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Appendices E1 through I1

Waste Isolation Pilot Plant
Carlsbad, New Mexico

APPENDIX E1

RCRA GROUNDWATER PROTECTION INFORMATION

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APPENDIX E1
RCRA GROUNDWATER PROTECTION INFORMATION

E1-1 Introduction

The Waste Isolation Pilot Plant (WIPP) Project was authorized by the U.S. Department of Energy (DOE) 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 national defense programs and activities. To fulfill this mandate, the WIPP facility has been designed to perform scientific investigations of the behavior of bedded salt as a repository medium and the interactions between the salt and radioactive wastes.

The DOE plans to dispose of transuranic (TRU) waste at the WIPP facility. Much of this TRU waste is co-contaminated with chemical constituents that are defined as hazardous under Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), Subpart II, Sec. 261. This waste is called TRU mixed waste and is the subject of this application. TRU mixed waste will be received from numerous DOE TRU mixed waste generator and/or storage sites over the WIPP facility operating life of 25 years.

Because geologic repositories such as the WIPP facility are defined under the Resource Conservation and Recovery Act (RCRA) as land disposal facilities and as miscellaneous units, the groundwater monitoring requirements of 20 NMAC 4.1, Subpart V, §§264.600 through 264.603, must be addressed. 20 NMAC 4.1, Subpart V, §§264.90 through 264.101, applies to miscellaneous unit treatment, storage, and disposal facilities (TSDF) only if groundwater monitoring is needed to satisfy 20 NMAC 4.1, Subpart V, §§264.601 through 264.603, environmental performance standards. This appendix demonstrates that groundwater monitoring is not needed in order to demonstrate compliance with the environmental performance standards; therefore, 20 NMAC 4.1, Subpart V, §§264.90 through 264.101, will not apply to the WIPP facility.

The DOE is seeking to demonstrate, to a reasonable degree of certainty, that there will be no migration of hazardous waste or hazardous constituents via groundwater for as long as the waste remains hazardous. In March 1989, the DOE submitted a No-Migration Variance Petition to the U.S. Environmental Protection Agency (EPA) demonstrating that there will be no migration of hazardous waste or hazardous constituents from the WIPP facility during a proposed Test Phase. On November 14, 1990, the EPA granted the WIPP a Conditional No-Migration Variance under 40 CFR §268.6 for the activities proposed by the DOE. The EPA concluded that hazardous constituents would not migrate to groundwater from the repository during the proposed Test Phase (55 FR 47700).

20 NMAC 4.1, Subpart V, §264.601(a) requires the prevention of releases that may have adverse effects on human health or the environment due to migration of waste constituents in the groundwater or subsurface environment. The environmental performance standards

mandate that nine factors be considered in demonstrating compliance. The first seven of these factors have to do with the pathway and the last two deal with exposures. This appendix deals with the pathway factors to establish that no credible pathways exist during operations or the post-closure care period that will result in contamination of groundwaters in the vicinity of the WIPP in a manner that poses a threat to human health and the environment. Because no credible pathways exist, the exposure calculations mandated by the last two factors are not applicable and are not discussed. The pathway factors that are mandated include:

1. the volume and physical characteristics of the waste,
2. the hydrologic and geologic characteristics of the unit,
3. the existing quality of groundwater,
4. the quantity and direction of flow of groundwater,
5. the proximity to and withdrawal rates of current and potential groundwater users,
6. the patterns of land use, and
7. the potential for pathways via uptake by plant roots.

These factors will be referred to in the subsequent discussions as Factors 1 through 7.

The disposal unit is the Salado Formation which is a thick evaporite consisting mainly of halite, other salts, clays, and anhydrites. There are no significant sources of groundwater within the Salado. Even though the Salado is considered to be saturated, it has a porosity that is low, ranging from 0.5 to 1.5 percent. In addition, the permeability of the Salado has been demonstrated to be small, and generally, the movement of brines within the Salado is only in response to pressure gradients, such as the one that exists between the rock at lithostatic pressure and the excavation at atmospheric pressure. There have been no observations of any net flow of groundwater through the Salado within the WIPP underground. No one in the vicinity of the WIPP withdraws liquids from the Salado for any use. Future withdrawal is unlikely. In some areas in the region, freshwater is pumped into the Salado in order to manufacture brine for oil field use. Such activity in the vicinity of the WIPP is unlikely due to the lack of significant quantities of freshwater nearby. This commercial activity generally occurs closer to the freshwater supplies and in shallower sections of the Salado.

Much of the subsequent discussion focuses on the overlying and underlying formations. This is because these formations contain water bearing units that do exhibit flow and that are used in some instances as sources of groundwater. Understanding these formations is important to the argument that the Salado will isolate the waste and waste constituents from circulating groundwaters and thereby protect human health and the environment. Much of the argument in the following sections is based on the fact that the geologic processes at work in the vicinity of the WIPP are simply too slow to be of any consequence to the repository. The DOE is required to consider these processes over the longer term and is in the process of preparing a no-migration variance petition that demonstrates that waste will be isolated for at least 10,000

years. This petition is due to be submitted to the EPA in June, 1996. The calculations that have been performed for the petition form the basis for much of the discussion in this Appendix. They are summarized in Section E1-7c.

E1-1a The Volume and the Physical-Chemical Properties of the Waste

As is discussed in Chapter D, the WIPP facility is designed to hold 6.2 million cubic feet (ft^3) (175,600 cubic meters (m^3)) of transuranic (TRU) waste. 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. Each waste stream designated as a 3000 Homogeneous Solid is identified in Table C-2. This category includes wastes that are at least 50 percent by volume solid process residues. Waste in the homogenous waste category are expected to contain toxic metals an spent solvents.

S4000—Soils/Gravel
This waste summary category includes waste streams that are at least 50 percent by volume soil as identified in Table C-2. Soils are further categorized by the amount of debris included in the matrix. Waste in the soils/gravels category are expected to contain toxic metals.

S5000—Debris Wastes
This waste summary category 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 (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, as identified in Table C-2.

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. Waste in the Debris category are expected to contain toxic metals and spent solvents.

Detailed descriptions of the wastes can be found in section C-1b. Table C-3 lists the hazardous constituents of interest.

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 (the Transuranic Package Transporter II [TRUPACT-II] and the RH cask) and the TRU mixed waste containers are checked for surface contamination. Under some circumstances, 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 permit application, 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.

The waste itself will not contribute liquids to any naturally existing groundwaters within the disposal areas. This is because the DOE limits the amount of liquid that a generator can leave within a container of waste (see Section C-1b). Only wastes that are compatible with each other and are compatible with the repository and repository components that come in contact with the waste (i.e., panel closure materials, shaft seal materials) are placed in the WIPP as demonstrated in Appendix C1. Consequently, no reactions are expected that would generate unstable conditions.

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[1] 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 E1-1 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.

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[1]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.

Specific to the simulation, anoxic corrosion of ferrous metals and microbial degradation of cellulosics, plastics, and rubbers are 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 E1-1.

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 E1-1 and discussed further in Appendix D16, §D16-5.

E1-1b Geological and Hydrological Factors

To fulfill environmental performance standards for groundwater requirements as described in 20 NMAC 4.1, Subpart V, §§ 264.601(a) and 264.602, the following points are addressed in this appendix:

1. The potential for migration of hazardous waste or hazardous constituents from the facility to the uppermost aquifer by an evaluation of:

    a. The water balance of precipitation, evapotranspiration, runoff, and infiltration (Factor 4)

    b. Unsaturated zone characteristics (e.g., geologic materials, physical properties, and depth to groundwater) (Factor 2)

    c. The existing quality of groundwater, including other sources of contamination and other cumulative impacts on the groundwater. (Factor 3)

2. The potential for hazardous waste or hazardous constituents that enter the uppermost aquifer to migrate to a water-supply well or surface water by evaluation of:

   a. Saturated zone characteristics (i.e., geologic materials, physical properties, and rate and direction of groundwater flow) (Factor 4)

   b. The proximity of the facility to water supply wells or surface water (Factors 5, 6)

   c. The proximity to and withdrawal rates of current and potential groundwater users. (Factors 5, 7)

This document provides the data necessary to demonstrate that the migration of hazardous waste or hazardous constituents from the WIPP underground facility by way of the most likely water-bearing unit to water-supply wells (domestic, industrial, or agricultural) or to surface water is unlikely. To make this demonstration, the DOE considered formation permeability and fractures, the location and relationship of water-bearing units to the repository horizon, and the potential for flooding. Also considered were the characteristics of the waste, integrity of the waste containers, and the chemical composition of groundwater in the repository area, as recommended in the EPA's permit guidance for hazardous waste storage and disposal in geologic repositories. Evaluation of these specific factors is also required by the environmental performance standards found in 20 NMAC 4.1, Subpart V, §264.601. The facility design (E1-7) and waste containment (E1-8) of this appendix are key factors related to the ability of the WIPP site to isolate waste from groundwater with a high degree of certainty.

The demonstration provided in this appendix is formatted as follows:

- E1-2 is a groundwater protection summary.
- E1-3 describes the geographical setting and land use at the WIPP site.
- E1-4 provides a general summary of the geologic characteristics of the WIPP site that pertain directly to the ability of the WIPP site to contain waste.
- E1-5 presents local climatological data and describes the water balance at the WIPP site.
- E1-6 describes the hydrologic conditions and groundwater quality at the WIPP site.
- E1-7 describes facility design related to waste containment. This section includes numerical modeling of performance during the first 300 years after facility closure.
- E1-8 presents waste containment characteristics that ensure isolation of wastes in the WIPP facility.

- E1-9 presents a general summary that demonstrates that the WIPP facility meets groundwater performance standards and the requirements for groundwater protection, as required in 20 NMAC 4.1, Subpart V, §§264.601 and 264.602.

E1-2 Groundwater Protection Summary

Since 1975, an extensive program of site characterization and validation has been conducted at the WIPP site. The results of these studies have been summarized in numerous publications, including the following documents: 1) Geological Characterization Report (Appendix D1); 2) the WIPP Design Validation Final Report (Appendix D1); 3) Summary of Site-Characterization Studies Conducted from 1983 through 1987 at the Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico. The site characterization and validation phase was considered complete in 1987. Additional information has been acquired, however the design and location of WIPP has not been altered as a result of this information (Appendix D6). These studies provided information that was used to substantiate the conclusion that there is no possibility of migration of hazardous waste or hazardous constituents from the WIPP facility by groundwater. This section summarizes the factors (discussed in detail in Chapter D and in the appendices to Chapter D) that justify the determination that the groundwater monitoring requirements in 20 NMAC 4.1, Subpart V, §§264.90 through 264.101, and 20 NMAC 4.1, Subpart V, § 264.602, are not applicable to the WIPP site. Appendices I1 and I2 describe the containment capacity of the WIPP panel-closure system and repository sealing system in further detail.

