portion of mixed waste, not to the hazardous constituents. Therefore, a mixture of "source," "special nuclear," or "byproduct materials" and a RCRA hazardous waste must be managed as a hazardous waste, subject to the requirements of RCRA subtitle C (that is, RCRA standards for the management of hazardous waste). EPA's oversight under RCRA, however, extends only to the hazardous waste components of the mixed waste, not to the source, special nuclear, or byproduct materials themselves. The exempted radionuclides are instead addressed under the AEA./2/ DOE subsequently confirmed and clarified this interpretation in the Federal Register on May 1, 1987. Sections I.D and V.A of this notice further discusses the relationship between the AEA standards and the no-migration finding.

NOTE /2/ This interpretation, however, does not preclude EPA from requiring data on radionuclide content of wastes where necessary to carry out EPA's authorities under RCRA--for example, to ensure protection of personnel

carrying out RCRA inspections or oversight sampling.

EPA's July 3, 1986 interpretation went into effect immediately in states not authorized to administer the RCRA hazardous waste program--that is, in the ten states and territories where EPA directly regulates hazardous waste under the Federal RCRA regulations. At the same time, the July 3, 1986 notice informed authorized states that they were required to apply for and receive authorization from EPA to regulate mixed waste under RCRA. To date, twenty-three states and territories (including New Mexico, where the WIPP is located) have obtained authority to regulate mixed waste under the state RCRA hazardous waste programs. Thus, mixed wastes are currently regulated as hazardous under Federal RCRA requirements in thirty-three states and territories.

C. WIPP Project

Today's notice addresses mixed waste that DOE intends to ship for testing and experimentation to the WIPP site near Carlsbad, New Mexico, during a preliminary test phase. At the site, the waste will be placed in a mined underground repository, located in a salt bed approximately 2,150 feet below the earth's surface. Over an approximately five-year period, DOE plans to test and evaluate the behavior of the waste in the repository, as well as the characteristics of the surrounding formation, to determine the site's acceptability for the long-term disposal of radioactive waste. Today's no-migration determination requires DOE to remove the waste from the repository if the site proves to be unacceptable for long-term disposal.

Over the long-term, the WIPP repository has been designed as a permanent disposal site for transuranic (TRU) radioactive wastes resulting from nuclear weapons production at ten DOE sites around the country./3/ TRU wastes are defined as wastes contaminated with alpha-emitting radionuclides with an atomic number greater than 92 (that is, heavier than uranium) in concentrations of greater than 100 nanocuries per gram of waste. In addition, TRU wastes by definition have half-lives of more than twenty years, although the actual half-lives of radionuclides in waste to be placed in the WIPP are often hundreds or thousands of years. The TRU wastes targeted for the WIPP consist of a variety of materials, including tools, equipment, protective clothing, rags, graphite, glass, and other material contaminated during the production and reprocessing of plutonium; contaminated organic and inorganic sludges; contaminated process and laboratory wastes; and contaminated items from decontamination and decommissioning activities at DOE facilities. As TRU wastes, these wastes are distinguished from high-level radioactive waste, such as used reactor fuel, and low-level radioactive waste. Other disposal strategies are being developed for high-level and low-level radioactive wastes.

NOTE /3/ The DOE facilities that intend to send TRU waste to the WIPP are Idaho National Engineering Laboratory, Idaho Falls, Idaho; Rocky Flats Plant, Golden, Colorado; Los Alamos National Laboratory, Los Alamos, New Mexico; Argonne National Laboratory, Argonne, Illinois; Savannah River Plant, Aiken, South Carolina; Oak Ridge National Laboratory, Oak Ridge, Tennessee; Hanford Reservation, Richland, Washington; Mount Plant, Miamisburg, Ohio; Lawrence Livermore National Laboratory, Livermore, California; and Nevada Test Site, Mercury, Nevada.

The land in the area of the WIPP is owned by the Federal government and administered by the Bureau of Land Management. The four-mile by four-mile

plot of land overlying the repository has been temporarily withdrawn from public use by the Department of Interior; it is now under the control of DOE. Before DOE can bring waste to the site, however, either Congress or the Department of Interior must take new land withdrawal action. The repository is designed to hold TRU wastes that are currently stored at the DOE generating facilities, as well as new TRU wastes that will be generated over the next 25 years. The underground waste disposal area of the WIPP, when completed, will cover 100 acres, with a total design capacity of 6.45 million cubic feet (or approximately 850,000 drums of waste). To date, 15 acres of underground disposal rooms have been mined.

Although DOE has conducted extensive studies of the WIPP site and the repository's performance, uncertainties still remain. For example, concerns have been raised over the possibility that gas generated underground at the WIPP could, over the long term, build up to unacceptable pressures, leading to possible releases from the repository. To address this and other questions, DOE plans to conduct testing and experimentation over the next several years. This testing will include in-situ experiments with actual TRU wastes underground, as well as other investigations. These in-situ tests would initially involve wastes amounting to approximately 0.5 percent of the total repository capacity. From these tests, DOE hopes to gather data that will allow it to demonstrate compliance with EPA's standards for disposal of radioactive materials (40 CFR part 191 subpart B) and long-term no-migration of RCRA hazardous constituents, as well as in identifying any engineering modifications that may be necessary to meet these standards. DOE is also considering the need for an "operations demonstration" during the test period. The purpose of this demonstration, which might involve up to an additional three to eight percent of the total WIPP capacity, would be to show DOE's operational readiness to ship waste to the WIPP and to place it underground. (Today's approval does not cover placement of wastes for the purposes of the "operations demonstration." DOE would have to submit for EPA's consideration and amendment to its no-migration petition; and EPA decision on such an amendment would be proposed in the Federal Register, with opportunity for public comment.)

As a condition of today's approved petition, DOE must remove all hazardous wastes from the repository if it is unable to meet EPA standards for permanent disposal of hazardous and radioactive wastes at the conclusion of the test period./4/ However, if the WIPP proves acceptable as a permanent repository, and if DOE successfully petitions EPA for a long-term no-migration determination, DOE will then be able to begin full-scale disposal of waste at the site. Drums, metal boxes, and metal canisters of waste will be shipped to the WIPP from the generating sites and placed in underground rooms. Under current plans, the room will be backfilled with crushed salt and sealed. After an operating period of approximately 25 years, DOE plans to seal the shafts of the mine with cement-clay plugs and compacted salt and decommission the facility. After decommissioning, the salt of the Salado Formation will creep inward and is expected to encapsulate the waste within 60 to 200 years.

NOTE /4/ Under 40 CFR 268.6(a)(5), petitioners seeking a no-migration demonstration must provide sufficient information to assure the Administrator that the disposal unit will comply with other applicable Federal, State, and local laws. Therefore, if the WIPP cannot comply with radioactive disposal standards under 40 CFR part 191, it would not satisfy the conditions for a long-term no-migration determination.

Access to the WIPP site will be restricted. The Department of Interior

temporarily withdrew the lands on the WIPP site from public use in 1983, allowing DOE to begin construction of the facility. Before DOE can bring waste to the site, however, either Congress or the Department of Interior must take new land withdrawal action. In addition, DOE and the State of New Mexico have agreed to prohibit in perpetuity all subsurface mining, drilling, and resource exploration unrelated to the WIPP project at the WIPP site. As a further protection, the Federal government has acquired the entire surface and subsurface estate at the WIPP site. Finally, to discourage drilling in the vicinity of the repository in the distant future, DOE intends to place permanent warning markers at the site.

D. Regulatory Status of the WIPP

The WIPP is located in the State of New Mexico, which received authorization for mixed waste on July 25, 1990 (See 55 FR 28397, July 11, 1990.) As an "existing" hazardous waste management facility at the time of New Mexico's authorization for mixed waste, WIPP is eligible for RCRA interim status. Facilities "in existence" (which include facilities under construction) at the time a waste is identified as hazardous under RCRA can obtain interim status if their owner/operators submit a Part A application to EPA or the appropriate state. If DOE submits an application to New Mexico and secures interim status, it will be legally authorized to receive mixed waste at the WIPP--subject of course to the land disposal restrictions. The WIPP must also comply with the RCRA interim status standards, codified at 40 CFR part 265, and eventually obtain a RCRA permit under 40 CFR parts 264 and 270.

The interim status requirements of part 265 establish general facility standards. For example, the WIPP is required under these standards to have a waste analysis plan for its mixed waste, a contingency plan describing pocedures that DOE will take in the case of an emergency, and a closure plan describing how the facility will be closed. In addition, the State of New Mexico has recently requested that DOE submit to it the RCRA Part B permit application for the WIPP; this application must be submitted no later than six months after the State's request, or by February 28, 1991. The RCRA permit for the WIPP (if granted) will establish detailed operating, closure, and post-closure conditions in accordance with 40 CFR part 264, subpart X. (As a geological repository, the WIPP is regulated under the RCRA category of subpart X "miscellaneous units.") The permit's scope would extend to all facility activities related to mixed waste.

Several commenters on EPA's proposed decision on the WIPP expressed confusion over the relationship between a no-migration decision by EPA and a RCRA permit issued by the State. In explanation, EPA notes that its no-migration determination is relatively narrow in scope, only addressing the question of whether hazardous constituents will or will not migrate from the underground repository. To ensure no-migration, EPA's determination imposes certain conditions (e.g., a volume limitation and retrievability of waste); these conditions will be enforced by EPA. On the other hand, the State RCRA permit is significantly broader than a no-migration finding, since it will impose the full technical and general facility standards of 40 CFR part 264, and it will apply to the above-ground operations as well as operations underground. The permit may include certain requirements already imposed under EPA's no-migration determination, or it may establish more stringent requirements, if the State of New Mexico determines that they are necessary. The State permit will be issued under State procedures, which include public notice, comment, and an opportunity for a public hearing. The conditions of the permit will be enforced by the State.

As discussed earlier, EPA's authority under RCRA over waste destined for

the WIPP extends only to mixed hazardous and radioactive waste, and it is further limited to the hazardous components of the mixed waste. The potential release of radioactive material from the WIPP is addressed under the Atomic Energy Act (AEA). EPA has promulgated standards under the AEA limiting releases associated with the disposal of radioactive wastes. These standards, which are codified at 40 CFR part 191, consist of two parts: Subpart A dealing with releases during the operational phase of a permanent disposal facility, and Subpart B, dealing with long-term releases after decommissioning. Under these regulations, a facility is not defined as a disposal site until it has been designated as a permanent respository and removal is not contemplated; since this decision will not be made for the WIPP until after the test phase, the WIPP is not legally subject to the part 191 standards. Under an agreement with the State of New Mexico, however, DOE has agreed to comply with the Subpart A standards, beginning with the initial receipt of waste at the WIPP--that is, before the facility has been designated as a permanent repository. The subpart B standards also do not yet apply to the WIPP because they have been remanded to EPA by the U.S. Court of Appeals at the First Circuit, and therefore are not in effect at this time. DOE, however, has agreed with the State of New Mexico to demonstrate compliance with the remanded standards (if final standards have not been developed) before a final decision is made to dispose of waste permanently in the repository. This decision will be made on the basis of data gathered during the test phase at the WIPP.

Finally, EPA emphasized that today's finding addresses only the specific question of whether hazardous constituents will or will not migrate from the WIPP as long as the waste remains hazardous. Issues raised by the transportation of waste to the WIPP site, or by handling and possible treatment of waste before it reaches the WIPP, are beyond the scope of EPA's legal authority in evaluating no-migration petitions, and thus are not addressed in this notice.

II. DOE Petition and EPA Proposed Determination

The mixed waste DOE intends to ship to the WIPP for testing includes solvent-contaminated wastes, which became subject to the land disposal restrictions on November 8, 1986, and characteristic wastes (containing heavy metals such as lead), which became subject to the land disposal restrictions on August 8, 1990. (However, it should be noted that EPA granted a two-year national capacity variance to mixed characteristic wastes, deferring the effective date of the disposal prohibition until May 8, 1992 (June 1, 1990, 55 FR 22520).) In addition, some mixed wastes are likely to include wastes that are hazardous under EPA's new toxicity characteristics rule (55 FR 11798), although the Agency has not yet promulgated land disposal restrictions for these wastes.

To comply with the land disposal restrictions, DOE has sought to demonstrate to EPA, in a no-migration petition submitted in March 1989, that placement of these wastes untreated in the WIPP repository will not lead to migration of hazardous constituents beyond the disposal unit boundary. In response to EPA concerns, DOE provided additional supporting material after its initial submission, including addenda in October 1989 and January 1990. DOE's final petition was bound into eight volumes in March 1990 (DOE/WIPP 89-003, Revision 1) and is included in the docket for this rulemaking.

After careful review of DOE's petition as well as information from numerous other sources, EPA proposed in the Federal Register of April 6, 1990 to grant DOE's petition with certain conditions. (See 55 FR 13068 for a more detailed discussion of the information provided by DOE and of the basis for EPA's

proposed decision.) Under EPA's proposal, DOE would be allowed to place untreated mixed waste in the WIPP repository within the scope of the testing and experimentation activities described in the petition. EPA's proposal would not have allowed DOE to conduct its proposed operations demonstration, nor would it have allowed DOE to conduct two pilot-room tests, which had originally been suggested by EPA. If the testing failed to show that the WIPP could meet the no-migration standards for the long-term disposal of mixed waste, DOE would be required to remove the waste from the underground repository. The proposal also included the following conditions: (1) The waste must be placed in the WIPP in a retrievable form; (2) DOE must provide annual written reports on the test phase progress to EPA; (3) a carbon adsorption device capable of achieving a 95 percent efficiency must be installed in the discharge system of the bin experiment rooms; (4) DOE must implement a specific air monitoring plan; (5) DOE must certify that it has secured control of the surface and subsurface estate at the WIPP site before wastes can be placed in the repository /5/ and (6) during the test phase, DOE must provide detailed waste characterization and analyses on the waste emplaced in the WIPP.

NOTE /5/ DOE recently secured the last outstanding mineral lease at the WIPP site, thereby satisfying this condition. As a result, EPA has eliminated this condition in its final determination.