The WIPP site geologic, brine sampling, and hydrologic investigations indicate there will be little groundwater available to mobilize and transport waste from the facility to any water-bearing zones, both below or above the repository. The groundwater protection information provided in this appendix demonstrates that during the Disposal Phase and the RCRA post-closure care period: 1) insufficient groundwater will come in contact with the waste to saturate it, and 2) there is no potential for possible contaminated groundwater to migrate from the disposal horizon to the accessible environment, due to the existence of hydrologic gradients toward the facility level from all surrounding water-bearing zones during these phases of the project (DOE, 1990; see Chapter E1-6b of this Appendix).

Because the WIPP site is a unique land-disposal unit constructed far below the surface in very low permeability evaporite sediments, the water-bearing unit most likely to be affected by releases from the repository is the Culebra member of the Rustler Formation, which lies 1,400 feet (ft) (426.7 meters [m]) above the repository horizon. The Culebra is the most likely pathway to transport contaminated groundwater to the accessible environment or to surface water because the repository is separated from the first underlying aquifer by over 2000 ft (609.6 m) of evaporite sediments and the Culebra is the most transmissive sedimentary unit found at the WIPP. The possibility of transport of hazardous waste or hazardous constituents to the Culebra will be discussed later in this section.

The WIPP facility horizon is located 2,150 ft (655.3 m) below the land surface in the Salado Formation, a bedded-salt formation. The thick sequences of predominantly very low- to low-permeability sediments and evaporites isolate the waste-disposal horizon from any infiltration from the surface as well as groundwater inflow from the overlying and underlying water-bearing units (Chapters E1-5, E1-6, and E1-7 of this appendix). The facility disposal horizon is isolated from the underlying water-bearing formations by about 2,000 ft (609.6 m) of very low permeability

sediments and evaporites. It is separated from the overlying Culebra by about 1,400 ft (426.7 m) of evaporites and other sedimentary rocks. All shafts extending to the facility horizon have been designed and constructed to minimize the infiltration of water from the overlying water-bearing units into the facility during the Disposal Phase (Chapter E1-7a of this Appendix). All groundwater seepage into the shafts is collected and routed for disposal by water collection rings built into the shaft liners. After waste emplacement, all shafts will have engineered seals and plugs installed, which will minimize fluid flow from the facility to overlying water-bearing units during the RCRA post-closure care period.

The WIPP Brine Sampling and Evaluation Program (BSEP) has shown that very small amounts of brine are trapped in the host-rock salt. During the disposal and post-closure period, the quantity of brine available is insufficient to consider it a potential transport medium (E1-7c) . Additionally, evaporation of the brine due to the normal mine ventilation prevents the accumulation of brine in quantities sufficient to come in contact with the waste itself during the Disposal Phase. Also the hydrologic gradient during the operational and RCRA post-closure care periods (20 NMAC 4.1, Subpart V, §264.117) is from the surrounding rock to the repository horizon, making transport away from the facility unlikely (E1-7c).

The WIPP site is located in a very sparsely populated region in which the major land uses are cattle grazing, oil and gas production, and potash mining. The facility is remote from significant surface-water resources, and the poor quality and small quantity of groundwater in the area limit its possible uses. Water in the water-bearing strata overlying and underlying the facility horizon is high in dissolved solids and is not potable. The only potable groundwater in the general area is found in isolated and discontinuous perched or semiperched water tables in the Dewey Lake or the Santa Rosa. The nearest wells that produce potable water used for domestic and livestock purposes are located 3 miles (mi) (4.8 kilometers [km]) south of the WIPP facility. The Dewey Lake is unsaturated in the vicinity of the WIPP shafts and waste panels, and the Santa Rosa is less than 2 ft (0.6 m) thick and does not yield water. There is no connection between the confined groundwater systems at the WIPP facility and nearby surface-water bodies. There is, therefore, no potential for waste placed in the WIPP facility to affect water resources by entering water-supply wells or surface-water systems. Site geology, hydrology, climate, land use, and geographic setting are described in more detail in the following chapters of this appendix, with additional, more detailed information presented in Appendix D6. In addition, the conclusion stated here is supported by the modeling in E1-7c.

During the 50 year period that covers the Disposal Phase and post-closure care period, the pressure in the underground disposal areas begin at atmospheric pressure (0.1 MPa) and climb to a pressure of 350 lb/in.^{2} (2.4 MPa), (see Table E1-2).The hydrostatic fluid pressures in the Salado, Castile, Culebra, and Magenta are all well above these pressures, thereby, inducing flow toward the repository openings. This flow is controlled by the thick geologic barriers and by shaft liners or shaft seals. The EPA concurred in 1990 that the potential for natural vertical hydrological interaction to affect the repository is low. (EPA, 1990)

To summarize, for waste to migrate to groundwater-bearing units, there must first be a transport medium. There must also be a pathway, such as a shaft, a drill hole, or fracture, that would connect the contaminated medium with overlying saturated water-bearing units that would be the most likely route to the accessible environment (Culebra). In addition, there must be a driving force or a hydraulic gradient to transport contaminants from the waste-disposal area. None of

these factors is considered to be significant at the WIPP facility, because of the natural characteristics of the site and the facility design including closures (see Appendix D6 and I2). No feasible transport medium or hydraulic gradient exists at the WIPP facility, and no natural pathway exists to allow migration of hazardous waste or hazardous constituents from the waste-disposal area to any water-bearing unit during the Disposal Phase and the RCRA post-closure care period. Migration of hazardous waste or hazardous constituents in groundwater during the Disposal Phase or RCRA post-closure care period is highly unlikely.

E1-3 Geographical Setting and Land Use

E1-3a Geographical Setting

The WIPP site is located in the Pecos River Valley section of the Great Plains physiographic province in the north-central part of the Delaware Basin. The land surface in the region surrounding the WIPP site slopes gently to the west and southwest at approximately 45 ft/mi (8.5 m/km). The surface elevations range from 3,550 ft (1,082 m) above mean sea level (MSL) along the eastern border of the site to 3,300 ft (1,006 m) MSL in the west. Eolian sand, which occurs as partially stabilized or active sand dunes, covers much of the site. The sand, of Holocene age, is very erratic in distribution and thickness. Appendix D6 (D6-1d) provides more detail on the geographical, geomorphic, and physiographic setting of the WIPP site.

The WIPP site is located in Eddy County 26 mi (41.8 km) east of Carlsbad, New Mexico, in an area known as Los Medaños (The Dunes) (Figure E1-1). This area is relatively flat and sparsely inhabited with little water and limited land uses. Most of the land is federally or state owned and is used principally for grazing. Other uses of land in the area include potash mining and oil and gas exploration and development.

Livingston Ridge, located about 4 mi (6.4 km) northwest of the WIPP facility, is the most prominent physiographic feature in the area. This northeast-trending escarpment is about 12 mi (19.3 km) long and 75 ft (22.9 m) high and marks the eastern edge of the Nash Draw (Figure E1-2). The late Permian Dewey Lake and the Pleistocene age Gatuña Formation and Mescalero caliche crop out along the ridge.

The Nash Draw is northwest of Livingston Ridge and is a shallow northeast-trending depression 3 to 9 mi (4.8 to 14.5 km) wide. It is the nearest drainage course to the west of the WIPP facility. Elevations within the Nash Draw range from 3,300 ft (1,005.8 m) MSL at its head in the northeast to 2,945 ft (897.6 m) MSL at Laguna Grande de la Sal near the Pecos River and are generally 200 to 300 ft (61 to 91.4 m) lower than the surrounding terrain (Figure E1-2). The Nash Draw is believed to have developed as a result of the subsurface dissolution of halite from the Rustler and upper Salado and gypsum and anhydrite from the Rustler, followed by subsidence of overlying materials.

East of the WIPP facility, the nearest major drainage course is the San Simon Swale (Figure E1-2). The swale is a southeast-trending depression about 25 mi (40.2 km) long and from 2 to 6 mi (3.2 to 9.7 km) wide that overlies the southern extent of the Capitan Reef. Elevations within the depression range from 3,650 ft (1,112.5 m) MSL in the northwest to 3,270 ft (996.7 m) MSL in the collapse feature called the San Simon Sink at the southeastern end of the

swale, about 18 mi (29.0 km) east of the WIPP facility. The sink is filled with fine sand and calcareous silt, and the surface of the swale is covered by eolian sand, which masks the relief.

The San Simon Swale probably originated from a combination of surface-stream erosion and solution subsidence because the area of collapse seems to be confined to the sink areas and is not pervasive over the entire swale (Nicholson and Clebsch, 1961). Rather, collapse in the sink areas steepened the local drainage gradient, resulting in headward cutting and widening of the swale.

San Simon Swale is one of a series of large deep-dissolution depressions filled with Cenozoic sediments, lying above the inner margin of the Capitan reef along the eastern side of the Delaware Basin (Anderson, 1978). Situated approximately 20 miles east of the WIPP site, San Simon Swale forms a southeasterly-trending depression approximately 25 miles long and from 2 to 6 miles in width. Much of the surface of the swale is covered by eolian sand, which masks the relief. Of particular interest within San Simon Swale is a compound collapse feature called San Simon Sink, which occupies an area about 2 miles long and 1 mile wide at the southeastern end of the swale (Bachman and Johnson, 1973).

San Simon Swale originated from a combination of surface stream erosion and solution-subsidence (Bachman & Johnson, 1973). During the Pleistocene, a major tributary of the Pecos River is thought to have flowed southeastward through what is now San Simon Swale to join the Pecos in western Texas. The initial course of this tributary was determined as it is eroded its way through the caliche caprock of the Ogallala Formation (Bachman and Johnson, 1973). The dissolution and subsequent removal of these beds resulted in the formation of numerous sinkholes, some of which coalesced to form, at least in part, the depression now known as San Simon Swale (Bachman and Johnson, 1973). Within San Simon Swale, the San Simon Sink formed as a secondary collapse structure, probably during the Pleistocene. Numerous ring fractures around the sink indicate that it has had a long history of successive collapse events since its initial formation (Bachman and Johnson, 1973). The most recent of these events is reported to have occurred in the 1930's (Nicholson and Clebsch, 1961). It is therefore assumed that salt dissolution in the underlying formation is continuing here and it is thought by some that the resulting brine is being carried in a southeasterly direction toward Texas (Bachman and Johnson, 1973).

Similar activity is not expected at the WIPP due to the dissimilarity in surface features and the lack of fresh water to dissolve the salt. In any event, these are slow processes and will have negligible effects, if any during the operation and post-closure periods.

Between the San Simon Swale and the WIPP facility is a broad, low mesa named "the Divide." Approximately 7 mi (11.3 km) east of the WIPP facility, the Divide rises about 100 ft (30.5 m) above the surrounding terrain and has an elevation of about 3,800 ft (1,158.2 m) MSL. It marks the local boundary between the southwestern drainage toward the Nash Draw and the southeastern drainage toward the San Simon Swale. The Divide is capped by the Ogallala Formation, of late Tertiary age, and an overlying caliche layer.

E1-3b Land Use

The WIPP site consists of 16 sections of federal land located in Township 22 South, Range 31 East (see topographic map in Chapter B). Lands were withdrawn from settlement, sale, location, or entry under the general land laws by Public Law 102-579, which authorized the land to be used for the operation of the WIPP facility. Surface-land uses in this area remain largely unchanged. Surface entry for mining, drilling, and resource exploration is restricted in the 16 sections.