EPA provided a 60-day public comment period on its proposed determination and held public hearings in Carlsbad, Albuquerque, and Santa Fe, New Mexico, during the comment period. The Agency received 103 written comments on its proposal from both individuals and organizations, and more than 300 people testified at the three hearings. Today's decision is based on a careful review of the public's comments and clarifying information provided by DOE, as well as EPA's further evaluation of the suitability of the site based on a field visit to the WIPP site on July 28, 1990.

III. Summary of EPA Determination

After a review of DOE's petition, supporting information, and public comment, EPA finds that DOE has demonstrated, to a reasonable degree of certainty, that hazardous constituents will not migrate from the WIPP repository as a result of its planned test activities, as required by the statute and regulations at 40 CFR 268.6. This determination is based on the condition that DOE only place hazardous waste within the scope of the test phase operations described in its no-migration petition and its performance assessment test plan. Consistent with the determination, EPA is approving DOE's no-migration petition for the WIPP for the test phase operations, subject to the conditions laid out in section VI of this notice. It should be noted that the proposed operations demonstration and pilot room tests cannot be conducted under the terms of today's decision. Before these activities could be carried out, DOE would have to submit an amendment to its no-migration petition, which EPA would evaluate. EPA would then propose a decision for comment before a final decision would be made.

EPA's action today allows DOE to place untreated mixed waste subject to the RCRA land disposal restrictions in the WIPP for testing and experimentation to determine whether the site is appropriate for the long-term disposal of mixed waste (that is, whether disposal at the site will conform with standards for the permanent disposal of hazardous wastes). Only the waste specified by DOE in its petition may be placed in the WIPP under this determination./6/ The quantity of waste that may be placed in the WIPP is

limited to 8,500 drums, or 1 percent of the facility's final capacity. DOE may not begin permanent disposal of the mixed waste subject to the RCRA land disposal prohibitions at the site and must remove all wastes from the underground repository if it cannot demonstrate no migration of hazardous constituents over the long term. (In addition to EPA's requirement that hazardous waste be removed from the repository, DOE has also committed to carry out such a removal in a consent agreement with the State of New Mexico.)

NOTE /6/ In its no-migration petition, DOE identified listed solvents and EP (Extraction Procedure) characteristic wastes as hazardous under RCRA. In addition, some of the waste described in DOE's petition may now be hazardous under EPA's recently promulgated Toxicity Characteristics (TC) rule (55 FR 11798). EPA has not yet promulgated treatment standards for TC wastes; however, it is required to do so under the statute. Once these standards have been promulgated, TC wastes placed in the WIPP will be subject to the land disposal restrictions. Because EPA's review of DOE's petition considered potential migration of hazardous constituents from all of the wastes DOE identified as scheduled for the WIPP, today's no-migration determination applies to wastes that are hazardous under the TC rule, as well as solvents and EP characteristic wastes, as long as the wastes were included in the petition.

In making its no-migration finding, EPA concentrated on whether releases of non-radioactive hazardous constitutents from the repository might occur during the test phase. In doing so, EPA addressed all possible routes of release, but focused in particular on the potential for volatile organic constituents released during testing to migrate out of the WIPP unit through the ventilation exhaust shaft. Because of the nature of the tests that will be conducted in the WIPP and their relatively short duration, EPA has concluded that releases of hazardous constituents from the unit through brine, salt, or other geological media is implausible during the test phase.

The retrievability of waste placed in the WIPP during the test phase is central to EPA's finding. Therefore, EPA has reviewed both the technical feasibility of retrieval and the practicability of DOE's retrieval plan. EPA has concluded that retrieval of wastes from the WIPP can be accomplished safely, and that DOE's commitment to retrieving the wastes and taking it above ground, if it proves necessary, is satisfactory. Finally, EPA considered the general design, construction, and mine maintenance program at the WIPP and has concluded that the mine is well-designed and will remain stable during the test period and well beyond. The specific conditions of today's finding are discussed in the following section and listed in summary form in section VI of this notice.

Although EPA's granting of DOE's petition is specifically based on a finding of no-migration of hazardous constituents from the unit during the test phase, EPA has thoroughly reviewed available information on the expected long-term performance of the WIPP repository. Given the geological stability of the area; the depth, thickness, and very low permeability of the salt formation in which the repository has been mined; and the properties of rock salt as an encapsulating medium, EPA believes that the WIPP is a promising site for the permanent disposal of mixed waste. To be sure, a number of uncertainties related to the long-term performance of the WIPP remain--for example, the extent and effects of gas generation, the effects of brine inflow into the repository, and the influence of a "disturbed rock zone" around the mined repository. DOE will be investigating these uncertainties in the test phase at the WIPP, and it will review whether technical

modifications to the repository design or the waste are necessary to ensure compliance with the regulatory standards.

It should be remembered that today's decision is only for the disposal of mixed waste during the test phase for testing and experimentation to determine whether the site is appropriate for the long-term disposal of mixed wastes. Before DOE may move from the test phase to full-scale operations, it must petition EPA again and demonstrate no migration over the long term--that is, it must successfully address current uncertainties about long-term WIPP performance. Information gathered by DOE during the test phase will be central to such a demonstration. Any EPA decision to approve (or deny) a no-migration petition for permanent disposal at the conclusion of the test phase will be made with full opportunity for public comment, as prescribed in 40 CFR 268.6(g).

Further technical details regarding EPA's final decision are provided in a background document. In addition, major issues raised by public commenters are discussed in section V of today's notice, as well as in a response to comments document. Both the background document and the response to comments document are available in the public docket for this action.

IV. Discussion of EPA Determination and Conditions of Determination

A. No-Migration Finding

To make a no-migration determination, sections 3004(d)(1), (e)(1), and (g)(5) of RCRA require EPA to find that "there will be no migration of hazardous constituents from the disposal unit or injection zone as long as the wastes remain hazardous." As EPA explained in the preamble to its proposed decision, it interprets this requirement to mean that constituents listed in appendix VIII of 40 CFR part 261 cannot migrate at hazardous levels from the disposal unit during the time that hazardous waste is present in the unit. If the hazardous waste within the unit becomes non-hazardous or if it is removed from the unit, further migration from the unit ceases to be an issue. In the case of the WIPP, DOE will have to remove all hazardous waste from the underground repository if it cannot demonstrate the long-term acceptability of the site; therefore, the effective period of EPA's finding is the test phase. Thus, EPA's decision today is based on the conclusion that the Appendix VIII constituents will not migrate at hazardous levels from the underground repository during the test phase and that DOE will remove all hazardous waste from the unit if testing cannot show that the site meets long-term no-migration standards.

EPA's no-migration finding for the WIPP test phase falls into several categories: Migration of hazardous constituents under anticipated test conditions in the repository; short-term stability of the repository; feasibility of retrieval; possible effect of accidents and spills; and effectiveness of controls against human intrusion during the test phase. These aspects of EPA's determination are discussed below.

No migration of hazardous constituents beyond the unit boundary. In the proposal, EPA explained in some detail its definition of the unit boundary for the WIPP and its standards for determining whether a constituent migrating from the unit is "hazardous." The proposed unit boundary was the Salado Formation at the WIPP site, bounded by the four-mile by four-mile land withdrawal area, except that, for air emissions during operations, the unit boundary was the point where the air exhaust ventilation shaft met the surface. EPA's definition of the unit boundary in today's decision is largely unchanged from the proposal; however, in response to public comment, it has slightly modified the unit defintion as it applies to air emissions. In the

final decision, the unit refers to that portion of the Salado Formation that falls within the WIPP land withdrawal area: specifically, any movement of constituents above "hazardous" levels into overlying or underlying formations, or beyond the lateral boundaries of the land withdrawal area would constitute migration. This unit boundary would apply to migration via air emissions during operations as well as via ground water or other routes after closure of the unit. (This issue is discussed in more detail in section V.H of today's notice.) EPA's definition of "hazardous" levels of migration remains unchanged from the proposal. As discussed below in Section V.G, EPA is relying on "health-based levels" to define migration--that is, levels that would be hazardous to a person exposed at the unit boundary for an entire lifetime.

The no-migration standard applies to all possible routes of release from the unit. EPA, however, has concluded that migration of hazardous constituents out of the unit during the test period is implausible by any route other than air. Waste will be containerized during the test period, and even it it were released from a container, there is no possibility that waste could migrate from the unit by ground water or directly through the salt rock within the test period. No commenters questioned this conclusion, which EPA discussed in the proposal.

Potential for Migration via Air Emissions. For air emissions during the test period, EPA's finding is based on a careful review of possible releases from the bin-scale and alcove tests DOE is planning to conduct during the test period. For reasons described below, EPA has concluded that any releases from the alcove-scale tests will be negligible. Therefore, it has focused its attention on the bin-scale tests. In these tests, headspace gases will be vented into the bin discharge system whenever the bins become pressurized through a pressure relief valve installed on each bin. The gases will then be passed on to the exhaust shaft. Because the purpose of the experiments is to gather data on the gas generation potential for the various types of wastes intended for disposal at the WIPP, the rate of gas generation and thus the amount of hazardous constituents expected to be released can only be estimated. Because of this uncertainty, DOE has proposed and EPA's decision today requires the inclusion of a carbon canister in the bin gas discharge system to remove any volatile organic constituents released from the bins. This carbon adsorption control device must be designed to achieve a control efficiency of at least 95 percent. As explained in its proposal, EPA has taken this control device into account in its no-migration finding for air emissions.

For its assessment of releases from the bin-scale tests, EPA used the concentrations of volatile organic compounds measured in the headspace of 210 drums containing waste generated at DOE's Rocky Flats Plant and stored at the Idaho National Engineering Laboratory. As described in the WIPP no-migration proposal, DOE has been able to provide little or no information on sampling plans, sample handling procedures, or quality assurance/quality control measures for these data. Therefore, EPA views the analytical results on these headspace samples as being semiquantitative. Nevertheless, even if these data underestimate the constituent concentrations by as much as an order of magnitude, the concentration of constituents at the unit boundary are still expected to be below health-based levels.

The results of EPA's assessment are shown in Table 1 below along with levels of regulatory concern.

Table 1.--Test Phase Compliance Point Concentrations in Air

Levels of

Constituents	Average headspace concentrations (g/m3)	Compliance point concentrations (micro-g/m3)	regulatory concern* (micro-g/m3)
Carbon tetrachloride	1.85	0.0027	0.03
Methlyene chloride	0.47	0.00069	0.3
Trichloroethylene	0.70	0.0010	0.3
1,1,1-Trichloroethane	13.2	0.019	10,000
1,1,2-Trinchloro-1,2,2-trifluoroethane	1.22	0.0018	30,000

EPA conservatively assumed that both test rooms planned for the bin-scale tests are filled to capacity. The capacity of each room is 120 bins; therefore, the total number of bins is 240. EPA then assumed an average gas generation rate of 5 moles per drum per year, a figure that DOE characterizes as representing the upper bound of the range of credible gas generation rates (Test Plan: WIPP Bin-Scale CH TRU Waste Tests, January 1990; SAND 89-0462. Each bin can hold the equivalent of six drum volumes of waste. Therefore, DOE's upper bound gas generation rate is equivalent to a total gas generation rate from all 240 experimental bins of 0.5 cubic meters per day. DOE has specified the general ventilation rate through the repository as 425,000 cubic feet per minute, which is equivalent to 17 million cubic meters per day. This entire volume of air is exhausted at the exhaust shaft and is available to mix with any gases released from the bin discharge system. The resulting dilution factor at the exhaust shaft is 34 million. EPA applied the dilution factor to the average headspace concentrations, together with the control device efficiency, to calculate the concentration of constituents in the exhaust shaft.

The compliance point concentrations (with the carbon adsorption control device installed in the bin discharge system) are an order of magnitude below the level of regulatory concern for carbon tetrachloride and are two to seven orders of magnitude below any other level of regulatory concern. These figures represent the bin-scale tests alone; however, the contribution of the alcoves is negligible by comparison. Although it would not be allowable under today's decision, DOE has provided data to show that even when 10 percent of the wastes, equivalent to 85,000 drums are emplaced in the repository before sealing of the rooms, the concentrations in the exhaust shaft would be two to eight orders of magnitude below the levels of regulatory concern.

Because the alcove experiments involve only 3,850 drums (more than a factor of 20 lower), the concentrations in the exhaust shaft from the alcove drums would be a factor of at least three to nine orders of magnitude below the level of regulatory concern. The actual concentrations would be even lower than this once the alcoves are sealed at the start of the experiment.

EPA recognizes that the actual bin gas generation rate may be higher than 5 moles per drum per year. However, even if the rate were significantly higher, concentrations at the unit boundary would still be below health-based levels, given the requirement for a carbon adsorption system designed for 95 percent efficiency. Therefore, EPA finds that DOE has demonstrated, to a reasonable degree of certainty, that hazardous constituents will not migrate beyond the repository boundary during the test phase at greater than health-based levels.

Short-term stability of the site. In the long term, salt creep will be the primary mechanism to seal the WIPP repository. In the short term, however, salt creep--which can lead to localized fracturing and rock fall--must be mitigated to ensure a stable repository environment. Repository stability has

been greatly enhanced during the test phase by several design modifications to the experimental area. The most significant alteration is rockbolting, a standard mining technique to ensure stability. The roofs of all test alcoves and bin test rooms will be rockbolted. This practice alone should prevent excessive cracking and rockfall during the entire test phase. The effects of early room closure, however, are of greater significance for the test alcoves because they cannot be inspected while the tests are underway, and because drums must be retrievable after the tests have been completed. For this reason, DOE will be reducing the dimensions of the test alcoves, which will slow down the rate of creep closure. Finally, DOE intends partially to backfill several alcoves with crushed salt to simulate disposal conditions. Backfilled test alcoves will be fitted with "stand-off" walls between the backfill and the mine walls, so that room closure does not impinge on the backfilled drums. These modifications ensure the successful retrieval of the drums from the alcoves at the conclusion of the test phase, if it proves necessary.

Feasibility of retrieval. Several commenters expressed concern that retrieval may not be technically feasible, and that, given this uncertainty, EPA cannot assume removal in its nomigration finding. These commenters pointed out specific instances where retrieval might be difficult or infeasible, such as in the case of fire or explosion. They also suggested that creep closure of the test alcoves would preclude removal--an issue discussed in the previous section. Finally, they argued that retrieval from backfilled alcoves has not been demonstrated and that considerable shuffling of waste underground during retrieval may have inherent risks.

EPA has concluded that DOE's Waste Retrieval Plan, in combination with mock retrievals, demonstrates that retrieval is technically feasible. All major aspects of the retrieval process are addressed in the plan, including radiological and hazardous waste contamination control, drum and bin handling, overpacking procedures for corroded or damaged drums, clean up of contamination, and backfill retrieval. While release or leakage of hazardous constituents from containers within the repository during the test period would certainly complicate retrieval, it would not render retrieval infeasible. Such events are adequately addressed by emergency response procedures defined for the WIPP. The specifics of the various emergency response procedures are detailed in several DOE publications referenced in the Waste Retrieval Plan. In addition, while EPA agrees with commenters that a fire or explosion would make retrieval more difficult, the Agency is imposing additional conditions to minimize the potential for such an event. (See section V.I.1 of today's notice for a detailed description of this point.) Thus, adequate safeguards have been imposed and will be implemented in the event of an accidental release of hazardous constituents.

It should be noted that the Waste Retrieval Plan is backed by successful mock retrieval demonstrations, although EPA recognizes that mock retrieval demonstrations performed thus far at the WIPP did not include removal of waste from the alcoves themselves. Other aspects of the removal process, however, were simulated in the retrieval demonstration. Mock retrieval experiments on backfilled alcoves and on bins will be performed before any waste is placed in the WIPP.

EPA agrees with commenters that shuffling of the waste during the retrieval process could increase the risk of a release; however, safe movement of the waste containers is technically feasible, and EPA has concluded that DOE's routine container-management procedures are adequate. Furthermore, any removal activities will be conducted under the oversight of the State of New Mexico, either during RCRA interim status or under permit conditions, which will ensure an appropriate level of care. Finally, the Environmental

Evaluation Group, an independent group established by Congress to provide review of the WIPP project, provides oversight over waste management and safety aspects of WIPP operations, including removal.

A number of commenters raised the possibility of drum corrosion during the test phase, which could lead to spillage and complicate retrieval. EPA has concluded, however, that the potential for significant drum corrosion during the test phase is limited and will not substantially affect the retrieval of wastes. While it is true that salt is very corrosive, the rate of corrosion of the drums being stored in the repository is expected to be low. This is because several key factors affecting the rate of drum corrosion allow for favorable drum storage conditions. In particular, the rate of corrosion is affected by the composition of the brine contacting the drums. That is, corrosion proceeds most rapidly if the brine is unsaturated and contains dissolved oxygen. However, the brine in the WIPP repository is both saturated with salt and contains low levels of dissolved oxygen; therefore, drum corrosion would be inhibited. Moreover, the rate of corrosion is directly affected by the amount of brine contacting the drums. Since the repository is expected to remain dry during the test period and thus there will be minimal drum-brine contact, EPA does not expect the drums to corrode significantly. For these reasons, EPA has concluded that the useful drum life in the WIPP will exceed the period of this determination, including retrieval time, and it sees no reason to question DOE's statement that the drums will maintain integrity for twenty years.

In addition, EPA notes that containers at the WIPP will be subject to monitoring and inspection procedures required under RCRA 40 CFR part 265 (and, once a permit has been issued, under 40 CFR part 264). These requirements will be administered by the New Mexico Environmental Improvement Division, with EPA oversight. If any questionable drums were identified, mitigative measures--such as overpacking--could be undertaken. To be sure, drums that are sealed in the alcove during the alcove tests cannot be routinely inspected. However, under DOE's test plan, these tests are expected to last approximately five years. Thus, inspection would be possible well within the useful life of the drum.

Finally, as EPA discusses in this and the following section, spillage from drums (however unlikely) can be contained and cleaned up, and corroded drums can be overpacked. Thus, EPA disagrees with commenters that drum corrosion might prevent the safe removal of drums from the WIPP, if removal proves necessary.

Limited effect of accidents and spills. Numerous commenters argued that accidents or spills at the WIPP site would complicate retrieval of wastes or might lead to migration. EPA agrees that accidents or spills might complicate retrieval, but it has nevertheless concluded that the cleanup of spills and the removal of contaminated material from the WIPP is technically feasible. The WIPP Retrieval Plan outlines DOE's planned approach to the removal of contaminated material; in addition, the feasibility of safe removal of such material was demonstrated in DOE's mock retrievals. Moreover, neither EPA nor public commenters identified any spill situations that by themselves would lead to a release from the repository.

EPA has addressed the possibility of fire or explosion in the WIPP by new waste characterization requirements in today's decision. Under these requirements, DOE must test every container shipped to the WIPP for flammable gases. If flammable gases are identified, the waste cannot be placed in the repository. Therefore, under the terms of EPA's determination, explosion or fire in the WIPP is not a credible event. (After DOE has developed a greater body of data on wastes shipped to the WIPP, it is likely that waste characterization requirements addressing flammability can be relaxed.

However, this could only take place through a modification of the determination, with opportunity for public comment.)

Effectiveness of controls against human intrusion. During the period covered by today's determination, DOE will maintain active control over the WIPP site, and unauthorized access will be prohibited. Furthermore, the site will be operating under RCRA interim status and permit conditions, administered by the State of New Mexico, and therefore will have to comply with the RCRA security requirements. These requirements include prevention of unknown entry of persons or livestock to the active portion of the facility. Finally, DOE has secured all mineral leases at the WIPP site, eliminating the possibility of the disturbance of the repository as a result of mining or drilling. For these reasons, the Agency has concluded that migration resulting from human intrusion will not occur during the term of the determination.

B. Conditions of Determination

1. Limitation to Testing and Experimentation

In EPA's proposed finding, it limited activities involving mixed waste at the WIPP repository to the testing and experimentation described in DOE's petition and referenced documents. The Agency has retained this condition in its final determination. Consequently, DOE will be restricted to its planned test phase activities, as described in the "WIPP Test Phase Plan: Performance Assessment," Revision O (DOE/WIPP 89-011, April 1990). Before DOE could conduct activities beyond the scope of this test plan, it would have to petition EPA to modify its no-migration finding.

Several commenters on the proposal expressed uncertainty about what specific activities would fall under the definition of "testing and experimentation"; in addition, the commenters asked for clarification of when DOE would have to notify EPA of changes from activities described in the performance assessment test plan.

With respect to the first point, DOE could conduct in the repository only those tests or experiments designed to provide data to demonstrate the long-term acceptability of the WIPP. Thus, DOE's planned "operations demonstration" has been explicitly excluded from the allowed activities; other non-testing activities would similarly be excluded. For clarification, EPA has modified this condition, which originally read "placement of waste for the primary purpose of conducting an operations demonstrated is prohibited under this variance * * *," by dropping the word "primary." Several commenters suggested that the inclusion of the word "primary" amounted to an invitation to DOE to conduct a full-scale operations demonstration with the excuse that some testing was also going on. This was not EPA's intention, and therefore it has modified the condition accordingly. EPA, however, stresses that it does not understand this condition as preventing DOE from incidentally testing some operational aspects of its system when it places waste under ground for permissible testing. Such activity, in EPA's view, would not constitute an "operations demonstration" in the sense that DOE as well as DOE critics have used the phrase up to this point. In addition, EPA recognizes that some mixed wastes might be generated underground as a result of legitimate experimentation or air monitoring in the WIPP repository. These wastes, which might no longer have any experimental purposes, could nevertheless be stored in the repository until a final determination on the site was made. Because the materials were originally placed in the WIPP for permissible testing, continued storage of the wastes in the repository would be consistent with the terms of EPA's

decision.

With respect to the second point, tests and experiments conducted under today's determination would have to be consistent with the activities described in DOE's performance assessment test plan and its no-migration petition. For example, where substantially different wastes or waste containers are used, where waste volumes were increased above 0.5 percent (but less than one percent), or where tests outside DOE's planned three-phase bin and alcove-scale tests are contemplated, DOE would be required to notify EPA and, if the changes might affect the basis of EPA's finding, seek a modification to that finding. The only exception to this would be those wastes that are described in DOE's no-migration petition that are modified through various treatment technologies; because the composition of these wastes, if changed, would contain fewer toxic constituents, the Agency does not believe it would have to be notified before the wastes could be placed in the repository. EPA does note, however, that the pilot-room tests originally suggested by EPA and now contemplated by DOE, would be excluded under today's decision, because they go substantially beyond the program described in DOE's test plan and furthermore are inconsistent with other conditions of the determination (e.g., the volume limit and retrievability of wastes).

2. Limitation on Volume

In its proposed determination, EPA did not set a specific limit on the amount of mixed waste that DOE could place in the repository during the test phase. Instead, EPA argued that, because of the experimental program. Although several commenters supported EPA's approach, many opposed it, arguing that it was open-ended and allowed DOE to expand the scope of the test phase indefinitely. Although EPA continues to believe that its no-migration finding, as proposed, significantly restricts the nature of DOE activities during the test phase, the Agency nonetheless understands the concerns of the commenters. Therefore, it has decided to place a volume limitation of 8,500 drums or 1 percent of the total projected WIPP volume of wastes that can be placed in the repository under this determination.

In setting a volume limit, EPA notes that DOE's "WIPP Test Phase Plan" called for bin and alcove-scale testing of waste amounting to 0.5 percent of the projected WIPP capacity, while in Congressional testimony, DOE indicated that bin, alcove, and pilot-room tests might require waste amounting to approximately 2 percent of the WIPP capacity. Because EPA has determined that the pilot-room tests, as currently planned, could not be conducted under the proposed no-migration finding, it believes that the 2 percent volume limit would be inappropriate. At the same time, EPA also believes that limiting DOE to the amounts specified in the current test plan might not provide sufficient flexibility for DOE to modify those plans, particularly in response to comments from reviewing organizations. Consequently, EPA has decided to impose a limit of 1 percent of total WIPP capacity (or 8,500 drums), a figure that provides some flexibility to DOE and at the same time gives the public assurance of an opportunity to comment if significant increases over DOE's proposed waste volumes are needed.

EPA emphasizes that it is not basing the 1 percent limit on any technical determination of how much waste would be necessary for DOE to carry out an adequate testing program. Rather, EPA in effect is defining a limit that it would consider to be a significant departure from the activities described in DOE's no-migration petitiion and its final test plan. Before DOE could exceed that limit, it would have to repetition EPA, and any EPA approval of an expanded test program would have to undergo public comment. EPA also emphasizes that the 1 percent figure represents an upper limit on the amount

of waste that may be placed in the WIPP under today's determination. This limit would not override the condition that waste could be placed in the WIPP only for testing and experimentation within the scope of DOE's Test plan. Waste would not be allowed in the repository for other than testing and experimentation, even if the volume of waste involved did not exceed the 1 percent limit.

Many commenters also suggested that EPA shorten the proposed ten-year expiration date for petition approval. EPA has not adopted this suggestion, because, as it discussed in the proposed decision, it believes such a limit might artificially constrain legitimate testing. EPA does not believe the difference between five years (the projected length of DOE's test phase) and ten years is significant in terms of the likelihood of release of hazardous constituents from the repository. Furthermore, it has concluded that this difference in time will not significantly effect retrievability. However, EPA acknowledges that the timing and procedures for removal of waste if DOE is not able to demonstrate the long-term acceptability of the WIPP at the close of the ten-year period was not clear in the proposed finding. Therefore, the Agency has amended the conditions of the finding to address this concern. This issue is discussed below.

3. Waste Retrieval

The requirement that DOE retrieve wastes from the repository if it cannot demonstrate the long-term acceptability of the site remains unchanged from the proposal. As discussed above in section IV.A, EPA has found such retrieval to be feasible within the general parameters of the plans submitted with the petition. In addition, EPA has added a clause spelling out in more detail the timing of retrieval. Under this requirement, DOE must submit to EPA a specific retrieval schedule no later than six months after it is determined that the WIPP cannot meet the long-term disposal standards, or six months before the expiration of the petition approval (i.e., 10 years after petition approval), whichever comes first. This schedule would have to detail retrieval procedures and include a schedule for the removal of the waste as rapidly as technically feasible. Before retrieval took place, the plan would be subject to public comment and EPA approval.

4. Waste Retrievability

DOE is required to place all waste in the repository in a readily retrievable manner. This condition is unchanged from the proposal. By "readily retrievable," EPA means adoption of the specific measures identified in DOE's petition to maintain room stability (i.e., room sizing, rock bolting), the use of easily retrieved waste containers (e.g., boxes, bins, and drums), and the absence of backfilling--except in alcove tests where standoff walls will be used. (EPA notes that testing in pilot-scale rooms, which the Agency originally suggested and DOE is now considering, would not be allowed under this condition, because--as currently planned--they would involve backfilling of waste in the pilot rooms without standoff walls. DOE would have to seek a modification of the no-migration finding, with opportunity for public comment, before conducting such tests.)

5. Carbon Adsorption Device

Today's decision requires DOE to install a carbon adsorption control device in the bin discharge system of each room designed to achieve a 95 percent control efficiency. The Agency believes a 95 percent control efficiency is

readily achievable. (See 55 FR 25454.) The design must be based on a total design gas volume consisting of a design gas generation value of at least 5 moles per drum per year from the bins and the volume of gas used to purge the bin exhaust manifold. EPA also wishes to clarify that the design value for the frequency of carbon replacement must be verified by testing and modified as needed to prevent breakthrough from occurring. The testing must consist of measurements of the adsorption capacity of carbon for the bin exhaust gases, as described in the petition. EPA is also requiring DOE to maintain design records, including any test data, and operating records in the facility operating record, as described in the notice of the proposed decision. (See 55 FR 13068, Section IV.J.) Records must be maintained for the term of today's determination (i.e., ten years from today's date), or three years after the creation of the records, whichever is longer. In addition, the records must be maintained during the course of any enforcement action for which they are relevant.

EPA is not requiring DOE to perform testing to verify the control efficiency of the carbon bed. However, DOE must monitor the bin exhaust manifold to show that no migration above health-based levels occurs at the unit boundary. This must be further confirmed by monitoring at the exhaust shaft. Although the 5 moles per drum per year design value for gas generation is believed to be conservative, the overall average rate of gas generation from TRU wastes is not known with certainty; this is the purpose of the bin and alcove tests. The control efficiency actually achieved will be higher or lower depending on the rate at which gas is generated during the tests. However, even if gas generation rates were to be as high as 25 moles per drum per year, the design would still achieve the no-migration standard.