The major use of land within 10 mi (16.1 km) of the center of the site is cattle ranching. At present, none of the ranches within a 3-mi (4.8-km) radius of the WIPP facility uses well water for livestock. The Smith Ranch used well water for domestic consumption and grazing until 1978, but the quality was poor, and they now use water supplied by pipeline. That well, located about 2 mi (3.2 km) north-northwest of the WIPP facility is now closed (Figure E1-2). Drinking water at the Smith Ranch is supplied by the International Mineral and Chemical Corporation (IMCC), which has a well system in the Capitan Aquifer. The Mills Ranch, located about 3.5 mi (5.6 km) south-southwest of the site, uses groundwater from a well completed in a sand section of the Dewey Lake for domestic supply. Water for use at the WIPP facility is supplied by the Double Eagle Water Company pipeline, owned by the City of Carlsbad.

The WIPP site lies in a sparsely populated area. Less than ten people reside at the Mills Ranch, the residence nearest the WIPP facility. The nearest town, Loving, New Mexico, has a population of about 1,700. Loving lies about 18 mi (29.0 km) southwest of the site (Figure E1-2). There are three active potash mines within 10 mi (16.1 km) of the WIPP site. The closest is the Western Ag-Mineral Company potash mine located approximately 5 mi (8.0 km) west-southwest of the WIPP site. The nearest economically exploitable potash reserves are approximately 0.6 mi (1 km) laterally from the waste panels, although the extraction of reserves within the land withdrawal area is precluded by federal law.

E1-4 Site Geology

E1-4a Site-Specific Exploration Techniques

Detailed site-specific exploration techniques have been and are being utilized at the WIPP site. Among these are geophysical surveys, including seismic reflection, resistivity, gravity, electromagnetic, and magnetic techniques; borehole exploration, including coring, geophysical logging, and hydrologic testing; and geologic mapping. The Geological Characterization Report in Appendix D1 and the Summary of Site-Characterization Studies Conducted from 1983 through 1987 at the Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico, in Appendix D6 summarize the exploration methods.

E1-4b Site Stratigraphy

The WIPP facility is constructed near the middle of a sequence of evaporite beds about 3,600 ft (1,097.3 m) thick that consist primarily of halite and anhydrite (Figures E1-3, E1-4). This chapter summarizes the stratigraphic units from the surface down to the Castile, including the Salado. Special emphasis is placed on the water-bearing units and the Salado Formation whose

properties preclude the potential for migration of hazardous waste or hazardous constituents from the WIPP site during the Disposal Phase. Detailed descriptions of local stratigraphy are provided in Appendix D6.

E1-4b(1) Permian System

The nearly 13,000 ft (3,962.4 m) of Permian strata that were deposited within the Delaware Basin area constitute the most complete Permian sequence in North America. At the WIPP site, the average thickness of the Permian sequence is about 12,800 ft (3,901.4 m). The upper part of the sequence, in which the facility is located, is composed of approximately 3,600 ft (1,097.3 m) of thick evaporite beds (primarily halite and anhydrite) with only minor amounts of clastic material. The Permian System is divided into four series which are, in ascending order, the Wolfcampian, the Leonardian, the Guadalupian, and the Ochoan. The Permian-age rocks of interest here are part of the Ochoan Series. The Ochoan sediments are of marine origin and are separable into two distinct sections: 1) a thick lower section of evaporites, and 2) a thinner upper layer of redbeds. The lower section includes, in ascending order, the Castile, the Salado, and the Rustler. The upper section consists of the Dewey Lake.

The Castile Formation

The Castile underlies the Salado. The thickness of the Castile at and near the WIPP site is approximately 1,540 ft (469.4 m). Lithologically, the Castile contains a sequence of three thick anhydrite beds, separated by two thick halite sequences. These low-permeability evaporite units lie between the rocks of the Bell Canyon and the overlying Salado. The evaporites of the Castile were deposited in the Delaware Basin on the basinal side of the Permian Capitan Reef. These evaporite deposits almost completely filled the basin prior to deposition of the Salado.

The Salado Formation

The WIPP underground structures are being excavated in the Salado Formation. A core hole, ERDA-9, was drilled at the center of the WIPP site through the Salado and into the Castile. At ERDA-9, the top of the Salado is 848 ft (258.5 m) below ground surface (BGS), and the base is at 2,824 ft (860.8 m) BGS for a total thickness of 1,976 ft (602.3 m). The waste-disposal horizon is located approximately 2,150 ft (655.3 m) BGS. The ERDA-9 borehole is now open to the Culebra member of the Rustler.

The Salado is composed predominantly of halite, which constitutes about 85 to 90 percent of this formation at the WIPP facility. The next-most-abundant rock type in the formation is anhydrite. The remainder of the formation is polyhalite and other potassium-rich rocks, with subordinate amounts of glauberite, magnesite, sandstone, siltstone, and claystone.

The Salado is divided informally into three members: an unnamed lower member, the McNutt potash member, and an unnamed upper member. The WIPP underground facility is in the lower member, which is 1,094 ft (333.5 m) thick and is composed of alternating thick layers of halite and thinner interbeds of anhydrite and polyhalite. Thin bands of magnesite form a carbonate-rich zone in the lower part of most of the polyhalite and anhydrite seams. Seams of claystone underlie the anhydrite and polyhalite seams. The clay seams, in turn, are underlain by dark to medium-gray argillaceous halite, which grades downward into polyhalite or clear halite.

The McNutt potash member is 380 ft (115.8 m) thick at the center of the WIPP site and differs from the other members of the Salado in that it is rich in potassium-bearing minerals. In addition to potassic rocks, the McNutt contains thin seams of anhydrite and polyhalite within the dominant halite.

The upper unnamed member is 502 ft (153.0 m) thick at the center of the WIPP site and is composed predominately of halite with minor amounts of anhydrite and polyhalite. It also contains two persistent beds of very fine-grained sandstone, the Vaca Triste sandstone and Marker Bed (MB) 101. These halite-cemented sandstones are found throughout the Delaware Basin. These relatively thin sandstone beds occur, respectively, 30 to 40 ft (9.1 to 12.2 m) and 112 to 120 ft (34.1 to 36.6 m) below the top of the member. A detailed discussion of the stratigraphy of the Salado at the underground facility level is given in Appendix D6.

The Rustler Formation

In the WIPP site area, the Salado Formation is overlain conformably by the Rustler Formation. The Rustler is approximately 310 ft (94.5 m) thick at the center of the site. Overall, the lithology of the Rustler is quite variable, containing carbonates, sulfates (gypsum, anhydrite, polyhalite), clastic materials, and halite. The Rustler is the youngest unit in the Ochoan evaporite sequence and is a key marker bed of the upper Permian in Texas and New Mexico. The Rustler is divided into five members in the WIPP site area: 1) at the base, an unnamed unit of clayey siltstone and very fine-grained sandstone with thin interbeds of anhydrite and halite; 2) the Culebra, a unit of thin bedded, finely crystalline dolomite; 3) the Tamarisk, mostly anhydrite or gypsum and some unconsolidated clayey silt; 4) the Magenta, a cross-laminated, fine-grained dolomite; and 5) the Forty-Niner, anhydrite with a single interbed of clayey silt. The unnamed lower member is approximately 120 ft (36.6 m) thick and is dominated by siltstone and claystone with lesser amounts of anhydrite and halite. The anhydritic upper Forty-Niner is approximately 66 ft (20.1 m) thick. The Culebra and Magenta are water-bearing in the vicinity of the WIPP site. These two members are discussed below. Additional detail on Rustler stratigraphy is given in Appendix D6.

The Culebra Member

The Culebra occurs in the Rustler between 704 and 727 ft (214.6 and 221.6 m) BGS near the center of the WIPP site. It is a thinly bedded microcrystalline dolomite that contains many small spherical cavities (vugs), ranging from 0.08 to 0.8 inches (in.) (2 to 20 millimeters [mm]) in diameter. These vugs may be partially filled with secondary anhydrite, gypsum, or calcite. Although many cavities are open, they do not appear to be interconnected except along fractures.

The Culebra has been examined extensively during mapping of the Waste Shaft, the Exhaust Shaft, and the Air Intake Shaft. These observations, along with the results of the evaluation of numerous core samples, have indicated that most zones of interconnected porosity and formation permeability are along fractures. Both open and sulfate-filled vugs and fractures are locally abundant across the site area. The majority of the Culebra sediment is of uniform size, fine-grained carbonate mud, which upon lithification produced finely crystalline dolomite.

The Magenta Member

The Magenta occurs in the Rustler between 596 and 620 ft (181.7 and 189.0 m) BGS near the center of the WIPP site. It is characterized by alternating wavy laminae of silty dolomite and anhydrite altered locally to gypsum. The dolomite is bounded above and below by anhydrite of the Forty-Niner and the Tamarisk, respectively.

The Dewey Lake

The Dewey Lake is the uppermost unit of the Late Permian Ochoan Series at the WIPP site and represents the top of the Paleozoic section in the Delaware Basin. At the center of the WIPP site, the Dewey Lake is 474 ft (144.5 m) thick. The Dewey Lake consists of mudstone, siltstone, and interbedded thin lenticular beds of sandstone.

E1-4b(2) Triassic System

Late Triassic rocks in the northern part of the Delaware Basin belong to the Santa Rosa, a sandstone that unconformably overlies the Dewey Lake. The Santa Rosa occurs in the vicinity of the WIPP site as an erosional wedge pinching out near the center of the site. It consists of fine-to-coarse-grained sandstone with interbeds of siltstone and mudstone. Throughout most of the area, the Santa Rosa is covered by surficial Cenozoic deposits.

E1-4b(3) Tertiary and Quaternary Systems

Cenozoic and more recent rocks found at the WIPP site consist of the Pleistocene- and Holocene-age Gatuña Formation, the Mescalero caliche, and recent windblown sand and playa deposits. Although not occurring at the site, the Ogallala Formation occurs in the WIPP site area.

Recent (Holocene age) deposits in the vicinity of the WIPP site include windblown sand, alluvium, and playa deposits. The most prevalent recent deposits consist of the windblown sand that covers most of the WIPP area (Figure E1-5). The sand occurs as either tracts of conspicuous dune fields or as sheet deposits. The dune deposits can be up to 100 ft (30 m) thick, whereas the sheet deposits are typically no more than 10 to 15 ft (3.0 to 4.6 m) thick.

Alluvial deposits occur in ¼- to ¾-mi-wide (0.4 to 1.2 km-wide) belts along declivities into the Nash Draw, for example, along the base of Livingston Ridge and locally in small depressions (Figure E1-5). These deposits are similar to small alluvial fans or sheet deposits.

Playa deposits consist of eolian sand, alluvium, and gypsum and halite. The nearest playas are about 5 mi (8.0 km) west of the WIPP site within the Nash Draw (Figure E1-5).