6. Air Monitoring Plan

EPA is requiring air monitoring for activities conducted under today's no-migration finding to confirm that there is no migration of hazardous constituents above health-based levels beyond the unit boundary. As described in its notice of proposed decision (55 FR 13068), EPA has concluded that the only possible migration pathway during the test phase is through the exhaust shaft. Therefore, in accordance with the requirements of 40 CFR 268.6(c), the Agency is requiring DOE to implement the air monitoring plan submitted with its petition, subject to the clarifications, modifications, and reporting requirements described in the notice of proposed decision, except as noted below.

In its proposed decision, EPA solicited comment on whether additional monitoring should be conducted in the underground repository with portable explosimeters to detect any buildup of methane, hydrogen, or other flammable gases. No comments were received in favor of portable explosimeters. Therefore, EPA has decided not to require their use. At the same time, however, EPA has determined that only by testing individual waste containers to be placed in the WIPP can it be assured that no fire or explosion hazard exists. Thus, EPA is including an additional condition requiring such testing, as described in section IV.B.7.a of today's notice.

EPA also solicited comment on whether to allow a reduction in monitoring frequency from weekly to monthly. EPA received no comments on this question and has decided to retain a weekly minimum monitoring frequency. Furthermore, EPA solicited comment on whether other constituents, in addition to the five constituents proposed, should be targeted for routine quantitation. No comments were received on this question; therefore, EPA has decided to retain the five target constituents listed in the notice of proposed decision, with provisions for targeting additional constituents, as described in the

proposal.

In the proposal, EPA spelled out a variety of quality assurance and quality control requirements, making mention of the "Report on Minimum Criteria to Assure Data Quality." Since that time, EPA has revised this report and has retitled it "Quality Assurance and Quality Control" (August 1990), a copy of which has been placed in the docket to this rule. Therefore, EPA is requring DOE to follow the requirements of the revised report, in addition to adhering to the specific quality control requirements described in the DOE monitoring plan and EPA's notice of proposed decision. EPA wishes to clarify that it intends the "method limit of quantitation," the term used in the notice of its proposed decision, to be synonymous with the term "method detection limit," or MDL, used in the report, "Quality Assurance and Quality Control." In addition, EPA is requiring DOE to maintain documentation of all aspects of quality assurance and quality control, as described in the revised report, in the WIPP facility operating record; this documentation must be available for inspection by the Agency. The records must be maintained for the term of today's determination or three years after they are created, whichever is longer. In addition, the records must be maintained during the course of any enforcement action for which they are relevant.

Initial monitoring results underground at the WIPP have revealed significant background levels of 1,1,1-trichloroethane and carbon tetrachloride./7/ The levels measured can interfere with the evaluation of accuracy if the approach described in the notice of proposed decision is used. Therefore, EPA is changing the method by which relative accuracy is determined. Instead of computing accuracy based on a matrix spike alone (as the relative difference between the concentration recovered from the sampler and the concentration of the targeted analyte as determined from the known concentration in the audit gas cylinder), the computation should be adjusted for the actual background concentration measured in a matrix duplicate at the time the matrix spike is collected. Therefore, DOE must collect and analyze both a matrix spike and a concurrent matrix duplicate.

NOTE /7/ Significant levels of methylene chloride were also detected in background samples. However, laboratory contamination is the most likely explanation for the measured levels of methylene chloride.

EPA further solicited comment on what specific quality assurance (QA) objectives it should require for data acceptability. DOE requested that EPA allow less accurate measurements at concentrations near the detection limit. The data provided by DOE, however, gave no basis for establishing an alternative QA objective for accuracy, due to high background levels. Because of this, and because EPA is not requiring data that are below the method detection limit (MDL) to be used in the evaluation of relative accuracy (the MDL is generally considerably higher than the limit of sensitivity of the analytical procedure), EPA has concluded that the plus or minus 10 percent requirement can be achieved. Therefore, no change is being made to the QA objectives established in the notice of proposed decision.

Finally, EPA proposed to require calibration of the ventilation exhaust fans on a quarterly basis. In its comments on the proposal, DOE interpreted this to mean a full dynamic calibration, which it argued is needed only on a yearly basis. EPA means to require only a check on the fan calibration on a quarterly basis, using the methods described in the notice of proposed decision. EPA agrees that a full calibration is needed only on a yearly basis.

Several commenters expressed concern that EPA is allowing monitoring at the top of the exhaust shaft instead of at the entrance to the shaft. They argued

that EPA should require DOE to monitor the entrance and exit of the shaft to demonstrate EPA's statement that there will be no difference between measurements. EPA disagrees with these commenters. Even if, as suggested by one commenter, the integrity of the concrete shaft liner were compromised, it is inconceivable that any depletion of concentrations of hazardous constituents could be detected, given the large volume of air that the exhaust shaft is designed to handle during operation. EPA's overriding concern regarding the specific location of the exhaust shaft monitoring station is that it be situated so as to enable ready access for operation and maintenance purposes. Indeed, EPA views ready accessibility as one of a number of important quality assurance objectives. Therefore, EPA continues to accept monitoring at the top of the exhaust shaft.

7. Waste Analysis

a. Flammability. EPA received a number of comments that flammable gases could build up in waste containers, creating a fire and explosion hazard. After reviewing these comments and new information made available during the public comment period, EPA has concluded that, while a fire or explosion is unlikely, the possibility of accidental ignition of flammable gases in waste containers cannot be ruled out. Were a fire or explosion to occur as a result of accidental ignition of flammable gases in the void space of a waste container, retrieval could be much more difficult, should retrieval become necessary. Moreover, such an event could itself cause migration above hazardous levels beyond the uniboundary.

For these reasons, EPA believes that no waste container should be emplaced in the underground repository if it contains flammable mixtures of gases in any layer of confinement, or mixtures of gases that could become flammable when mixed with air. To assure a sufficient margin of safety, EPA defines any mixture as potentially flammable if it exceeds 50 percent of the lower explosive limit (LEL) of the mixture in air.

To ensure that individual waste containers have met the prohibition on flammable gases, the Agency is requiring that every waste container be tested for hydrogen, methane, and volatile organic compounds (VOCs) as a class. Given the heterogeneity of the waste package, the Agency is also requiring that headspace sampling be representative of the entire void space of the waste container. EPA expects that all layers of confinement in a container will have to be sampled until DOE can demonstrate to the Agency, based on the data collected, that sampling of all layers is either unnecessary or can be safetly reduced. The testing of wastes that exhibit high rates of radiolysis should be performed a relatively short time before the container is actually emplaced underground. Otherwise, hydrogen levels could build up to flammable levels following sample collection and analysis. Therefore, DOE must determine, and document, the length of time that headspace gases can be expected to remain below flammable levels (i.e., 50 percent of the mixture LEL) after sampling has been performed, for both newly generated and retrievably stored wastes, and to ensure that the waste containers are emplaced in the WIPP within that time.

If testing reveals the presence of significant levels of flammable VOCs, DOE must perform an explicit flame test to determine if a flammable mixture can be formed with air. Significant levels of flammable VOCs are defined as measured concentrations (excluding methane) of 500 parts per million or greater. If testing shows that VOCs are insignificant, i.e., below 500 parts per million, DOE may determine the lower explosive limit of the mixture from the lower explosive limits of methane and hydrogen using the Le Chatelier formula, as described in Section V.I.a of today's notice.

All testing must satisfy the quality assurance and quality control requirements described in EPA's report "Quality Assurance and Quality Control" (August 1990) and must meet quality assurance objectives or plus or minus 10 percent on precision and accuracy. DOE must also maintain records on all testing performed and other documentation needed to comply with this condition at the generating site or in the WIPP facility operating record. These records must be available for inspection by EPA, and must include documentation of all aspects of quality assurance and quality control, as described in the above-referenced document. Records must be maintained for the term of today's decision, or three years after they are generated, whichever is longer. They also must be retained for the duration or any enforcement action related to this part of today's decision.

b. RCRA Constituents--Short-term characterization. In response to comments regarding the accuracy of the waste composition estimates provided by DOE in its no-migration petition, EPA is modifying its proposal to require that DOE analyze headspace gases in containers that are shipped to the WIPP and compare the results of this analysis to the estimated values provided in the no-migration petition. Since it was the values in the petition that EPA evaluated in today's decision, DOE must ensure that the analytical data derived from the actual test-phase wastes are similar to the petition estimates. Wastes that are not compositionally similar may not be placed in the WIPP.

(1) Bin-scale tests. DOE must compare actual measurements of headspace concentrations of volatile organics in each of the drums containing wastes to be used in the bin-scale tests to the headspace concentrations reported in DOE's petition. The comparisons must be made in terms of both maximum and mean concentrations. (EPA considers only headspace concentrations to be necessary because migration through air was determined to be the only viable route of migration during the test phase.)

The comparison of the maximum concentrations is designed to ensure that the wastes to be emplaced in the WIPP are in fact similar to the wastes described in the petition. In its proposed decision, EPA noted concerns with the precision and accuracy of some of the analytical data in the petition and took this uncertainty into account during its evaluation. To address concerns over the quality of its data, DOE will be conducting an extensive characterization program on wastes to be shipped to the WIPP for the bin-scale and alcove tests under greatly improved quality assurance/quality control (QA/QC) procedures. (See, e.g., DOE's Pre-Test Waste Characterization Plan, Revision 6, in the docket to today's decision.) Because of improved data quality, EPA expects these new data to differ somewhat from those contained in the petition. However, the Agency believes that the measured maximum concentrations identified in individual drums in DOE's pretest waste characterizations program should be generally comparable to the maximum values reported in the petition.

There are no established criteria for quantitatively defining "comparability" in this context. EPA, however, has concluded that, if the measured headspace concentration in a given drum are no more than a factor of two over the maximum reported for the drum in the petition, the wastes are reasonably comparable. In selecting a factor of two, EPA notes that some differences between the new date and that contained in the petition are expected. This is because the new data will represent a larger sample and analytical results may be more accurate. (As noted in EPA's proposal, the precision and accuracy of the analytical data in the petition were not always documented.) For these reasons, EPA has concluded that it is reasonable to expect some concentrations will be measured that will exceed the maximum values reported in the petition. EPA, however, also believes that the data

should not be significantly different and concludes that a factor of two represents a reasonable expectation.

Accordingly, DOE may place the contents of individual drums into bins for the bin-scale tests if the measured headspace concentrations do not exceed the reported maximums by more than a factor of two./8/ Testing and verification must be completed before the waste is shipped to the WIPP. If the measured concentration of any of the pertinent hazardous constituents in a drum headspace exceeds the allowable maximum, the contents of the drum from which the sample was collected cannot be shipped to or emplaced in the WIPP, unless DOE subsequently treats the waste so as to reduce headspace concentrations to below the maximum levels. Alternatively, DOE may petition EPA to modify the conditions of its determination. Any such modification would require public comment. Further, DOE must maintain records of all relevant test data at the generating site or the WIPP for the term of today's determination, or three years after the data are generated, whichever is longer. In addition, records must also be retained for the duration of any enforcement action for which they are relevant.

NOTE /8/ As with the condition related to flammability discussed previously, DOE must demonstrate that samples collected for these analyses are representative of the entire headspace within the drum, including the headspace within inner bags.

The maximum allowable concentrations for hazardous constituent by waste type (the maximum reported concentrations multiplied by two) are presented in Table 2.

Table 2.--Maximum Headspace Concentrations

[In volume precent]

Constituent	Type I	Type II	Type III	Type IV
Carbon tetrachloride	0.08	0.18	0.58	8.18
Methylene chloride	0.44	0.84	0.50	1.42
1,1,1-Trichloroethane	1.88	5.68	2.12	14.96
Trichloroethylene	0.08	0.34	0.28	0.28
1,1,2-Trichloro-1,2,2-trifluoroethane	0.05	1.62	5.74	20.80

EPA's no-migration finding for air releases was based upon the mean headspace concentrations of volatile constituents reported by DOE. Accordingly, EPA has concluded that comparison of the new, pre-test characterization data with the mean concentrations reported in the petition is also necessary to ensure that EPA's estimates of volatile emissions are valid for the actual test-phase wastes. In determining a reasonable factor for this comparison, EPA considered the "safety margin" indicated by the no-migration demonstration. For the constituents of concern, this safety margin ranges from approximately eleven to well over sixteen million, varying by constituent. EPA has no reason to believe that the headspace concentrations for 1,1,1-trichloroethane and 1,1,1-trichloro-1,2,2-trifluoroethane (with safety factors of six and seven orders of magnitude, respectively) could be high enough to alter the no-migration finding. For the other constituents (carbon tetrachloride, methylene chloride, and trichloroethylene), and safety factors are lower (one, two, and two orders of magnitude, respectively). EPA, therefore, has concluded that DOE must compare the new headspace data for

these constituents to the mean values reported in the petition./9/ To ensure that the no-migration finding remains valid for these constituents, EPA is requiring that the mean values for the test phase wastes cannot exceed ten times the mean values reported in the petition.

NOTE /9/ See footnote 8.

EPA is confident that the factor of ten (back-calculated from the modeling for carbon tetrachloride) is sufficiently conservative for all three of the constituents. Even though no additional safety factor has been added for carbon tetrachloride, EPA notes that the modeling upon which the calculation was based contains several conservative assumptions (e.g., that both test rooms are filled to capacity). EPA also notes that, during the test phase, emissions will be monitored and it will be clear well in advance if emission levels are approaching the no-migration limits, and corrective measures could be taken. Therefore, EPA is comfortable with a safety factor of ten for the comparison of the mean values.

DOE must compare the predicted mean values (multiplied by ten) against the average of the measured concentrations of the headspaces of all drums of a single waste type used to make up each bin. That is, the mean from the population of drums going to each bin (by waste type) must be compared with the reported mean for that waste type. If the calculated mean exceeds the reported mean by more than a factor of ten, that bin cannot be emplaced at the WIPP under today's decision. Testing and verification must be completed before the waste is shipped to or emplaced in the WIPP. As with comparisons of maximum concentrations, DOE must maintain records of all relevant test data at the generating site or at the WIPP facility for the term of today's determination, or for three years after generation, whichever is longer.