Twenty-seven ft (8 m) of the Gatuña were encountered at the center of the site, and 9 ft (2.7 m) was recorded from the Air Intake Shaft. The Gatuña consists of reddish-brown, poorly consolidated sand, gravel, and silty clay. Beneath a cover of windblown sand, much of the site area is covered by a hard, resistant petrocalcic horizon informally known as the Mescalero caliche, which is about 4 to 10 ft (3.0 m) thick in the site area.

The Ogallala Formation, of Miocene age, is a major water-bearing unit supplying groundwater for a large area of the Permian Basin east of the WIPP site. This unit does not occur west of the San Simon Swale, except for thin exposures about 7 mi (11.3 km) east of the WIPP facility. Therefore, activities at the WIPP facility will not impact the Ogallala Aquifer.

E1-5 Climatology and Water Balance

E1-5a Climatology

The regional and local climates are arid to semiarid. The past five-year average annual precipitation at the WIPP is 14.4 in. (36.6 centimeters [cm]), about half of which is received from thunderstorms during June through September. Daytime summer temperatures consistently exceed 90 degrees Farenheit (°F) (32.2 degrees Celsius [°C]) and occasionally rise above 100°F (37.8°C). Winter afternoon temperatures often rise as high as 70°F (21.1°C). Nighttime lows during the winter average near 23°F (-5.0°C), occasionally dipping below 14°F (-10.0°C) . Prevailing winds are from the southeast; however, strong winds are frequent (especially in the spring) and can blow from any direction, creating potentially violent windstorms that can carry large volumes of dust and sand. Climatic data are currently being collected approximately 2,000 ft (609.6 m) northwest of the Property Protection Area. Additional discussion of the local climate of the WIPP site is given in Appendix D4.

E1-5b Local Water Balance

The infiltration and percolation rates of meteoric water into the sediments overlying the facility horizon have been investigated for the Bureau of Land Management. At least 96 percent of precipitation is lost due to evapotranspiration. On the average, therefore, the annual amount of infiltration is less than 0.5 in. (1.3 cm) per year and may, for many years, be essentially nonexistent (Appendix D6).

The widespread presence of the Mescalero caliche, which has existed several feet below the surface for approximately 500,000 years, indicates that, on a regional scale, not enough infiltration has taken place to result in its complete dissolution. (Bachman, 1985; 1976; and 1974) The upper surface of the hard caliche typically is covered with a mat of plant roots, which indicate that most of the moisture that reaches that surface is taken up by plants and transpired. It is difficult to arrive at a precise figure for the amount of water that infiltrates downward into the formations overlying the WIPP site. Infiltration is apparently negligible as evidenced by the absence of a near-surface groundwater body or regional water table above the Rustler at the WIPP site (see Appendix D6-1c[9] for additional detail on the Mescalero Caliche).

A regional water-balance study (RWBS) has been conducted covering approximately 2,000 square mi (5180 square km) in Eddy County east of the Pecos River (Figures E1-6 and E1-7). The RWBS (Hunter, 1985) encompassed all local stratigraphic units above the Salado and below the Ogallala. The results of the RWBS showed that recharge to the Rustler water-bearing units by unconfined water from the Capitan Reef, for example, was not occurring at, or in the vicinity of, the WIPP site. The RWBS also showed that the uncertainties in local and regional precipitation, infiltration, evapotranspiration, and groundwater discharge from the Rustler are so large that water-budget techniques cannot be used either to determine the amount of

recharge or to determine that recharge is actually occurring. Hydrologic and isotopic studies place tight constraints on the possibility of recharge to the Rustler presently being active at the WIPP site (see Appendix D6-2c for additional detail on Rustler recharge).

The only documented points of naturally occurring groundwater discharge in the vicinity of the WIPP are into the saline lakes in the Nash Draw and into the Pecos River, primarily near Malaga Bend. Although this is local flow associated with the Nash Draw and unrelated to groundwater flow at the WIPP site, it is presented here for completeness. Discharge into one of the lakes from Surprise Spring (see Figure E1-1) was measured by Hunter in 1985 at a rate of less than 0.35 ft^3 (0.01 m^3) per second in 1942. Hunter also estimated total groundwater discharge into the lakes is 24 ft^3 (0.67 m^3) per second. According to Mercer (1983) discharge from the spring comes from fractured and more transmissive portions of the Tamarisk of the Rustler, and the lakes are hydraulically isolated from the Culebra and lower units.

Groundwater discharge into the Pecos River is greater than discharge into the saline lakes. Groundwater discharge into the Pecos River between Avalon Dam north of Carlsbad and a point south of Malaga Bend was no more than approximately 32.5 ft^3 (0.92 m^3) per second. Most of this gain in stream flow occurs near Malaga Bend (see Figure E1-1) and is the result of groundwater discharge from the residuum at the Rustler/Salado contact zone.

The only documented point of groundwater recharge is also near Malaga Bend, where an almost immediate water-level rise has been reported by Hale et al. in 1954 in a Rustler-Salado well following a heavy rainstorm. This location is hydraulically downgradient from the repository, and recharge here has little relevance to flow near the WIPP. Examination of the potentiometric surface map for the Rustler/Salado contact zone indicates that some inflow may occur north of the WIPP, where freshwater equivalent heads are highest. Additional inflow to the contact zone may occur as leakage from overlying units, particularly where the units are close to the surface and under water-table conditions.

No direct evidence exists for the location of either recharge to or discharge from the Culebra. The freshwater-head surface map (Figure E1-8) implies inflow from the north and outflow to the south. Recharge from the surface probably occurs 9 to 19 miles (15 to 30 km) northwest of the WIPP in and north of Clayton Basin where the Rustler crops out. An undetermined amount of inflow may also occur as leakage from overlying units throughout the region.

The freshwater-head contour map (Figure E1-8) indicates that flow in the Culebra is toward the south. Some of this southerly flow may enter the Rustler/salado contact zone under water table conditions near Malaga Bend and may ultimately discharge into the Pecos River. Additional flow may discharge directly into the Pecos River or into alluvium in the Balmorhea/Loving Trough to the south.

Recharge to the Magenta may also occur north of the WIPP in Bear Grass Draw and Clayton Basin. The potentiometric surface map indicates that discharge is toward the west in the vicinity of the WIPP, probably into the Tamarisk and the Culebra near the Nash Draw. Some discharge from the Magenta may ultimately reach the saline lakes in the Nash Draw. According to Brinster in 1991, additional discharge probably reaches the Pecos River at Malaga Bend or the alluvium in the Balmorhea/Loving Trough.

Isotopic data from groundwater samples suggest that groundwater travel time from the surface to the Dewey Lake and the Rustler is long and rates of flow are extremely slow. A discussion of this is included in Appendix D6, Section D6-2a(3)(a)(ii). In the discussion in Appendix D6, the radio isotopic data are interpreted within the context of the groundwater basin model. Radiogenic isotopic signatures observed by Lambert (1987) require a conservative minimum residence time in the Culebra of several thousands of years and more probably reflect minimum ages of from 10,000 to 30,000 years.

Potentiometric data from four wells support the conclusion that little infiltration from the surface reaches the transmissive units of the Rustler. Hydraulic head data are available from a claystone in the Forty-niner from wells DOE-2, H-3, H-4, H-5, and H-6. Beauheim, in 1987, compared these heads to heads in the surrounding Magenta wells and showed that flow between the units at all four wells may be upward. This observation offers no insight into the possibility of infiltration reaching the Forty-niner, but it rules out the possibility of infiltration reach in the Magenta or any deeper units at these locations.

Recharge to the waste disposal horizon would require the infiltration and percolation of precipitation from the surface and through the overlying sedimentary sequence. The hydrologic investigations discussed above demonstrate that this is not occurring at the WIPP facility.

It is concluded from these investigations that infiltration of precipitation and recharge to either the facility repository horizon or the water-bearing units of the overlying Rustler is not sufficient to cause the future migration of hazardous constituents to the accessible environment. It is also concluded that the waste will not come into contact with infiltrating precipitation and groundwater recharge.

E1-6 Site Hydrology and Water Quality

E1-6a Surface Hydrology

Surface water is generally absent at the WIPP site. The nearest large surface-water body, the Laguna Grande de la Sal, is located about 10 mi (16 km) southwest of the WIPP site in the Nash Draw, where shallow brine ponds occur (Figure E1-2). The only other surface water is the Pecos River, which is 12 mi (19 km) southwest of the WIPP site at its closest point. Small man-made livestock watering holes ("tanks") occur several miles from the WIPP site but are not hydrologically connected to the formations overlying the WIPP facility. The source of water in these tanks is generally runoff from precipitation but may be supplemented by windmills or water hauled in by trucks. Additional detail on the surface water hydrology of the WIPP site area is presented in Appendix D6-2b.

E1-6b Subsurface Hydrology

Several water-bearing zones have been identified and extensively studied near the WIPP facility. Limited amounts of potable water are found in the Dewey Lake and the overlying Santa Rosa several miles south and east of the WIPP facility. Two water-bearing units, the Culebra and the Magenta, occur in the Rustler and produce brackish to saline water in the vicinity of the site. Another saline water-bearing zone that occurs west of the site beneath the Nash Draw is the so-called "Brine Aquifer" at the Rustler/Salado contact. These water-bearing horizons, which occur

above the Salado, are described below but do not represent useable aquifers at the site, due to either their very poor water quality, low yields, or unsaturated conditions. Brine and gas occurrences in the Salado and the Castile are also described in the following sections.

E1-6b(1) Hydrology of the Castile Formation

The Castile is composed of a sequence of three thick anhydrites separated by two thick halites. This formation acts as an aquitard, separating the Salado from the underlying water-bearing sandstones of the Bell Canyon. Except for the isolated brine reservoirs locally found in the fractured anhydrites, very little hydrologic data are available from the Castile. In the halite zones, the occurrence of circulating groundwater is restricted because halite at these depths does not readily maintain porosity, open fractures, or solution channels. Drill stem tests conducted in the Castile show the permeability of the anhydrite and salt beds underlying the WIPP facility to be negligible, and in most tests, values for permeabilities were too low to be determined accurately with conventional methods. Based on the limitations of the instrumentation used to measure these very low permeabilities, a conservative estimate for permeability would be less than 0.1 microdarcy.

No regional groundwater flow system is present in the Castile. The only significant water present in the formation occurs in isolated brine reservoirs in fractured anhydrite. Geochemical data support the hypothesis that the brines represent trapped Permian seawater that is now halite saturated and in equilibrium with the host rock. The result of an additional study suggested that the brine occurrences are the result of the isolation of waters transmitted to the Castile from the adjacent Capitan Reef via an intermittent or episodic hydrologic connection and that Castile brine has been isolated from between 360,000 and 880,000 years. Therefore, these brine reservoirs are not increasing in volume or pressure, are unconnected with other aquifers or the surface, and have little potential to dissolve the host rocks or move through them. The regional and local hydrogeology and the structural and dissolution characteristic of the Castile are discussed in detail in Appendix D6.