The allowable average concentrations for each waste type in drums to be used in a single bin are presented in Table 3./10/

NOTE /10/ The allowable concentrations are the reported mean concentrations for each waste type multiplied by ten. In calculating the mean headspace concentrations, EPA used one-half the detection limit indicated in the no-migration petition to represent concentrations where the constituent was not detected.

Table 3.--Mean Headspace Concentrations

[In volume percent]

Constituent	Type I	Type II	Type III	Type IV
Carbon tetrachloride	0.24	0.26	0.30	6.90
Methylene chloride	0.39	0.42	0.33	0.93
Trichloroethylene	0.25	0.28	0.29	0.38

(2) Alcove tests. EPA has found emissions from the alcove tests to be inconsequential in comparison to the bin-scale tests. Accordingly, EPA is not requiring testing of the headspace of drums used in the alcove tests to demonstrate comparability with reported concentrations in DOE's petition./11/ Before any drums can be shipped to the WIPP for alcove tests, however, DOE must verify (by waste type), through results of the bin-scale tests conducted up to that point, that the measured mean concentrations for specific hazardous constituents do not exceed the reported mean values by more than a

factor of ten. (See Table 3.) (This condition would not require DOE to conduct all bin-scale tests before the alcove tests could proceed; however, based on discussions with DOE, EPA believes that most of the bin-scale tests will be conducted before the alcove tests begin.) EPA is also not requiring DOE to test the drums to determine maximum concentrations for specific hazardous constituents, because it believes that sufficient data will have been compiled from tests conducted in bin-scale drums to determine if there is a concern. In this regard, EPA notes that the drums for both the bin-scale and the alcove tests will be randomly selected from the population of each appropriate waste type. Therefore, there is no reason to believe that the wastes used in the alcove tests will be any more or less accurately characterized by the data in the petition than will be the wastes used in the bin-scale tests. For this reason, EPA has concluded that the data collected from the drums selected for the bin-scale tests can be appropriately extrapolated to the drums for the alcove tests.

NOTE /11/ Although today's decision does not require DOE to characterize RCRA constituents in the drums to be used in the alcove tests, DOE has informed EPA that it intends to test some statistical number of drums that are to be used in the alcove test. In addition, as discussed earlier, DOE will be required to test the headspace of drums used in the alcove tests for fammability.

c. RCRA Constituents--Long-term characterization. In its proposed decision, EPA expressed some concern over the limited waste characterization data provided by DOE in support of its petition. While EPA concluded that the data were sufficient for the no-migration demonstration for the test phase, it also believed that further characterization was required, before any finding could be made for the operational and post-closure phases. EPA believes that this further characterization will be necessary both to further confirm DOE's estimates of waste composition and to ensure that the wastes are sufficiently similar to allow the results of test-phase experimentation to be extrapolated to the wastes that DOE wishes to emplace at the WIPP in the operational phase. That is, the Agency wished to ensure that the test-phase wastes are accurately represented by the estimates and are representative of the remainder of the wastes./12/ In addition, more accurate source term data may prove necessary, EPA believes, in long-term modeling exercises. Toward these ends, the Agency proposed to require DOE to report all characterization data that will be collected.

NOTE /12/ By "representative," EPA is referring to those factors that should contribute to migration of hazardous constituents. The purpose of the test-phase experiments is to evaluate gas-generation process and provide a database of information that can be used to predict gas generation potential of the wastes that are planned to be emplaced during the operational phase. Thus, the issue of whether the test-phase wastes are "representative" deals with whether the results of the test-phase experiments can be extrapolated to the remaining wastes. To that end, DOE's approach is based upon an "envelope" or "bounding" concept wherein wastes whose characterization (for gas-generation potential) is within that envelope would be considered "represented" by the test-phase wastes.

After carefully reviewing public comments, EPA continues to believe that the data provided by DOE in its petition are sufficient for its finding with respect to the WIPP test phase, where air emissions are the major concern (especially given the standards on headspace concentrations and flammability

imposed in today's decision). The additional waste characterization data under development by DOE during the test phase will be important for any review of a subsequent no-migration petition for operational and post-closure periods, where groundwater migration and other issues may arise; however, the data are not needed for today's decision. Accordingly, EPA has not included detailed requirements for waste characterization of the test-phase wastes (beyond the headspace concentrations and flammability limits) or of wastes generated at the ten DOE sites as a condition for today's final decision. However, DOE is developing waste characterization plans, including sample collection, preservation, and analytical procedures, to demonstrate the extent to which the test phase wastes are representative of the other wastes from the ten sites, and to confirm the actual levels of RCRA constituents in headspace gases and sludges. If certain wastes that are generated at the ten sites are not represented (as defined in footnote 12) by the wastes that were tested during the test phase, they could not be shipped to the WIPP without further Agency evaluation, including the possibility for public comment or treatment of the waste.

Over the past several months, EPA--and the State of New Mexico--has reviewed a number of documents concerning DOE's pre-test waste characterization plans. EPA will continue to provide comments to DOE to assist DOE in evaluating whether the waste characterization data that DOE will be collecting are sufficient to make long-term finding for the WIPP. If adequate data are not collected, EPA will not be in a position to approve any no-migration petition for the operational and post-closure phases, if DOE submits such a petition. At a minimum, the wastes should be analyzed for the following constituents:

Acetone
Benzene
Bromoform
Butanol
Nitrobenzene
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
2-Butanone
Carbon tetrachloride
Chloroform
Chlorobenzene
Cyclohexane
1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloroethene
cis-1,2-Dichloroethane
Ethyl benzene
Ethyl ether
Formaldehyde
Hydrazine
Methanol
Methylene chloride
4-Methyl-2-pentanone
1,1,1-Trichloroethane
Trichloroethylene
1,1,2-Tricholoro-1,2,2-trifluoroethane
1,3,5-Trimethylbenzene
1,2,4-Trimethylbenzene

m-Xylene
o-Xylene
p-Xylene
Cadmium
Chromium
Lead
Mercury
Selenium
Siver

Testing for these constituents should include headspace analysis of all waste types for the organic compounds, as well as total analysis of the sludges for both the organic compounds and the metals./13/ Since these data are not necessary for today's finding, but rather will be evaluated as part of a subsequent review of a petition for the operational and post-closure periods (if DOE chooses to submit such a petition), EPA has concluded that the specifics of this testing should not constitute a condition in today's decision.

NOTE /13/ As indicated in Section I.D of today's notice, the State of New Mexico is responsible for enforcing RCRA interim status standards at the WIPP and for issuing a RCRA permit to the facility. In carrying out these responsibilities, the State may require additional or more stringent waste characterization requirements.

8. Reporting Requirements

Reporting requirements associated with EPA's final no-migration determination are unchanged from the proposal--that is, annual written reports are required on the status of DOE's performance assessment during the test phase--except that the final determination requires that DOE send reports to EPA's Region VI office in Dallas, Texas, as well as to the EPA Office of Solid Waste at EPA headquarters. Because Region VI will have direct enforcement authority over the WIPP, EPA believes that it is important for reports to go directly to the regional office as well as to EPA headquarters.

V. Discussion of Major Issues

EPA received more than 400 comments on its proposal, some supporting EPA's proposed decision and others opposing it. Commenters raised a wide variety of issues, including the general scope of EPAs review and its proposed decision; the suitability of the site; the consistency of EPA's proposed approach with the statutory no-migration standards; adequacy of waste characterization; the feasibility and likelihood of retrieval; the impact of possible human intrusion; and many other issues. The major issues raised by the public are discussed below as well as in other sections of this notice. These and the other issues raised by commenters are also discussed in detail in a Response to Comment document prepared by EPA. This document is available in the public docket to this decision.

A. Appropriateness of "Exemption" for DOE

A number of commenters criticized EPA for proposing to grant to DOE what they regarded as an "exemption" from the hazardous waste regulations for its WIPP operations. They questioned why EPA would grant an "exemption" or "variance" to DOE for radioactive wastes, given the risks of this material.

Numerous commenters also questioned DOE's record at other sites, and argued that DOE should be required to comply with all applicable regulations--without special "exemptions" or "variances"--before it was allowed to place waste in the WIPP repository for any purposes.

EPA stresses that it is not granting an "exemption" to DOE from the hazardous waste regulations. This action, however, is a "variance" only in a very narrow sense. HSWA establishes two routes by which a regulated party may dispose of waste in compliance with the land disposal restrictions: It may pretreat wastes according to specified treatment standards, or it may dispose of the waste in a unit that meets the stringent no-migration standard. DOE has chosen the second route of complying with these restrictions--an option that is in some respects the more stringent of the two. For example, if DOE were to choose treatment as its approach, DOE would no longer be required to demonstrate that no hazardous constituents would migrate from the WIPP before the treated waste (which might still remain hazardous) could be placed underground. In any case, EPA reemphasizes that its action today in no way exempts DOE from the hazardous waste regulations; instead, it is a determination by EPA that the placement of untreated mixed waste in the WIPP during the test phase complies with the statutory and regulatory restrictions on land disposal under RCRA. Furthermore, it should be noted that the WIPP must also comply with the other hazardous wastes standards of RCRA, as well as other applicable standards. Other standards applicable to the WIPP are described in Section I.D of this notice.

EPA recognizes the concerns of many commenters over acknowledged problems at other DOE sites. EPA, however, does not believe that problems at other sites should rule out approval of a no-migration petition for the WIPP. The issue at hand is whether there will be any migration of hazardous constituents from the WIPP disposal unit. EPA has carefully and independently reviewed all the information provided by DOE in its petition, as well as all available information from other sources. As a consequence of this review, EPA has concluded that DOE has demonstrated, to a reasonable degree of certainty, that hazardous constituents will not migrate from the disposal unit, under the conditions prescribed in Section VI of this notice.

B. Timing of EPA Decision

A number of commenters expressed concern about what they considered to be EPA's undue haste in proposing to grant DOE's no-migration petition for the WIPP, and they criticized EPA's tentative schedule or a final decision. They suggested that EPA may have taken undue shortcuts in the regulatory process, or that DOE's petition was given an insufficient level of technical review.

EPA disagrees with these commenters. The Agency deliberated on DOE's original petition for more than a year before its proposed no-migration determination for the WIPP in April 1990, and it spent an additional five months in the review of public comments before reaching a final decision. In the course of this review, EPA conducted a complete and thorough evaluation of DOE's petition, material provided by DOE in support of its petition, independent studies of the WIPP, and public comments on the proposed no-migration determination. In addition, EPA staff conducted three investigatory visits to the WIPP site. The results of EPA's review are summarized in today's notice and in the Agency's proposed decision in April 1990. Technical details are provided in EPA's Response to Comments Document and its Background Document, both of which are available in the docket for this rulemaking.

EPA acknowledges that it placed a high priority on the review of DOE's WIPP petition. The Agency disagrees, however, that it took any undue shortcuts in

the review or omitted any significant procedural steps. EPA's decision was made in full accord with the procedures for no-migration determinations, codified at 40 CFR 268.6, and with EPA's procedures for site-specific decisions under RCRA. EPA modeled its procedures for handling the WIPP no-migration petition (as well as other no-migration petitions now under review) on its procedures for handling RCRA delisting petitions. These procedures ensure a thorough and complete Agency review, with public notice and full opportunity for public comment.

C. Scope of Determination

In its proposed no-migration determination for the WIPP, EPA noted that it did not consider the release and possible risks associated with radioactivity; rather, its review addressed the release of hazardous constituents from the disposal unit. EPA pointed out in its proposal that the statutory language on no-migration referred to the release of hazardous constituents, which do not include radionuclides, and that risks of radioactivity from the materials DOE is placing in the WIPP fall within the scope of the Atomic Energy Act rather than RCRA. The Agency further noted that risks associated with transportation lay outside the scope of its no-migration review. Finally, EPA did not seek to determine whether the approach proposed by DOE--that is, deep geologic disposal of TRU wastes at the WIPP site--was the best possible alternative for handling that waste. Despite EPA's explanation of the scope of its no-migration review, numerous commenters raised issues related to radioactivity, transportation, and alternatives to the WIPP. EPA understands the concerns of these commenters; however, it continues to believe these concerns lie outside the scope of its legal authority and are better addressed in other forums.

Radioactivity was a major concern of many commenters. A number, in particular, argued that, since EPA's charge is to protect human health and the environment, it must address the release of radionuclides in any evaluation of the no-migration potential of waste from the WIPP. EPA, however, believes that the potential for radioactive releases from source, special nuclear, and byproduct material is not within the scope of the no-migration determination. First, as EPA explained in its proposed no-migration finding for the WIPP, the Agency's authority over mixed wastes under RCRA extends only to the hazardous components of the waste, not to the radionuclides exempted from RCRA. (EPA explained this position more fully in its mixed waste clarification notice of July 3, 1986, 53 FR 37045. See also Section I.B above.) Second, release of radionuclides is not within the specific mandate of the no-migration language in RCRA or the regulatory standards codified at 40 CFR 268.6. Under the statute, EPA may not find a method of disposal protective of human health unless ". . . it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit . . . for as long as the waste remains hazardous." Hazardous constituents are a term of art under the statute, referring to compounds listed in 40 CFR part 261, appendix VIII. No type of radionuclide is listed in the appendix. Moreover, EPA regulations at 40 CFR 268.6 do not contemplate evaluation of the radioactive risks of a given unit.

EPA acknowledges that it has a general authority and responsibility under RCRA and other acts to protect human health and the environment, and that this standard is an overriding consideration in any no-migration decision, including a decision regarding the WIPP. The Agency believes, however, that the standards issued by EPA under the Atomic Energy Act and the Clean Air Act are the proper standards for protection of human health and the environment

from radiation risks at the WIPP site. Air emissions from the WIPP during the test phase will have to comply with the Clean Air Act standards for radioactive release in 40 CFR part 61 and (under agreement with the State of New Mexico) with AEA standards issued under 40 CFR part 191 subpart A. In chapter 6 of its Final Safety Analysis Report, DOE calculated radionuclide emissions from the WIPP according to EPA-approved models to document compliance with Clean Air Act and AEA standards. DOE is also preparing a NESHAP notice of anticipated start-up to file with EPA, in accordance with Clean Air Act standards. Finally, long-term releases of radionuclides will be controlled under AEA disposal standards codified at 40 CFR part 191 subpart B. These regulations, which were specifically designed to address potential radioactive releases, are the appropriate authority for addressing any such releases at the WIPP site.