E1-6b(2) Hydrology of the Salado Formation

The massive halite beds within the Salado host the WIPP facility emplacement horizon at a depth of 2,150 ft (655.3 m) BGS. The Salado represents a regional aquiclude due to the hydraulic properties of the bedded halite that forms most of the formation. In the halites, the presence of circulating groundwater is restricted because halite does not readily maintain primary porosity, solution channels, or open fractures. During the mapping that was conducted as part of the construction of the Waste Shaft, the Exhaust Shaft, and the Air Intake Shaft, the halites of the Salado did not produce any observable fluid inflow. In addition, significant brine flows have not been encountered in hydrologic testing from the surface.

The results of the permeability testing, within the underground facility, are generally consistent with a permeability of the overall undisturbed salt mass that is approximately 0.001 to 0.01 microdarcy. Underground hydrologic tests in pure halite show no observable response, indicating either extremely low permeability or no flow whatsoever, even though appreciable pressures are applied to the test interval (Appendix D6). Testing of anhydrite units in the underground facility indicate that permeabilities are generally within the range found for halite. Results of "successful" hydrologic tests of the Salado from the surface indicate permeabilities

from approximately 0.01 microdarcy to a high of 25 microdarcies. Later evaluation of the tests indicated that the data from the Salado in Well DOE-2 are the most reliable, indicating a maximum permeability of 0.3 microdarcy. Field testing of the Salado from the surface has had only limited success. The apparent causes of this are 1) the formation permeability appears to be below the testable minimum for the equipment used (approximately 0.01 to 0.1 microdarcy), and 2) hole aging during the time between hole completion and attempted testing of the Salado caused great difficulty in finding locations in the borehole that allowed successful setting of packers to isolate test intervals. Evaluation of all existing hydrologic test data from the Salado indicate that data from testing of undisturbed halite at the underground facility level are the most representative permeability data available. Hydrologic data from testing in the WIPP underground were used in hydrologic modeling discussed in Section E1-7c . Such very low permeability values indicate that any fluid flow within the competent halite is extremely slow and would result in an imperceptible rate of fluid movement in conventional hydrologic considerations. The only significant variation to these extremely low permeabilities stated above occurs in the disturbed rock zone (DRZ) in the immediate vicinity of the underground excavation. Gas-flow permeability tests indicate a marked increase in the permeabilities within approximately 6 to 7 ft (1.8 to 2.1 m) of the underground excavation. This apparent increase in permeability is restricted to the disturbed zone immediately surrounding the excavation and is believed to be a result of near-field fracturing and possible matrix dilatancy due to stress relief associated with excavation. This interpretation of gas-flow permeability tests is complicated by uncertainties in the degree of saturation of the Salado, pressure threshold effects inherent in the testing techniques, and local inhomogeneities due to fracturing in the disturbed rock zone near the underground facility openings.

Marker Bed 139, an anhydrite unit which lies approximately 3.28 ft (1 m) below the facility floor, exhibits increased permeability due to fracturing in the disturbed rock zone. Separation along these fractures in the floor of WIPP facility rooms and drifts may be quite large (several centimeters). Hydrologic testing in Marker Bed 139 at one location of the facility suggested that separate fracture systems exist and yielded transmissivity values of approximately 6×10^{-4} to 1×10^{-3} ft^2 per day (10×10^{-6} to 2×10^{-6} m^2 per second). Geotechnical evaluations have shown that Marker Bed 139 may be connected to the floors of rooms and other excavated areas through fractures. However, pathways for brine and gas migration in the floor and in Marker Bed 139 are limited to zones directly below the excavations, as fracturing does not extend more than 5 or 6 ft (1.5 or 2.0 m) beyond the edge excavated areas. In the pillars and away from the excavation outside of the disturbed rock zone, the anhydrite bed will not exhibit open fractures due to compressive loading and migration of fluid away from the excavation through Marker Bed 139 is not expected. Should a spill reach Marker Bed 139, migration to overlying or underlying water-bearing units will not occur.

Salado Formation Brine and Gas Inflow

Minor quantities of gas and brine have been encountered in the salt beds of the WIPP facility excavation. The inflows of brine occur as "weeps" on the exposed surfaces of the underground workings and as accumulations in some of the boreholes drilled outward from the workings, most noticeably in the downholes. Gas (mostly nitrogen) is usually associated with the brine inflow and can be observed as gas bubbles in the brine occurrences. Moisture content measurements of the Salado host rock (salt) have been made as part of the BSEP (Deal, et al., 1991, 1989, 1988). These measurements are based on the easily moved fluid content in the low range of

temperatures (77° to 482°F, or 25° to 250°C). The BSEP has measured moisture content of more than 500 core samples representing different lithologies and different areas of the underground facility. The results of these measurements indicate that moisture content ranges from 0.01 to 6.67 percent (for one isolated clayey sample), with most samples less than one percent. Stratigraphic variations in moisture content were shown to be related to the clay content of the units. Based upon the thickness of the various stratigraphic units, a weighted-average amount of brine that occurs naturally in the rock and is not bound crystallographically or sealed in fluid inclusions, is in the order of 0.1 to 0.6 percent by weight (up to 1.6 percent by volume) of the surrounding rocks. Most of the measured brine inflows in boreholes have averaged a few hundredths of a gallon (a few hundredths to a few tenths of a liter) per day. The liquid and gas movement observed in the walls, floors, and roofs of the excavated surfaces is believed to be the result of the pressure gradient caused by the excavation. Geochemical studies by Stein and Krumhansh, 1986, p.24 on the origin of the brines have led to a fundamental conclusion that the formation of secondary polyhalite and magnesite near the stratigraphic horizon containing the brine indicates vertical fluid movement on the order of tens of feet, at most. Furthermore, the evidence suggests that this fluid movement occurred soon after deposition. Silicate diagenesis, resulting in solutions depleted in magnesium relative to potassium and magnesium-rich solid phases, is also interpreted as having occurred relatively soon after deposition. Thus this segregation of fluid compositions preserved a record of diagenetic processes that principally occurred before the close of the Paleozoic. This, and the fact that even weep samples show considerable variability, argue strongly against any sort of an interconnected hydrologic system at this stratigraphic level during the last hundred million years.

During the Disposal Phase, the majority of the moisture entering the facility from the host rock will evaporate and be removed in the air circulated by the underground ventilation system. Additional detail of the hydrogeology of the Salado is presented in Appendix D6.

For the computer simulation, 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 flows. This model was chosen because it can be simulated using standard numerically 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 E1-3 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 x 10^{-22} ft^2 (3.16 × 10^{-23} 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 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 E1-4.

The results of the computer simulation will be discussed subsequently.

E1-6b(3) Hydrology of the Rustler/Salado Contact

The contact zone between the Rustler and the Salado at the WIPP site was tested in 20 cased and open drillholes. In the Nash Draw and areas immediately west of the site, the contact exists as a dissolution residue capable of transmitting water. Moving eastward from the Nash Draw

toward the WIPP site, the amount of dissolution decreases, and the transmissivity of this interval decreases. All tests within the boundary of the WIPP site showed very low transmissivities, ranging from 3×10^{-5} to 3×10^{-3} ft^2 (2.7×10^{-6} to 2.7×10^{-4} m^2) per day.

E1-6b(4) Hydrology of the Culebra Member

The Culebra member of the Rustler has been studied extensively during the site characterization program. Because it is the most transmissive hydrologic unit in the WIPP site area, it is considered the most likely hydrologic pathway to the accessible environment for any potential contamination.

Detailed test results are available for a number of wells completed in the Culebra member prior to 1983. Results for both single and multiwell hydrologic tests show that the Culebra is a fractured, heterogeneous system with varying local anisotropic characteristics. Calculated transmissivities for the Culebra within the WIPP site boundary have a wide range with values between 9×10^{-2} to approximately 69 ft^2 (8.4×10^{-3} to 6.4 m^2) per day, with the majority of the values being less than 1 ft^2 (9.3×10^{-2} m^2) per day. Transmissivities generally decrease from west to east across the site area. A detailed summary of Culebra hydrogeology is given in Appendix D6.

Potentiometric surface maps have been constructed using water-level data from area monitoring wells (see Appendix D6). The Culebra is heterogeneous and anisotropic, and the flow path of water moving through the Culebra near the WIPP is affected by fractures and variable water densities caused by compositional variability. Consequently, the regional direction of flow may have little or no relationship to local flow paths. An interpretation of flow direction in the Culebra is depicted in Figure E1-8. This map shows the most likely regional flow direction of groundwater in the Culebra near the WIPP to be predominately to the south. The flow directions were computed from variable density corrected potentiometric surfaces. The average linear velocity between the WIPP facility and the southern boundary of the WIPP site is 1.77×10^{-3} ft (5.0×10^{-4} m) per day. The average linear velocity is based on the 15 wells that are within the WIPP site boundary.

E1-6b(5) Hydrology of the Magenta Member

Because the Magenta is generally much less permeable than the Culebra at and near the WIPP site, less testing of the Magenta has been performed. The hydrologic characteristics of the Magenta were determined in 15 test holes in the area of the WIPP site. Transmissivities within the WIPP site boundary calculated from the results of these tests range from 1×10^{-2} to 3×10^{-1} ft^2 (9.0×10^{-4} m^2) per day. The results of recent testing of the Magenta in wells H-14, H-16, and DOE-2 indicated that transmissivities were 5.6×10^{-3} ft^2 (5.0×10^{-4} m^2) per day for well H-14, 2.8×10^{-2} ft^2 (2.6×10^{-3} m^2) per day for well H-16, and 1.0×10^{-3} ft^2 (1.0×10^{-3} m^2) per day for well DOE-2 (see Figure E1-9 for well locations). Well H-16 located adjacent to the Air Intake Shaft is not sampled by the Water Quality Sampling Program (WQSP) and is not shown on Figure E1-9.

Water-level data have been collected, and potentiometric surface maps have been constructed. The direction of groundwater flow at the WIPP site, as estimated from the potentiometric surface map, is toward the west-southwest, toward the Nash Draw. Potentiometric surface maps and

additional detail on the hydrogeology of the Magenta are provided in Appendix D6. The average hydraulic conductivity in the Magenta at the WIPP facility was calculated from transmissivity and aquifer thickness values as 1.18×10^{-3} ft (3.0×10^{-4} m) per day. The calculated hydraulic conductivity values and potentiometric contours were used to calculate average linear groundwater-flow velocity of the Magenta aquifer at the WIPP facility. The average linear velocity in the Magenta at the WIPP site is 3.18×10^{-5} ft (9.6×10^{-7} m) per day.

E1-6b(6) Hydrology of the Dewey Lake

Hydrologic investigations at and near the WIPP site have not identified a continuous zone of saturation within the Dewey Lake. Where saturated conditions exist in the formation, they are generally in perched or semiperched water tables, and their occurrence is localized. Several wells believed to be completed in the Dewey Lake are located within several miles (several kilometers) of the WIPP facility. These wells include Ranch Well, Barn Well, Twin Wells, Fairview Well, and Unger Well. Of these wells, one is used occasionally by a ranch house for drinking water (Barn Well at the Mills Ranch), and the remainder supply water for livestock (Figure E1-9). The spatial distribution of saturated conditions in the Dewey Lake is variable. The recently drilled monitoring well WQSP-6A, located in the southwestern corner of the WIPP site boundary, did reveal that the formation was saturated in that location. This well extended the margin of the local saturated area northward from the Mills Ranch. A down-hole video survey showed the Dewey Lake to be fractured at this well location.

The Dewey Lake near the WIPP facility and shafts is not saturated and has not produced water during testing. Four intervals of the Dewey Lake were tested in drill holes at the WIPP site. Although no saturation was encountered during drilling, ten wells were completed as observation wells. The data obtained showed that there was no evidence of a zone of saturation in any of these wells. Additional data concerning the hydrogeologic characteristics of the Dewey Lake are given in Appendix D6. The unsaturated characteristics of the Dewey Lake of the WIPP facility does not offer a transport pathway for migration of potential contaminants from the WIPP shafts to water-supply wells.

E1-6b(7) Hydrology of the Santa Rosa

At the WIPP site, exploratory holes were drilled through the Gatuña and the Santa Rosa. The Gatuña and the Santa Rosa occur within 50 ft (15.2 m) of the surface, and little or no water was encountered in these formations. Only one hole reported a small zone of moisture in the Santa Rosa, but observation wells completed in the formation were dry. Two private wells (Comanche and Clifton Wells) located approximately 10 mi (16.1 km) east of the WIPP site produce potable water from the Santa Rosa, and they are used for livestock watering.

E1-6c Water Quality

In addition to the study of site hydrology, surface and groundwater quality have been characterized for two major reasons: 1) to establish baseline levels of naturally occurring inorganic solutes, radionuclides, and potential organic contaminants in water prior to waste emplacement, and 2) to define the existing use in the area for ground and surface water as a supply for domestic, industrial, and livestock consumption. The drilling of seven new sampling

wells which better meet the needs of sampling for water quality were completed in November 1994. Water-quality data from the new wells are expected to strengthen the baseline and eliminate biases created by the deterioration of the old surveillance well system.

Evaluation of the WIPP site area hydrology and water-quality data indicates that the existing and potential future use of groundwater in the WIPP vicinity is extremely limited due to nonsaturated conditions and very poor water quality. Table E1-2 lists the wells that have been sampled as part of the WIPP WQSP and the formation sampled by each well. The well locations are shown in Figure E1-9. The subsections below describe the general quality of the groundwater that occurs in the WIPP site area. Groundwater quality data from the WQSP have been reported annually as part of the Site Environmental Report (Appendix D4). Detailed discussions of water chemistry for the water-bearing units at the WIPP are given in Appendix D6.

Rustler/Salado Contact

Based on data from 20 wells sampled in the WIPP vicinity from the Rustler/Salado contact, the highest concentrations of total dissolved solids (TDS) in the WIPP water-bearing formations were contained in the Rustler/Salado contact. TDS values ranged from 79,800 milligrams per liter (mg/L) in well H-07b1 to 480,000 mg/L in well H-01. Sulfates and chlorides of calcium, magnesium, sodium, and potassium made up the primary dissolved mineral constituents of this brine.

Culebra Member

The water quality of the Culebra varies greatly. The TDS values range from 2,900 mg/L at well H-08b to about 291,000 mg/L at well WIPP-29. These two wells are fairly remote from the site, but even closer to the WIPP facility, a marked variation in water quality is observed. Well H-02a is located one-half (0.8 km) west of the site and has a TDS of 13,500 mg/L, whereas well H-15, which lies 1 mi (1.6 km) east of the site, has a TDS of 231,000 mg/L. The chemical constituents consist predominantly of chlorides and sulfates of sodium, calcium, magnesium, and potassium.

Magenta Member

The water-quality data for the Magenta indicate that the water is saline to briny, with TDS values ranging between 5,460 to 270,000 mg/L. The predominant dissolved species are sodium, calcium, magnesium, chloride, and sulfate.

Surface Water

No surface water occurs in the immediate area of the WIPP site. Several surface-water bodies located within an approximate 25-mi (40.2-km) radius of the site, such as the Pecos River, the Laguna Grande de la Sal, and livestock tanks that are fed from surface runoff, are sampled and monitored for water quality. Data were collected and reported as part of the WIPP Radiological Baseline Program, the WQSP, and the Ecological Monitoring Program. Surface-water sampling is now conducted and reported as part of the WIPP Environmental Monitoring Program.

Surface-water samples have been collected at four surface-water bodies near the WIPP site: Hill Tank, Red Tank, Indian Tank, and the Laguna Grande de la Sal/Laguna Tres (Figure E1-10).

The water chemistry of the three tanks is similar and is a calcium-bicarbonate-type, having a TDS less than 240 mg/L. The Laguna Grande de la Sal, a saline lake, contains water that is a sodium-chloride-type with a TDS concentration of 320,000 to 350,000 mg/L. Surface-water quality data are discussed in more detail in Appendix D6.

E1-7 WIPP Facility Design

The WIPP facility consists of surface and subsurface installations designed to receive, handle, and safely manage TRU mixed waste in the underground. Several design features, particularly in the shafts connecting the surface and subsurface operations, are utilized to assure that groundwater and precipitation do not enter the facility and that no wastes will enter the local groundwater system during the Disposal Phase. This section summarizes these design features of the WIPP facility.

E1-7a Shaft Designs

The WIPP facility design includes four shafts: the Waste Shaft, the Salt Handling Shaft, the Exhaust Shaft, and the Air Intake Shaft. Each shaft includes a shaft collar, a shaft lining, and a shaft key section. The shaft and shaft liner design information is discussed in detail in the Site Characterization and Validation studies from 1983 to 1987. The shaft design features have not changed. Additional shaft design specifications are presented in Section D-10a(2)(e).

The reinforced concrete shaft collars extend from the surface to the top of the underlying consolidated sediments. Each collar serves both to retain adjacent unconsolidated sands and soils and to prevent surface runoff from entering the shaft. The shaft linings extend from the base of the collar to the top of the salt beds approximately 850 ft (259.1 m) below the surface. The shaft lining serves to inhibit water seepage into the shafts from water-bearing formations, such as the Magenta and Culebra members of the Rustler. The liners are also designed to retain loose rock. The shaft liners are concrete except in the Salt Handling Shaft, in which 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 100 ft (30.5 m) below and into the Salado. The shaft key functions to resist lateral pressures and to contain the water seals.

Two separate water-seal rings are incorporated in each key. Performance of the seals is monitored by inspection of the bottom of the key for seepage. If groundwater is detected flowing past the upper ring, this condition is corrected by injecting chemical sealants or cement grouts to stop the leakage.

On the inside surface of each shaft, excluding the Salt Handling Shaft, there are three water-collection rings. The first is located just below the Magenta interval, the second just below the Culebra interval, and the last at the lowermost part of the key section. These collection rings function to collect any groundwater that may seep into the shaft through the liner. The groundwater is piped to the storage tanks located at the station at each shaft. The water is transported to the surface in portable tanks for disposal. On January 17, 1992, the New Mexico

Environment Department (NMED) issued an approved Discharge Plan to expand the WIPP sewage facility. The discharge plan allows for the disposal of brine waters in the evaporation lagoon and the expanded sewage facility, which was completed in January 1993.

E1-7b Repository Seals

Upon closure of the WIPP facility, permanent shaft seals will be emplaced. Seals may also be placed in boreholes at the WIPP site. These seals will function primarily to limit any seepage into the facility from overlying water-bearing units or from infiltration from the surface. In addition, seals will prevent any contaminated water in the facility from reaching the accessible environment during the RCRA post-closure care period and beyond (see Appendix I2 for repository seal system details).

The general approach taken in the preliminary design concepts for shaft and borehole seals at the WIPP facility is to limit the inflow of groundwater from formations above the facility level until the host rock and the backfill encapsulate the waste because of salt consolidation. Water from other sources, such as saturated interbeds near the facility horizon or from the host salt itself, may also enter the repository following decommissioning. Although these water sources are volumetrically less significant, the seal system is designed to limit inflows and to inhibit the expulsion of contaminated brines through the shafts upon pressurization due to host formation consolidation. Existing boreholes will be sealed, thus, they are unlikely to become significant flow paths. Therefore, borehole seals provide some additional assurance that dissolution will be minimized. Appendix I2 provides detailed information that indicates design, materials, and modeling for the shaft seals. Appendix I2 also indicates information on the assumptions and modifications in the modeling code.

In addition to shaft seals, each panel will be engineered with a panel-closure system, which considers all appropriate repository geomechanical characteristics. The following discussion presents the site conditions relevant to the design of this panel-closure system. An important site condition applicable to design implementation is the transport of VOCs through the DRZ. The potential air-flow regimes through the DRZ include the dilated salt, unfractured anhydrite, fractured salt, and fractured anhydrite with clay seams. Therefore, the mechanisms for formation of a DRZ and their potential influence on the VOCs are considered in the panel-closure system design. Further, because brine that may react with the barrier material is present in very small amounts, the chemical and physical characteristics of brine are discussed.

E1-7b(1) The Salado Formation at the Repository Horizon

Halite is the most abundant mineral in the Salado Formation and occurs in thick beds with thinner beds of polyhalite or anhydrite. The halite usually contains trace or minor amounts of clay, anhydrite, or polyhalite. These beds are laterally continuous horizontal layers at the repository horizon. Thin clay seams 0.06 to 0.25 in. (1 to 2 mm) thick underlie the anhydrite beds. Three anhydrite beds are of interest: two above (anhydrite "a" and "b") and one below (Marker Bed 139 [MB 139]) the repository horizon (Powers et al., 1978).

These lithologic units affect the rock-mass response to excavation at the repository horizon. The stratigraphy influences the development of the DRZ, which in turn influences the panel-closure system geometry and the choice of design components.

Unfractured halite beds are, for all practical purposes, impermeable (Appendix D6). Argillaceous halite is slightly more permeable. Permeabilities of interbedded anhydrite units is typically higher. All of these permeabilities, along with references to original data, are given in Appendix D16, Section 16-6.

E1-7b(2) Disturbed Rock Zone

Following the underground excavation at the WIPP, a DRZ forms in the rock surrounding the excavation. This DRZ is delineated by the zone of rock in which mechanical and air-flow properties change in response to the excavation. The DRZ has been characterized using visual methods, geophysical methods, in situ gas-flow measurements, laboratory analysis, and numerical modeling.

The DRZ relevant to the panel-closure system consists of five elements:

- Dilated salt
- Fractured salt
- MB 139
- Fractures in MB 139
- Overlying and underlying clay seams.

E1-7b(2)(a) Mechanisms for DRZ Development

Excavation of a drift changes the stress distribution in the salt surrounding the opening, creating a DRZ. This zone develops primarily because of the creep of salt surrounding the access drift. As the salt moves toward the opening, it fractures and becomes disturbed. Salt surrounding a drift undergoes dilational (volumetric increase) deformation because of the stress redistribution caused by the excavation of the drift itself. The dilated salt in the DRZ can be described as grain boundary opening and microcrack generation manifested as volumetric strain. It is estimated that the dilated rock zone extends to about 3 radii from the centerline of the drift. (For example, for the air-intake drift, the DRZ would extend out to a radius of 30 ft [9 m].)