EPA also acknowledges public concerns about transportation safety and agrees that it is important for DOE to take every necessary measure to ensure the safety of shipments to the WIPP. The question of transportation risks, however, lies outside the scope of EPA's no-migration authority, and therefore the Agency has not addressed them in its review. Instead, overall issues of transportation safety for the WIPP project are addressed under the National Environmental Policy Act (NEPA) through the Environmental Impact Statement process and by the Nuclear Regulatory Commission, which by agreement with DOE has oversight over shipping containers and the waste form during transportation.

Finally, EPA has reviewed comments suggesting that alternatives other than the WIPP--for example, long-term storage of TRU wastes at the sites of generation--should be chosen for management of TRU wastes. The Agency continues to believe that deep geological burial is a promising strategy for the disposal of radioactive waste. But, in any case, the question of whether acceptable alternatives to the WIPP exist, or whether other approaches might be preferable, lies outside the scope of EPA's review. Under the statute, DOE may place untreated mixed waste in the WIPP repository if it can meet the statutory standards for no migration. Alternative approaches to deep geological burial are more appropriately addressed under the NEPA process.

D. EPA Oversign over the Test Phase

Several commenters on EPA's proposed determination argued that EPA should assert direct oversight over the testing and experimentation during the test phase. For example, some commenters argued that, before any waste was placed in the repository, EPA should make a finding that in-situ testing at the repository was both necessary and sufficient. Others identified what they considered to be flaws in DOE's test plans--e.g., sealing the alcoves in the alcove-scale tests--and argued that EPA should not allow waste to be placed in the repository before those flaws were addressed.

Although EPA believes that DOE has generally laid out a reasonable test program for the WIPP, it disagrees with commenters who argue that the Agency must find, as part of today's determination, that DOE's test plans are necessary and sufficient. The question before EPA is whether there will be any migration of hazardous constituents beyond the unit boundary for as long as the waste remains hazardous, not whether alternatives to in-situ testing are available, or whether DOE's testing program has shortcomings. If DOE can demonstrate no migration for the test phase, which EPA concludes it has done, then it has met the statutory standard for placement of untreated hazardous wastes in the WIPP.

At the same time, the results of the test phase will be critical in review of a no-migration petition for long-term disposal at the WIPP, if DOE chooses

to submit one. EPA, therefore, has put DOE on notice that date from the bin and alcove tests must be of good quality. For example, if the adequacy of alcove seals cannot be demonstrated, any data derived from the alcove tests will be of questionable value. Similarly, it is essential for the long-term finding that DOE adequately characterize test waste for RCRA constituents. Toward this end, EPA has described in some detail in section IV.B.7 of this notice the types and quality of data on waste characterization it expects to see in any petition for long-term disposal. However, for the reasons discussed above, the Agency has concluded that it is not appropriate to address the scope or details or DOE's test plans in today's decision--except insofar as they involve possible migration of waste from the disposal unit or the retrievability of the waste.

E. Site Suitability

In reaching its proposed determination, EPA reviewed more than 300 studies of the WIPP site, not only by DOE and its contractors, but also by independent researchers and groups such as the U.S. Geological Survey and the Environmental Evaluation Group. The overwhelming conclusion that EPA drew from these studies is that the WIPP has been located in a remarkably stable formation, and that it is a promising site for the permanent disposal of radioactive waste. Although there remain some questions about the site, which DOE will be addressing during the test phase, EPA expressed its conclusion that the site was sufficiently well characterized for the test phase to proceed. Thus, EPA agreed with the National Academy of Sciences and DOE's Blue Ribbon Panel that it makes sense to begin testing in the WIPP repository as soon as regulatory requirements are satisfied.

Several commenters on the petition, however, raised issues associated with the suitability of the WIPP site. Commenters, for example, expressed concern about the possibility of karst formation in the vicinity of the WIPP site and the general role of dissolution process in the area; the assumed existence of a pressurized brine pool below the repository; and the rate of brine inflow into the repository. These issues are discussed briefly below and are addressed in more detail in EPA's Response to Comment document for this rulemaking.

A number of commenters expressed concern that the WIPP landscape had the characteristics of a karst terrain. A karst terrain is a kind of topography that is typically formed over limestone, dolomite, or gypsum through dissolution processes; it is usually characterized by closed depressions or sinkholes, caves, and underground drainage. The implication for the WIPP, according to commenters, is that contamination from the repository if it reached the overlying Rustler formation, could be transported rapidly to the accessible environment. Commenters also suggested that ground water in overlying karst formations might attack the repository shaft seals, after closure, and enter the Salado Formation--the salt bed in which the WIPP repository has been constructed. This might lead to dissolution of the halite, allowing a potential pathway for migration past the unit boundary.

The commenters argument that the WIPP area is karstic is based primarily on the presence of several acknowledged and alleged dissolution features in the WIPP area. These include sinkholes in Nash Draw, several kilometers from the WIPP site; dissolution features identified in the WIPP 33 drill hole, just outside the site boundary; and "Barrows Bathtub," a depression about one kilometer from the proposed underground disposal area. Such features, according to commenters, demonstrate that the WIPP site is found in a mature karst area and that wastes can be expected to leak from the WIPP shortly after closure.

As a result of commenters' concerns, EPA reevaluated the question of karst in reaching its final decision. This reevaluation included a field investigation of the WIPP site, in the company of one of the commenters. The tour covered the most important features that the commenters believed were karstic in the vicinity of the WIPP. The closest of these was approximately one kilometer from the surface buildings at the facility. On the basis of this review, EPA has concluded that karst is not now an issue at the WIPP, and is unlikely to become one for many thousands of years, if ever.

EPA recognizes the presence of some localized, surface dissolution features in the general area of the WIPP, particularly in Nash Draw. This is not surprising, given that the geologic units within the area are composed of rock that would be susceptible to dissolution under the correct hydrologic and geochemical conditions. However, evidence suggests that these are ancient features and that current rates of dissolution are extremely slow. For example, dissolution rates at the Nash Draw have been estimated at one-third of a foot every one thousand years, rates that would not threaten the WIPP repository for millions of years. In addition, the widespread occurrence of caliche--a surface feature indicating arid conditions and limited surface dissolution--in the WIPP area suggest the stability of the surface landscape over at least the last 10,000 years. At the same time, borings drilled at and near the WIPP site have failed to encounter solution channels indicative of a karst environment. Finally, it should be noted that the Salado Formation lies 260 meters below the surface, shielded by relatively impermeable rocks. Thus the repository horizon is isolated from any ongoing dissolution process. The fact that the Salado Formation in the area of the WIPP has remained largely unaffected by dissolution processes over its 225-million-year history is evidence of its stability.

Numerous commenters also expressed concern about the presence and possible effects of pressurized brine in the Castile formation underlying the Salado. One bore hole in the immediate vicinity of the repository--WIPP 12--encountered a large brine pocket in the Castile. Geophysical measurements suggest that this pocket extends underneath the repository itself. Commenters expressed the concern that this brine might, in the long run, threaten the WIPP through dissolution processes or, if a bore hole were drilled at some future date through the repository into the brine pocket, pressurized brine might force contamination to the surface.

After reviewing the comments and other data in the record, EPA continues to believe that the brine pockets in the Castile formation--although they contain a substantial amount of fluid--do not offer a significant threat to the repository. Castile deformation, which led to the formation of the brine pockets, was initiated millions of years ago in association with major tectonic tilting of strata in the Delaware Basin. The region is tectonically inactive at present, implying that new development of major Castile features is not occurring. In addition, the brine pool is completely saturated with respect to halite and therefore has no potential to dissolve the surrounding host rock. Since the Castile and Salado Formations are hydrologically distinct, there no credible hydrologic connection between the two formations. Finally, because of restrictions on access, there is no realistic possibility of a borehole reaching brine pockets beow the repository during the test period. Therefore, this issue does not arise for today's determination. DOE's performance assessment, however, is addressing the possible effects of such a borehole after repository closure.

A number of commenters also expressed concern about the effects of brine inflow into the repository and the validity of permeability values used for the Salado Formation. EPA has reviewed the information pertinent to this discussion and believes that, while a good understanding of brine inflow into

the repository exists, additional studies must be conducted to understand the true nature of brine inflow and to quantify inflow in a manner more indicative of facility conditions. These tests will be performed during the WIPP test phase. They will be important in any decision on the long-term acceptability of the WIPP site. Brine inflow, however, will not be a problem during the test phase and thus is not an issue for today's decision.

Finally, commenters expressed concern that DOE's petition and EPA's proposed decision did not fully address the long-term closure scenario expected at the repository. Commenters cited data predicting high rates of gas generation and argued that this gas might delay or prevent creep closure of the repository. As a worst case, gas generation exceeding lithostatic pressure might fracture surrounding salt or threaten the seal system of the repository. In fact, DOE, EPA, and other groups have recognized that the issue of gas generation, and its relation to repository performance, must be adequately addressed before permanent disposal of waste takes place at the WIPP. The major purpose of DOE's in-situ tests in the WIPP with actual wastes is to explore the issue of gas generation. Today's decision will allow these tests to proceed. The Agency believes that the end of the test phase is the appropriate time for it to make a determination of whether the repository is or is not suited for long-term disposal, since the results of the experiments performed during the test phase will help quantify gas generation rates, as well as identify different mitigative measures if the rates prove unacceptable.

F. Conditional Determination

Several commenters took issue with EPA's "conditional" approach in its proposed decision. EPA's proposed determination was based on: (1) The finding that hazardous constituents would not migrate from the disposal unit during the test period, and (2) the requirement that DOE remove the waste at the conclusion of the test period unless it could demonstrate that there would be no migration over the long term. According to commenters, this approach is inconsistent with the statute, which requires a finding that hazardous constituents will not migrate from the unit as long as the waste remains hazardous. The commenters argued that, under the statutory standard, DOE should be required to demonstrate that hazardous waste permanently placed in the repository would not migrate from the unit before DOE could place any waste underground, even temporarily. EPA, however, continues to believe that its proposed approach is consistent with the statute and has not amended its finding.

As commenters point out, RCRA specifies that hazardous constituents must not migrate from the unit for as long as the waste remains hazardous. The phrase "from the unit" is a key element of this standard. If the waste is removed from the unit at the end of the test period, migration of hazardous constituents from the unit after that time is clearly impossible, because there are no longer any hazardous constituents in the unit to migrate. Consequently, in the case of temporary placement, for example during the WIPP test phase, the appropriate question is whether hazardous constituents will migrate during the period of temporary placement. (As discussed elsewhere in today's notice, EPA has concluded that hazardous constituents will not migrate from the unit during the test phase.) At the same time, of course, it is important to see that removal at the end of the test period is reasonably assured. EPA judged DOE's no-migration petition for the WIPP on these grounds. (See Section V.G. for discussion of this point.)

One group of commenters argued further that, if EPA were to continue with its "conditional" approach, it should review DOE's test plan to ensure that

in-situ testing at the WIPP was necessary to demonstrate long-term no migration and that the specific test to be conducted would be sufficient. Although EPA has commented on DOE's test plan, EPA disagrees with these commenters on the type of EPA review that is necessary. On the basis of its review, EPA has concluded that DOE's test plan is well designed and the testing will yield important information on the long-term performance of the repository. EPA, however, has not and believes that it should not formally analyze DOE's in-situ testing at the WIPP to determine whether it is necessary or sufficient, and it does not believe such an analysis is within the scope of a no-migration review. As long as DOE can demonstrate that hazardous constituents will not migrate from the disposal unit, it is legally entitled to place prohibited waste in the WIPP. There is nothing in the statute that further compels a petitioner to demonstrate that placement in the unit is "necessary."

G. Definition of No Migration

Sections 3004 (d)(1), (e)(1), and (g)(5) of RCRA state that land disposal is prohibited, unless "it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone as long as the waste remains hazardous." In its proposed no-migration decision on the WIPP, EPA adopted the same interpretation of this standard as it has in its no-migration regulations for underground injection wells; that is, the Agency interpreted the standard to prohibit the migration of hazardous constituents in concentrations high enough to render the waste hazardous. (See 53 FR 28122, July 26, 1988.) Critics of this approach argued that Congress clearly meant that not a single molecule of a hazardous constituent could migrate from the unit, as long as the waste remaining in the unit was hazardous. Under this standard, DOE's WIPP no-migration petition could not have been approved, because at least some molecules of volatile organics listed as hazardous constituents will migrate via the air route during operations--although most likely at several orders of magnitude below levels of detection.

In today's decision, EPA is retaining its proposed definition of "no-migration" of hazardous constituents. As explained in detail in the preamble to the proposed decision, EPA believes that this approach is fully consistent with the language of the statute and is protective of human health and the environment. EPA also notes that its interpretation of "no-migration" was recently upheld in a decision on the underground injection well rules by the U.S. Court of Appeals for the District of Columbia. (NRDC v. EPA No. Slip. Op. (D.C. Cir. 1990)). In this decision, the Court accepted EPA's argument that "no migration of hazardous constituents * * * for as long as the waste remains hazardous" may be read to mean no migration of constituents above hazardous (or health-based) levels. As a result, EPA has decided to retain the same standard in its final decision on the WIPP petition.

H. Definition of Unit Boundary

In today's finding, EPA has slightly modified its definition of the disposal unit boundary in response to public comments. In the proposal, EPA defined the unit boundary (or point of compliance) for groundwater migration as the Salado Formation, laterally bounded by the limits of the four-mile by four-mile land withdrawal area. For air emissions during operations of the WIPP, EPA defined the unit boundary as the point where the air shaft met the surface.

Numerous commenters expressed concern about the extent of the unit boundary for groundwater, arguing that it might allow broad areas of contamination underground; they objected to EPA arguing that there would be no migration from the unit even if the hazardous constituents moved up to two miles laterally. Several commenters suggested that the unit boundary in no case should be greater than the mined repository, and should probably be less. One group of commenters also pointed to what they believed was an inconsistency between the unit boundary for air and for groundwater. They argued that the unit boundary should be the same in both cases and that the unit boundary for air, therefore, should be no farther than the top of the Salado. After reviewing these comments, EPA has decided to retain its definition of the lateral boundary of the unit (i.e., the boundary of the land withdrawal area within the Salado Formation), but to define the boundary for air emissions as the top of the Salado Formation.

EPA has rejected commenters suggestion that the unit boundary be defined as the mined area (or some smaller area). As the Agency explained in detail in its proposed finding, it believes that, in the context of a geological repository, some credit should be given for the surrounding formation in which a waste is placed. The purpose of placing waste in a geologic repository is to isolate it from the general environment; it is not to prevent any movement of waste, however slight, within that formation. In fact, some lateral movement of waste into the surrounding formation can be an inevitable, and desirable, aspect of repository performance--as it is in the case of the WIPP. A no-migration standard that prohibited any lateral movement would run counter to the concept of a geological repository, without providng for any additional environmental protection or protection against any meaningful release.

In talking this general position, EPA believes that it is being consistent with the intent of Congress, for example as expressed in the Senate Report on the 1984 HSWA amendments: "In determining appropriate confinement from which migration shall not be allowed to occur, the term disposal unit or injection zones should be construed * * * in terms of the overall integrity of the disposal practice, keeping in mind, in particular, the potential for contamination of ground-water or surface water resources" (S. Rep. No. 284 98th Cong. 1st Sess. at 15). Wastes confined to the boundaries of the unit, as defined in EPA's final determination, would remain more than 1,000 feet from the nearest unconfined ground water. EPA also notes that its position is consistent with the recent court decision on its no-migration rules for underground injection wells. (NRDC v. EPA No. Slip. Op. (D.C. Cir. 1990).) In this decision, the court supported EPA's position that the term injection zone (which for underground injection wells is analogous to the Unit) includes confining material surrounding the porous formation into which the waste is actually injected. Similarly, EPA believes it is appropriate to consider at least a portion of the confining salt at the WIPP as part of the unit.

Critics of EPA's proposed definition of the WIPP unit suggested no alternative boundaries, other than somewhere within the furthest extent of the mined area. As discussed above, EPA has rejected this alternative. In the absence of any rationale for an intermediate boundary between the mined area and the proposed boundary, EPA has decided to retain the proposed approach. EPA emphasizes that the WIPP unit, under this definition, is fully isolated from the surrounding environment. If waste remains within the unit boundary, no meaningful movement of waste will have occurred, and no contamination of ground-water resources will result. Further, although there will undoubtedly be some lateral migration of contaminated material along marker beds within the salt formation, all projections indicate that this migration will be very

limited, in no way approaching the boundaries of the unit. (The most likely route of migration, instead, would be up the closed shafts to overlying formations.) Therefore, extensive underground movement of waste is not expected, regardless of the definition of unit.

In the case of air migration, EPA recognizes that its proposed definition caused some confusion. To address commenters' concerns, EPA has amended the unit definition for air during operations, placing the boundary at the top of the Salado Formation. The issue of where DOE should monitor to demonstrate compliance at that point, however, is a different question. (See section IV.B.6 for a discussion of this point.)

I. Waste Characterization

1. Flammability

In evaluating the potential for release of hazardous constituents in its proposed decision, EPA considered the potential for fire and explosion at the WIPP. The Agency noted that the Waste Acceptance Criteria (WIPP-WAC) prohibits explosives and compressed gases in TRU Wastes and requires that pyrophoric materials be rendered safe by mixing them with chemically stable materials, such as concrete or glass, or be processed to render them nonhazardous. In addition, the Nuclear Regulatory Commission requires that all waste containers be equipped with one or more carbon composite filters designed to prevent pressure buildup or the accumulation of flammable gases prior to shipment to the WIPP, as specified in "TRUPACT-II Authorized Methods for Payload Control" (TRAMPAC).14 EPA suggested that these requirements, in conjunction with the maintenance of general ventilation in the underground repository, make the possibility of fire or explosion extremely unlikely.15

NOTE 14 The Agency notes that TRAMPAC also sets limits on the thermal wattage, i.e., decay heat of individual waste containers to control the rate of generation of hydrogen gas by radiolysis (DOE, Safety Analysis Report for the TRUPACT-II Shipping Package, Appendix 1.3.7. revision 2, June 1989).

NOTE 15 The Agency notes that the WIPP-WAC also place restrictions on the total quantity of fissile material in a waste container to ensure criticality safety.

EPA containues to believe that a fire or explosion is unlikely. It acknowledges, however, the concerns of commenters that flammable gases could build up in waste containers, creating a fire and explosion hazard. The Agency has reanalyzed the available information and has concluded that the accidental ignition of flammable gases in waste containers cannot be ruled out, given the available data on waste characterization. At the same time, EPA has concluded that spontaneous combustion within an individual waste container, i.e., without an ignition source, is not credible.16

NOTE 16 See the conclusions in the Sandia National Laboratory memorandum from Slezak and Lappin to Mercer and Fredrickson, January 5, 1990.

Were a fire or explosion to occur as a result of accidental ignition of flammable gases in the void space of a waste container, retrieval could become more difficult, should retrieval be necessary. Moreover, such an event could itself cause migration of hazardous constituents above health-based levels beyond the unit boundary. For these reasons, EPA has concluded that no waste container should be emplaced in the underground repository if it

contains flammable mixtures of gases in any layer of confinement, or mixtures of gases that could become flammable when mixed with air. To assure a sufficient margin of safety, EPA considers any mixture to be potentially flammable if it exceeds 50 percent of the lower explosive limit (LEL) of the mixture in air.

EPA, consequently, is requiring DOE to ensure that individual waste containers have met the prohibition on flammable gases. DOE must implement this provision by testing each waste drum or individual container for hydrogen, methane, and volatile organic compounds (VOCs) as a class. EPA is establishing this condition because it does not judge available process knowledge to be sufficiently reliable or accurate to allow a determination on the flammability hazard of individual waste packages.

EPA recognizes that headspace testing of every drum or individual container on a continuing basis may pose a significant burden on DOE. Without sufficient data, however, EPA feels compelled to require that DOE conduct testing, given the potential consequences of a fire or explosion. Once sufficient data have been collected, however, EPA will consider the extent to which continued testing is necessary. Test data may well show that flammable gases are only present at levels well below the lower explosive limit, either for certain wastes (e.g., TRUCON content code or item description code) or from particular generating sites. If the test data in fact show that no fire or explosion hazard exists, DOE should submit the data to EPA and request that the testing requirement be modified accordingly. Any change in the terms of this condition will be made under the procedures of 40 CFR 268.6(e), which include public notice and opportunity for comment.

EPA is also requiring that headspace sampling be representative of the entire void space of the waste container. Initially, the Agency believes that each individual layer of confinement within the container will have to be sampled, given the limited data available for inner bags. EPA, however, expects that once DOE accumulates enough data, it may be able to show that for most package configurations in which bags are twisted and taped, similar levels of flammable gases will be found in all layers of confinement.17 However, it is anticipated that the occurrence of detectable quantities of free liquids, as determined by real-time radiography or visual inspection, will continue to indicate the need to sample the layer in which it occurs, unless DOE can demonstrate otherwise.

NOTE 17 EPA notes that DOE intends to open up and disassemble the drums selected for the bin-scale tests for visual inspection. Therefore, this requirement should not increase radiation exposure to workers.

EPA also believes that testing of wastes that exhibit high rates of radiolysis should be conducted within a relatively short time period of when the container is actually placed underground. Otherwise, hydrogen levels could build up to flammable levels following sample collection and analysis. DOE has accumulated considerable data on radiolysis rates for various materials in TRU wastes. DOE used such data in its application to the Nuclear Regulatory Commission for a certificate of compliance for the TRUPACT-II shipping package to determine the length of time a waste drum must aspirate (i.e., vent) before it can be shipped after retrieval from storage.18 Similarly, EPA is requiring DOE to determine, and document, the length of time during which headspace gases can be expected to remain below flammable levels (i.e., 50 percent of the mixture LEL) after sampling has been performed, for both newly generated and retrievably stored wastes, and to ensure that waste containers are emplaced at the WIPP within that time.

NOTE 18 DOE, TRUPACT-II Content Codes (TRUCON), DOE/WIPP 89-004, Revision 3, July 1989, and DOE, Safety Analysis Report for the TRUPACT-II Shipping Package, Appendix 1.3.7, Revision 2, June 1989.

If testing reveals the presence of significant levels of flammable VOCs, an explicit flame test must be performed to determine if a flammable mixture can be formed with air. American Society for Testing and Materials (ASTM) Method E 681-85, "Concentration Limits of Flammability of Chemicals," or equivalent, are acceptable test methods. Significant levels of flammable VOCs are indicated by measured concentrations (excluding methane) of 500 parts per million or greater, as propane, as determined by gas chromatography and flame ionization detection (GC/FID) or of 500 parts per million or greater, by volume, as determined by gas chromatography and mass spectrometry (GC/MS).19 If testing shows that VOCs are insignificant, i.e., below 500 parts per million, the lower explosive limit of the mixture may be determined from the lower explosive limits of methane and hydrogen using the Le Chatelier formula as follows: If LEL1, and LEL2 are the lower explosive limits of hydrogen and methane, respectively, and C1 and C2 are the measured concentrations of hydrogen and methane, respectively, expressed as volume percent, then if the fractions, C1/LEL1 and C2/LEL2 sum to 0.5 or greater, the mixture is considered to be flammable when mixed with air.20

NOTE 19 For purposes of determining concentration levels using GC/MS, only noncombustible compounds may be excluded from the sum total of non-methane VOC, e.g., carbon tetrachloride, tetrachloroethylene, chloroform, and bromoform.

NOTE 20 The lower explosive limits of hydrogen and methane are 4.0 and 5.0 percent, respectively, in air (Bureau of Mines, "Flammability Characteristics of Combustible Gases and Vapors," Bulletin 627, 1965).

2. RCRA Constituents

In its proposal, EPA expressed some concern with the quality of the waste characterization data provided by DOE in support of its petition. However, given the nature of the wastes, the safety margins between predicted emission levels and health-based levels, and required controls on air emissions, EPA concluded that the information provided by DOE (based primarily upon process knowledge) was sufficient to demonstrate, to a reasonable degree of certainty, no migration of hazardous constitutents during the test phase. Many commenters, nevertheless, criticized the quality and completeness of DOE's waste characterization information, and DOE's approach to waste characterization. Several commenters noted the critical role played by waste characterization in the prediction of no migration and stressed that EPA needed accurate waste descriptions, supported by detailed analysis, to evaluate the potential environmental impacts of waste disposal. In responding to these comments, EPA has differentiated between short-term issues (relevant to today's decision for the test phase) and long-term issues (relevant to a decision for the operational and post-closure phases, should DOE submit a petition for these phases).

a. Short-term issues. Many of the commenters expressed concern with the Agency's acceptance of waste characterization data based primarily upon process knowledge. Commenters stated that, in the case of the WIPP, waste characterization requirements have not been met.

EPA disagrees with the commenters' position that DOE's waste characterization information is insufficient for a no-migration determination

for the test phase. DOE's analysis of the wastes included an evaluation of the materials and processes from which the wastes were generated as well as actual chemical analysis of the wastes. In the former case, DOE provided flow diagrams and narrative descriptions of the processes that generated all 128 of the identified waste Content Codes as well as an identification of the RCRA hazardous constituents used in the process. DOE also provided estimated concentrations for each of the hazardous constituents expected in the wastes. This was designed to be a conservative characterization, in which it was assumed that any hazardous constituents that were used in a process would be present in the resulting waste stream, regardless of known physical processes that would reduce the likelihood that the constituents would in fact be present (e.g., volatilization). EPA notes that no comments were received indicating that wastes from the processes described by DOE would be expected to be compositionally different from the DOE-estimated compositions.

The bulk of the analytical data presented by DOE to corroborate the conclusions of the above-described characterization were focused on the only viable route of release during the test phase--namely, through the air. For this characterization, DOE provided results from over 200 headspace analyses, representing all four of the identified waste types; these samples were analyzed for numerous gases, including nine organics. Other analyses for which results were reported included Toxicity Characteristic and Extraction Procedure leaching tests, total volatiles, and total metals. While these analyses were not typically conducted on all four of the waste types, EPA notes that these tests are not directly relevant for characterizing the most likely route of release during the period that is subject to today's decision (i.e., the test phase).

Additionally, EPA in its proposal considered the "safety margin" indicated by calculations of air emissions. That is, even if the concentrations of hazardous constituents were significantly underestimated, the no-migration standard would still be met during the test phase.21 Additional assurances are provided by the air monitoring systems that will be operated to allow detection of emissions. Based upon the safety margin indicated by these factors, the Agency concludes that the level of waste characterization is acceptable for the test phase. Nevertheless, to ensure that the wastes to be used in the bin-scale tests are similar in composition to those described in the no-migration petition, EPA is requiring that DOE test the headspace of the wastes shipped to the WIPP (as a measure of the waste constituents' propensity to migrate through air) and compare the results to the values provided in DOE's no-migration petition. This comparison must be conducted and the waste must be found to be compositionally similar before the waste can be sent to and emplaced in the WIPP; if the waste is not similar to the estimated concentrations provided in the no-migration petition, the waste cannot be shipped to the WIPP unless it is modified compositionally, such that it is compositionally similar. The details of this comparison are described in section IV.B.7.b of today's notice.

NOTE 21 The safety factor assumes that an explosivity hazard is not present. To ensure against such a hazard, EPA placed an additional condition on the decision (see section IV.B.7).

Other commenters stated that, to the extent that DOE has provided any laboratory analysis of wastes intended for the WIPP, it is solely headspace analysis (i.e., analysis of the constituents' concentrations in the air under the lid of the drum) used as a surrogate for the waste in the drum. These commenters maintained that headspace analysis, while extremely useful for homogeneous phases, is limited, at best, for analyzing heterogeneous wastes

such as those intended for the WIPP. In the opinion of these commenters, headspace analysis is unreliable as a surrogate for direct analysis of liquids and solids in drums due to uneven partitioning of constituents.