Under the most severe conditions, the accumulation of creep deformation, the salt may fracture or separate along the bedding planes. In areas where stress states are favorable and where creep deformations are smaller, the salt remains essentially intact. Low-angle fractures and vertical fractures in salt are observed at several locations in the WIPP underground. The development of these fractures depends upon elapsed time after excavation and upon entry width. These fractures vary from tight fractures to visibly open fractures and are described as (These features are illustrated in Figure E1-4):

- Vertical surficial fractures in the sidewalls or ribs within 3 ft (1 m) of the drift.

- Low-angle (relative to horizontal) fractures that develop from the rib/roof and rib/floor intersections 3 to 6 ft (1 to 2 m) into the roof or floor. These fractures may be filled with sheared material immediately below the floor of the drifts. Floor fractures may intersect MB 139. Roof fractures may extend to the overlying anhydrite "b"/salt contact.

- Subhorizontal fractures that develop within the first 2 ft (0.5 m) of the roof. These provide the "drummy ground" that has been observed throughout the underground. These fractures are generally closed and show little evidence of relative displacement.

- Vertical surficial spalling in the roof that probably develops because of restraint imposed by remedial bolting, which causes tensile failure of the salt in localized areas.

- Low-angle (relative to horizontal) shear fractures that are visibly exposed laterally across the roof within 3 ft (1 m) of the excavation surface.

MB 139 is the major interbed closest to the panel-closure system location. MB 139 is a nominally 3-ft- (1-m-) thick stiff bed consisting of anhydrite and polyhalite. The anhydrite is brittle, unlike the viscoplastic halite. In its undisturbed state, it is tight, because natural fractures and bedding features are closed or salt-filled. Excavation of an access drift removes the vertical stress immediately below the drift and allows relaxation of the fractures. Because the unmined salt on either side of the access drift continues to vertically confine the MB 139, the extent of the DRZ is limited to the width of the drift. With time, the creep of the salt toward and into the drift causes upward deflection, or heave, of MB 139. As the bed deflects, the natural fractures and salt infilling are disturbed, and new fractures may be generated. If fractures develop in MB 139, its permeability will increase significantly. Such fracturing is not expected to heal naturally over the operational period of the panel-closure system.

Clay seams with thin clay and anhydrite bedding features may develop bedding separations (off-set cracks) in the roof and floor due to salt creep. They are tight in their natural compressed state. Excavation: 1) relieves the vertical stress above and below the drift, 2) allows shear and flexural displacements across the seam because of creep, and 3) exposes the seams to dehydration. Each of these effects may lead to enhanced permeability or transmissivity. Continued creep in the roof and floor causes separation along bedding planes in the roof and floor. These separations can be broad and continuous along the length of the drift and can attain to measurable apertures.

E1-7b(2)(b) <u>Influence on Contaminant Transport</u>

In areas where confining stress is high and deviatoric stress is low, the salt dilates and exhibits a permeability from 10^{-18} to 10^{-19} ft^2 (10^{-19} to 10^{-22} m^2), extending up to 3 radii from the drift centerline. This permeability is very low and will not permit flow of contaminants from the panel through the DRZ. Similarly, clay seams and unfractured anhydrite in the DRZ are low in permeability and will not permit flow.

In contrast, open fractures present an unrestricted flow path. However, since there are no significant accumulations of brine in a closed panel during the post-closure period, only gaseous components will flow through these fractures. Within the first 3 ft (1 m) of most underground excavations at WIPP, some fractures parallel to the drift are observed in boreholes at the midheight of the rib. In this region, the permeabilities are generally greater (about 10^{-16} ft^2

[10^{-17} m^2]) than at any other location in the salt. Between 3 and 6 ft (1 and 2 m) into the rib, permeabilities decrease to 10^{-18} ft^2 (10^{-19} m^2) and below; beyond 6 ft (2 m), the permeabilities rapidly decrease to the value associated with intact salt (10^{-21} ft^2 [10^{-22} m^2]) (Appendix D6).

In situ gas-flow/permeability measurements made over test intervals that include MB 139 indicate the following (Appendix D6):

- That flow rates in MB 139 near the center of excavations of comparable age increased as the span of the drift increased. In four of seven tests conducted from the center of test rooms (a 33-ft [10-m] span) in which the test intervals included MB 139, the transmissivity was so large that a gas pressure could not be sustained over a several-meter test interval.

- That flow rates (i.e., transmissivities) increased as the age of the opening increased; however, the influence of span was more important than age.

- That flow rates measured in test intervals located near the edge of excavations were low, indicating that the marker bed remained unfractured when it was vertically confined by the pillars.

In summary, the permeability measurements suggest that the dominant flow paths in the DRZ around the panel-closure system will be through fractures in the salt and anhydrite that develop around the panel-closure system location following excavation and during the period that waste is emplaced in the panel. If the fractured zone is not expected to heal sufficiently once concrete is emplaced, the fractured zone will be removed before concrete placement.

E1-7b(2)(c) Treatment of Rock Properties in the Numerical Model

Creep closure is the focus of the computer model implementing 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 E1-5. 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 E1-5)
- 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 E1-5)
- a lower compacted clay region within the Salado (designated Lower Salado Compacted Clay in Table E1-5)
- a basal clay component below MB 138 (designated Bottom Clay in Table E1-5)
- 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 E1-5). For those shaft regions in halite where enhanced flow expected through the surrounding DRZ before healing occurs is modeled by increasing the permeability of the adjacent shaft seal component is enhanced 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 1.8×10^{-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 E1-5.

E1-7c Contaminant Transport Calculations

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 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.

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 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 E1-12 and E1-17 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 EI-12). 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 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 EI-13. 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 EI-14). At the same time, the pore volume (void space) present in the repository is being reduced by creep closure, as shown in Figure EI-15. 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 EI-16. 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 EI-16 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 EI-17). Figure EI-17 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 brine 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. 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 EI-15.

E1-8 Waste Containment

Waste containers isolate the waste during waste emplacement operations and remain effective until after panel closure. Thus, during that portion of the disposal operations period when wastes are exposed to the ventilation system, the possibility of hazardous constituents migrating into a water-bearing unit, either above or below the repository, is extremely remote. By the time the

salt creeps sufficiently to breach a container, the waste panel will be closed. This guards against migration of any hazardous constituents during the whole operating lifetime of the repository (see Appendix I1 for detail on salt creep closure rates).

As stated in the previous section, the shaft seals will prevent migration of any contaminated liquid from reaching the accessible environment in the long term.

The Waste Acceptance Criteria (WAC) for TRU mixed waste destined for management at the WIPP site specifically restrict the inclusion of constituents that are chemically incompatible. In addition, the WAC controls the presence of explosives, pyrophorics, gas generators, heat generators, free liquid forms of waste, and corrosives. Thus, the potential for waste releases in the facility prior to hazardous waste management unit closure due to waste interactions is minimal. All materials shipped to and disposed in the WIPP facility must meet these stringent requirements for stability, compatibility, and physical form to ensure the safety of the repository when waste comes into contact with the Salado in the hazardous waste management unit first closed during the Disposal Phase activities.

E1-9 Summary and Conclusions

Release of hazardous waste or hazardous constituents from the WIPP site to the accessible environment via groundwater is unlikely. The most transmissive hydrologic unit in the WIPP area, and the most likely groundwater transport pathway, would be the Culebra water-bearing stratum in the Rustler overlying the underground facility. The natural characteristics of the site and the design of the WIPP facility ensure that there is no potential of hazardous waste or hazardous constituents reaching the Culebra during the disposal operations and post-closure periods and subsequently affecting the accessible environment. These characteristics include site geology, site hydrology, climate, and groundwater utilization in the WIPP area, as well as the WIPP shaft designs and the waste container configuration used during the Disposal Phase.

The inapplicability of RCRA groundwater monitoring requirements at the WIPP facility is determined based on the information provided in the previous sections of this document. The major points used in this determination are:

- The facility horizon is located 2,150 ft (655.3 m) below the land surface in the Salado, which is composed mainly of bedded salt. The salt acts as a very low-permeability regional barrier isolating the facility from water-bearing units above and below. The Castile underlying the Salado is also a very thick, low-permeability evaporite unit that further isolates the facility from underlying water-saturated units of the Bell Canyon. Drilling additional boreholes through the evaporites below the facility horizon would act to compromise the isolation characteristics of the repository.

- There appears to be little or no infiltration of precipitation deeper than the most shallow surface soils at the WIPP site, and no shallow perched saturated zones have been detected at the site. The shallowest water-bearing zone in the WIPP region is the Dewey Lake. The Dewey Lake is not saturated at the WIPP facility and does not represent a viable migration pathway to the accessible environment.

- The possibility of groundwater reaching the underground facility in quantities capable of transporting waste up the shafts to the Culebra or other water-bearing units is unlikely. The shafts do penetrate water-bearing units, but the shaft design incorporates features designed to minimize and control groundwater inflow to the facility and to divert any inflow for collection and disposal during operations. Long-term protection is provided by the salt itself and the final shaft seals. Shaft seals include removing the liners in the areas of the water bearing zones and establishing a new seal to assure no leakage occurs behind the liners.

- The waste container design, prohibition of free-liquid forms of wastes, and the hazardous waste management unit closures will ensure complete control and containment of the waste throughout the Disposal Phase activities.

- As shown by the computer simulations, no migration pathways or hydraulic gradients exist for the transport of contaminants from the disposal facility level via groundwater to the accessible environment during the disposal phase and the RCRA post-closure care period. The hydraulic gradients of all surrounding water-bearing units are toward the facility during the disposal and RCRA post-closure care periods, making migration of contaminants from the facility horizon to the nearest aquifer impossible.

- Groundwater quality in the vicinity of the WIPP facility, particularly in the Rustler and the Rustler/Salado contact water-bearing zones, is generally poor. Thus, groundwater from these water-bearing zones is not a resource for domestic, irrigation, or livestock use. The major groundwater resources in the area, the Capitan and Ogallala aquifers and surface water, are not hydrologically connected with the WIPP underground facility or water-bearing units overlying the WIPP repository.

This document serves as a demonstration that the RCRA groundwater monitoring requirements are not applicable to the WIPP facility, because they are unnecessary to meet or demonstrate compliance with environmental performance standards, as described in 20 NMAC 4.1, Subpart V, §264.601. The groundwater protection information provided demonstrates that, to the best of the DOE's knowledge, migration via groundwater of hazardous waste or hazardous constituents emplaced in the WIPP facility is unlikely to pose a threat to the environment. The facility provides effective isolation of hazardous waste or hazardous constituents from groundwater sources that would be the most likely pathways to the accessible environment. Because the DOE has demonstrated that migration of hazardous waste or hazardous constituents to any water-bearing formations at the WIPP site is unlikely, there can be little potential for hazardous waste or hazardous constituents to move via these water-bearing formations to water-supply wells (domestic, industrial, or agricultural) or to surface water. The DOE requests that the NMED Secretary find that groundwater monitoring, as mandated by RCRA for other types of land disposal facilities, is not applicable to the WIPP facility in accordance with 20 NMAC 4.1, Subpart V, §264.90(b)(4).