The Agency recognizes that there are limitations on the utility of headspace analysis as a surrogate for analysis of waste composition. Certainly headspace analysis is not appropriate for all evaluations for all waste types. In some cases, however, headspace analysis is the most relevant measurement. For purposes of the test-phase determination, headspace analysis is primarily used in the evaluation of gas generation and explosivity hazards. Since it is the composition of the gas that is of concern, analysis of the headspace (i.e., the actually evolved gas) is the most appropriate parameter to consider. If concentrations in the waste were used for the explosivity evaluation, the composition of the evolved gas would be modeled, or predicted, rather than actually measured.

EPA agrees with the commenters' concerns regarding the validity of a single headspace sample (under the lid) as representative of potentially evolved gases from heterogeneous wastes. This is especially problematic when the drums contain several inner layers of confinement, as do the drums that will be emplaced in the WIPP. Specifically, questions exist as to whether the headspace beneath the lid is compositionally different from the headspace in the inner layers. EPA is addressing this issue in the context of the testing condition related to headspace analysis. In that condition, EPA is requiring that DOE take representative samples of the headspace (which may require, in some cases, for DOE to take samples from inner bags) and analyze them to confirm its assertion that the headspace beneath the lid is, in fact, representative of the total evolved gas within the drums.

EPA also agrees that headspace analysis is not a suitable surrogate for direct analyses of the waste for purposes of evaluations where the total composition is a factor. However, for volatile organic constituents, EPA believes that headspace analysis can be a useful tool for determining whether the constituents are present. That is, if a volatile constituent is present in the waste, it is reasonable to assume that it will also be present in the headspace. Accordingly, results from headspace analyses were used to confirm the presence of volatile hazardous constituents, not to quantify their concentrations in the wastes.

Several commenters argued that DOE's quality assurance/quality control of waste characterization data was deficient. Others noted that DOE had been unable to provide adequate sampling plans and sample handling procedures for analytical work. EPA raised similar concerns with DOE's procedures, but, for the reasons described in the proposal and further elaborated upon above, the Agency has concluded that the data are sufficient for the test phase demonstration. At the same time, EPA advises DOE that it expects additional analytical data to support a long-term demonstration, where significantly greater quantities of waste are involved and routes of possible migration are not limited to release of volatiles to the air during operations.

b. Long-term issues. EPA notes that the "safety margin" for the long-term showing (i.e., the operational and post-closure phases) has not been determined. For that reason, the Agency believes that additional waste characterization data are needed to reduce the uncertainties before a decision on a long-term no-migration determination can be made. EPA, however, has decided not to make such testing a condition of today's decision, because the collection of such data is not relevant to the decision during the test phase; EPA, however, expects DOE to develop and implement waste characterization plans, including appropriate sample collection, preservation, and analytical procedures, that will allow a demonstration of the extent to which the test phase wastes are representative of the other

wastes from the ten generating sites and that allows greater precision in estimating potential for long-term migration (e.g, through routes such as ground water). If such data are not collected, EPA will not be in a position to approve a no-migration petition for the operational and post-closure phases, if DOE submits such a petition. EPA's expectations related to these data are presented in section IV.B.7.b of today's notice.

Many comenters expressed concerns regarding the extent to which the wastes that will be used for the test phase are representative of the other wastes that DOE wishes to emplace at the WIPP during the operational phase. It was stated by many commenters that, for the test phase, adequate waste characterization is vital to assure that tests will be performed on representative wastes. Commenters pointed out that almost 70 percent of the wastes proposed for storage do not yet exist. They asked what controls and safeguards were in place to ensure that these future wastestreams are adequately represented by existing wastes.

The Agency agrees with commenters' concern that the use of representative wastes in the test phase will be critical to the success of any DOE no-migration petition for the later (operational and post-closure) phases. More specifically, the test-phase wastes must be sufficiently representative of the other wastes that DOE wishes to emplace at the WIPP to allow extrapolation of data from the test-phase experiments to the behavior of the other wastes./22/ This issue is, in fact, the basis for the selection of wastes that will be used in the test phase experiments. The selection process will be based upon those parameters that contribute to gas generation and is designed to identify wastes that represent the spectrum of expected values for those parameters. Since waste selection and characterization, as part of the design of the experiments, is the responsibility of DOE, EPA believes that it is DOE's responsibility to establish and implement procedures to demonstrate that the wastes are, in fact, sufficiently representative.

NOTE /22/ It should be noted that, if one or more wastes that are generated at any of the DOE sites are not "represented" by the test wastes, these wastes could not be sent to the WIPP without further evaluation. However, this would not invalidate the testing for all other wastes that are generated at the ten DOE sites and are represented by the test wastes.

Many commenters also argued that EPA's proposed decision did not clearly establish whether all waste analysis data would be provided to EPA prior to emplacement of any waste or whether the data would be provided incrementally as waste is being emplaced. These commenters stated that they had serious concerns if the Agency is proposing to allow DOE to provide waste analysis data simultaneously with waste emplacement. They argued that waste analysis should be provided to the Agency not only before the waste is put into the ground, but before EPA can make a decision about a no-migration variance. They believed that this condition would allow EPA independently to assess the quality of the data. In the opinion of some commenters, delivering waste analysis information while the waste was "riding the Carlsbad elevators" would essentially render EPA's independent technical review of the data inconsequential.

EPA is not requiring that DOE submit the analytical data on the test waste for EPA review before the test wastes are emplaced. Much of the analytical work to be conducted by DOE is related to the eventual demonstration of no-migration over the long-term. Since EPA will evaluate these data as part of any subsequent petition for the later phases, EPA disagrees with the commenters' statement that this evaluation will be "inconsequential." Rather, it will be a critical element of that evaluation.

EPA, however, is requiring DOE during the test phase to evaluate headspace data before waste is placed in the repository, as described earlier. For example, DOE must evaluate the explosivity-related testing before shipping test wastes to the WIPP. Similarly, DOE must compare the analytical results of newly conducted headspace analyses to the waste characterization data in the no-migration petition before the waste is emplaced in the underground respository. Because the standards for both the flammability and the RCRA constituent analyses are objective and straightforward, EPA does not believe that Agency review of the data before placement is necessary.

The flammability and RCRA constituent requirements, described in detail in section IV.B.7, will address many of the commenters' concerns with the accuracy of the data. These requirements will also ensure that the wastes emplaced during the test phase are, in fact, the wastes characterized by DOE in the petition and evaluated by the Agency and the public.

J. Retrievability

Commenters also raised concerns about whether waste would ever be retrieved from the WIPP if it were placed in the repository, regardless of the technical feasibility of retrieval. Some questioned DOE's commitment to retrieval, even if the WIPP site proved unacceptable. Others argued that, even if DOE were willing to remove the waste, no other site would accept it, and therefore the waste would not be retrieved. Several commenters argued that DOE should identify a permitted site ready to receive retrieved waste before any waste should be allowed underground.

EPA believes that it has placed adequate safeguards in today's determination to ensure that DOE in fact removes the hazardous waste from the repository, if it cannot demonstrate the repository's long-term acceptability. Condition 3 in Section VI of today's determination explicitly requires retrieval of wastes if DOE cannot demonstrate compliance with the standards of 40 CFR Part 268 before the expiration of the petition approval. Failure on the part of DOE to remove wastes under these circumstances would constitute a violation of the terms of EPA's determination, leading to possible enforcement action by EPA. In addition, citizens could sue DOE under section 7002 to enforce retrieval of waste from the repository.

Because of this conditioin, EPA has not found it necessary to require DOE to identify a specific site where waste retrieved from the WIPP would be stored, or to require that a permit be granted for storage of retrieved waste before any waste is placed underground. Furthermore, EPA questions whether any such condition would be useful, given that wastes would probably not be removed (if removal proved necessary) for a five-to-ten year period. Current predictions on the best storage site for the waste up to ten years in the future would be at best open to question, and valuable permitting resources would be expended on a site that might never receive the waste.

K. Human Intrusion

Commenters generally accepted that DOE could maintain institutional controls over the test period to preclude human intrusion. One group of commenters, however, argued that EPA must consider the possible effects of human intrusion in the distant future before allowing the placement of any waste for testing. These commenters expressed particular concern about potential mineral resources at the WIPP site, and the possibility that knowledge of the site would disappear after decommissioning. Other commenters argued that permanent markers should be erected at the WIPP site once the facility is closed, and information regarding the type and location of the

markers should be published.

EPA generally believes that the issue of human intrusion is a long-term question, not relevant to the short-term operation of the WIPP during the test and operational phases. In the short-term, DOE management of the site and RCRA permit controls will ensure limited access. Long-term issues would be addressed at the time a petition is considered for permanent disposal. For this reason, EPA disagrees with commenters who argue that it must consider human intrusion in the distant future before allowing any testing at the WIPP.

More generally, EPA believes that, in the context of RCRA no-migration decisions, it should address the question of human intrusion by considering the likelihood of the intrusion, and imposing controls to make such intrusions unlikely. EPA agrees that permanent markers will be necessary (in fact, they are required under 40 CFR part 191 subpart B) and that information on the markers should be published. These issues will be addressed in any no-migration decision allowing permanent disposal.

In its final determination, EPA has removed one proposed condition related to human intrusion. In the proposal, EPA required that "DOE certify to EPA that it has secured control of the entire surface and subsurface estate at the WIPP site." This condition is now moot, because DOE has now secured control over all oil and gas and mineral leases at the site. EPA has placed documentation of this fact in the record for this rulemaking. Thus, because the condition has been satisfied, EPA has dropped it from its final determination.

VI. Conditions of No-Migration Determination

As a condition of granting DOE's no-migration petition, EPA is requiring that the following conditions be met by DOE:

(1) No wastes subject to this determination may be placed in the WIPP repository for purposes other than testing or experimentation to determine the long-term acceptability of the WIPP. In accordance with 40 CFR 268.6(e), DOE must notify EPA before it conducts any testing or experimentation not within the scope of the "WIPP Test Phase Plan: Performance Assessment," April 1990 (DOE/WIPP 89-011, Revision 0), as further explained in Section IV.B.1 of this notice. Placement of waste for the purpose of conducting an operations demonstration is prohibited.

(2) Wastes placed in the repository may not exceed 8,500 drums or 1 percent of the total capacity of the repository, as currently planned.

(3) All wastes placed in the WIPP must be removed if DOE cannot demonstrate compliance with the standards of 40 CFR 268.6, before the expiration of this petition approval, with respect to permanent disposal of mixed waste in the repository. DOE must submit a detailed schedule for retrieval of the waste, including times for completing retrieval as quickly as reasonably feasible, no later than six months after a determination that the repository cannot meet standards for long-term disposal under 40 CFR 268.6 or six months before the expiration of this petition approval, whichever occurs first.

(4) All wastes placed in the WIPP must be placed in a readily retrievable manner, as described in section IV.B.4 of this notice.

(5) DOE must install and operate a carbon adsorption device designed to achieve a control efficiency of 95 percent in the discharge system of the bin experiment rooms. DOE must monitor the control device outlet airstream in accordance with the monitoring plan described in section IV.K of EPA's proposed decision (55 FR 13089) as amended by section IV.B.7 of today's notice, and it must maintain design and operating records as described in section IV.J of EPA's proposed decision, as amended by section IV.B.6 of

today's notice. Records must be maintained at the WIPP facility for the term of this determination or for three years after they are created, whichever is longer. Records must also be maintained during the course of any enforcement actions for which they are relevant.

(6) DOE must implement the air monitoring plan described in section IV.K of EPA's proposed decision (55 FR 13089), as amended in section IV.B.7 of today's notice. Records must be maintained at the WIPP facility for the term of this determination or for three years after they are created, whichever is longer. Records must be maintained during the course of any enforcement action for which they are relevant.

(7) Conditions relating to waste analysis:

(a) DOE must ensure that each waste container emplaced underground at the WIPP has no layer of confinement which contains flammable mixtures of gases or mixtures of gases that could become flammable when mixed with air. This prohibition must be implemented by analytical testing of a representative sample of headspace gases from each waste drum or individual container, as described in sections IV.B.7.a and V.F.1.a of today's notice.

(b) DOE must analyze representative samples of the headspaces of containers to be used in the bin-scale test and compare these results to the estimated compositions provided in its petition for each waste type, as detailed in section IV.B.7.b of today's notice. If the waste is not compositionally similar, as defined in Tables 2 and 3 in section IV.B.7.b, that waste cannot be shipped to the WIPP until the waste has been treated or modified such that it is compositionally similar to the estimates provided in the no-migration petition. In addition, as prescribed in section IV.B.7.b, DOE must demonstrate the comparability of bin-scale wastes to wastes described in DOE's petition before placing waste in the WIPP for the alcove tests.

(c) Waste analysis records must be maintained for the term of this determination or for three years after generation, whichever is longer. Records must also be maintained during the course of any enforcement action for which they are relevant. The records may be maintained at the generating site or at the WIPP facility.

(8) DOE must provide to the EPA Office of Solid Waste and EPA Region VI annual written reports on the status of DOE's performance assessment during the test phase. These reports must include: A description of the tests to date and their results, modifications to the test plan, a summary of DOE's current understanding of the repository's performance, waste characterization data from pre-test waste characterization, and an annual summary of air monitoring data required in Item 6 above.

Beyond these specific conditions, the wastes placed by DOE in the WIPP and DOE's activities under this variance must be consistent with those described in the petition. Under Sec. 268.6(e), DOE must notify EPA of "any changes in conditions at the unit and/or environment that significantly depart from the conditions described in the variance and affect the potential for migration of hazardous constituents from the unit * * * " If the change is planned, EPA must be notified in writing 30 days in advance of the change; if it is unplanned, EPA must be notified within ten days.

Under Sec. 268.6(f), if DOE determines that there has been migration of hazardous constituents from the repository in violation of part 268, it must suspend receipt of prohibited wastes at the unit and notify EPA within ten days of the determination. Within 60 days, EPA is required to determine whether DOE may continue to receive prohibited waste in the unit and whether the variance should be revoked.

Finally, under Sec. 268.6(h), the term of today's petition approval runs for ten years, that is until November 14, 2000.

Dated: October 31, 1990.

Don R. Clay,

Assistant Administrator for Solid Waste and Emergency Response.

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