This document demonstrates that, to the best of my knowledge, there is little potential for migration of waste emplaced in the WIPP facility to pose a threat to the environment. The facility provides effective isolation of waste from groundwater sources that would be expected to be the

most likely pathway to the accessible environment. Because it has been demonstrated that there is very low potential for hazardous waste or hazardous waste constituents to enter any water-bearing formations at WIPP, there can be little potential for hazardous waste or hazardous waste constituents to move via these water-bearing formations to water supply wells (domestic, industrial, or agricultural) or to surface water. Groundwater monitoring, as mandated by RCRA, does not appear to be required at this time. As certified by a qualified geologist, this document meets the requirements of 40 CFR Part 264.90(b)(4).

WIPP RCRA GOUNDWATER INFORMATION

Certified by: (Geologist or Geotechnical Engineer)

MARK CRAWLEY
(Printed)

Mark Crawley
(Signature)

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TABLES

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TABLE E1-1

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 E1-2

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

TABLE E1-2

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)
75	3.585	283.34	15500	572.7	0.0474	79.10	26.92
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

TABLE E1-3

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 E1-4

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 E1-5

WELLS SAMPLED AS PART OF THE WATER QUALITY SAMPLING PROGRAM

Well Name	Water-Bearing Unit
DOE-1	Culebra
DOE-2	Culebra
H-02a	Culebra
H-03b1	Magenta
H-03b3	Culebra
H-04c	Magenta
H-04b	Culebra
H-05c	Magenta
H-05b	Culebra
H-06c	Magenta
H-06b	Culebra
H-07b1	Culebra
H-08b	Culebra
H-09b	Culebra
H-11b3	Culebra
H-12	Culebra
H-14	Culebra
H-17	Culebra
H-18	Culebra
P-14	Culebra
P-17	Culebra
Barn Well	Dewey Lake
Clifton Well	Santa Rosa
Comanche Wells	Santa Rosa
Engle Well	Culebra
Fairview Well	Dewey Lake
Mobley Ranch Well	Culebra
Poker Trap	Culebra
Ranch Well	Dewey Lake
Unger Well	Dewey Lake
USGS-1	Culebra
WQSP-1	Culebra
WQSP-2	Culebra
WQSP-3	Culebra
WQSP-4	Culebra
WQSP-5	Culebra
WQSP-6	Culebra
WQSP-6A	Dewey Lake

TABLE E1-6

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 E1-6

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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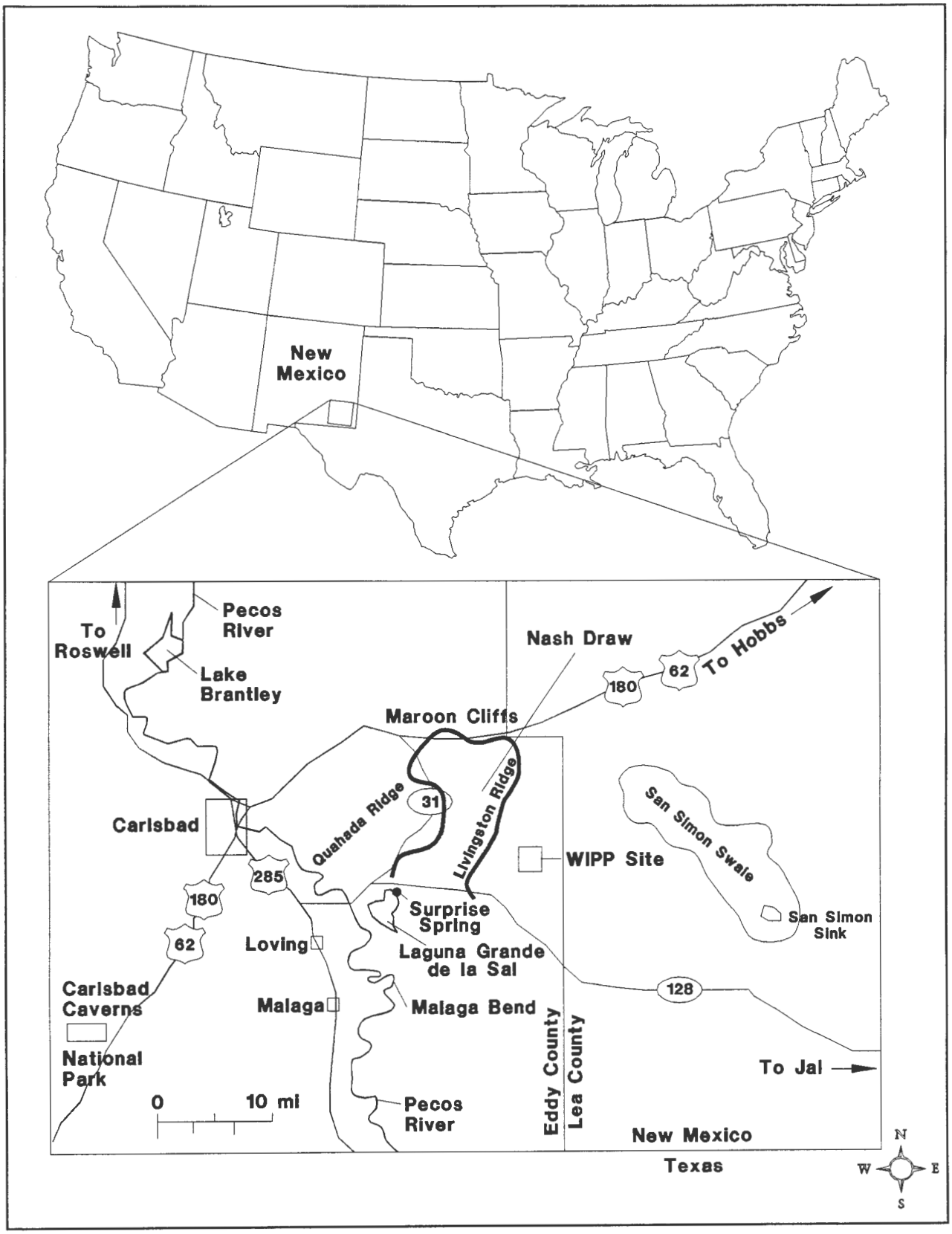

Figure E1-1
Location of the WIPP Site

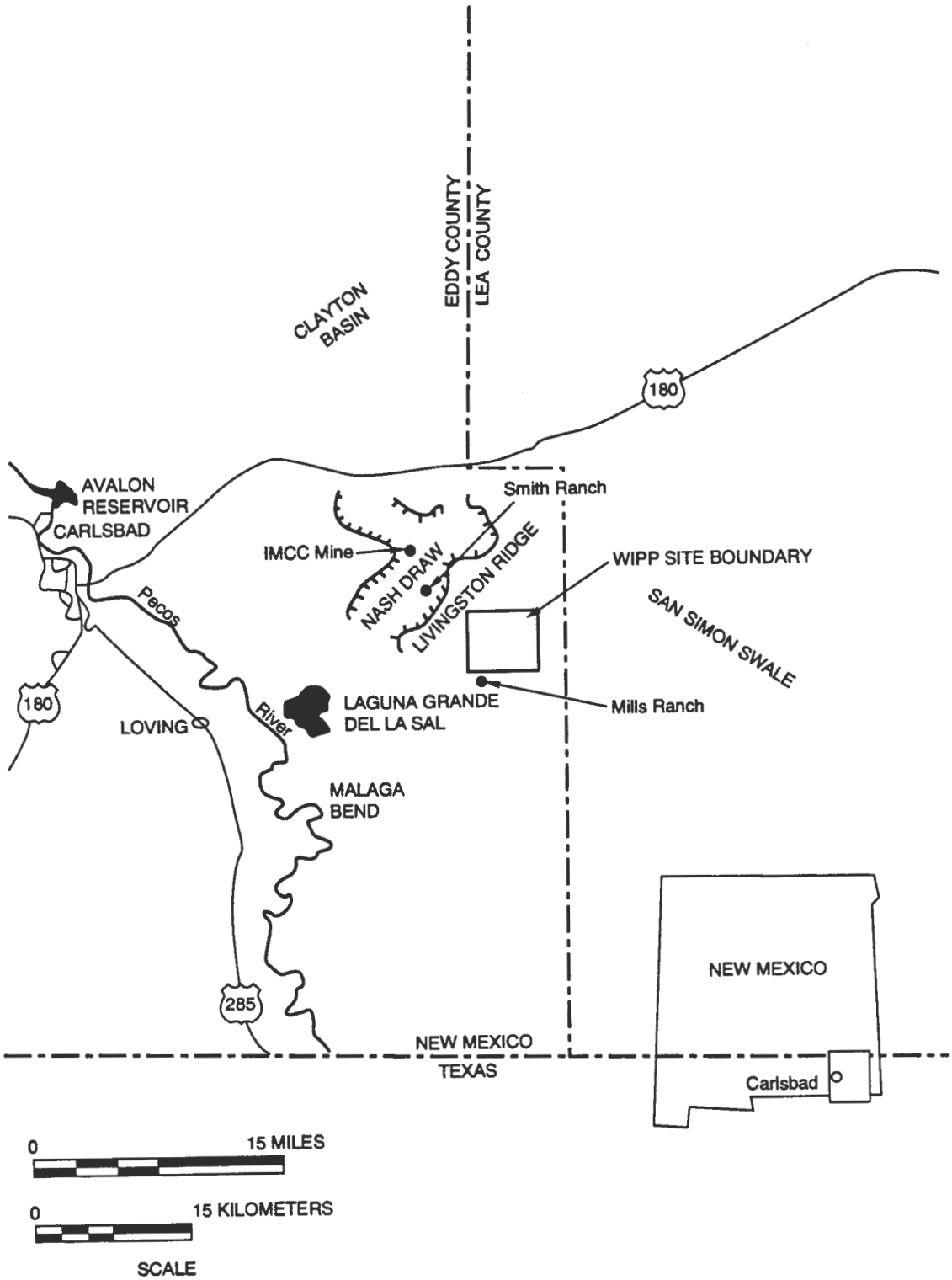

Figure E1-2
Generalized Physiographic Setting of the WIPP Facility Area

System	Series	Group	Formation	Member
Recent	Recent		Surficial Deposits	
Quaternary	Pliestocene		Mescalero Caliche	
			Gatuña	
Tertiary	Mid-Pliocene		Ogallala	
Triassic		Dockum	Santa Rosa	
Permian	Ochoan		Dewey Lake	
			Rustler	Forty-Niner
				Magenta
				Tamarisk
				Culebra
				Unnamed
			Salado	Upper
				McNutt Potash
				Lower
			Castile	
	Guadalupian	Delaware Mountain	Bell Canyon	
			Cherry Canyon	
			Brushy Canyon	

Figure E1-3
Site Geologic Column of the WIPP Vicinity

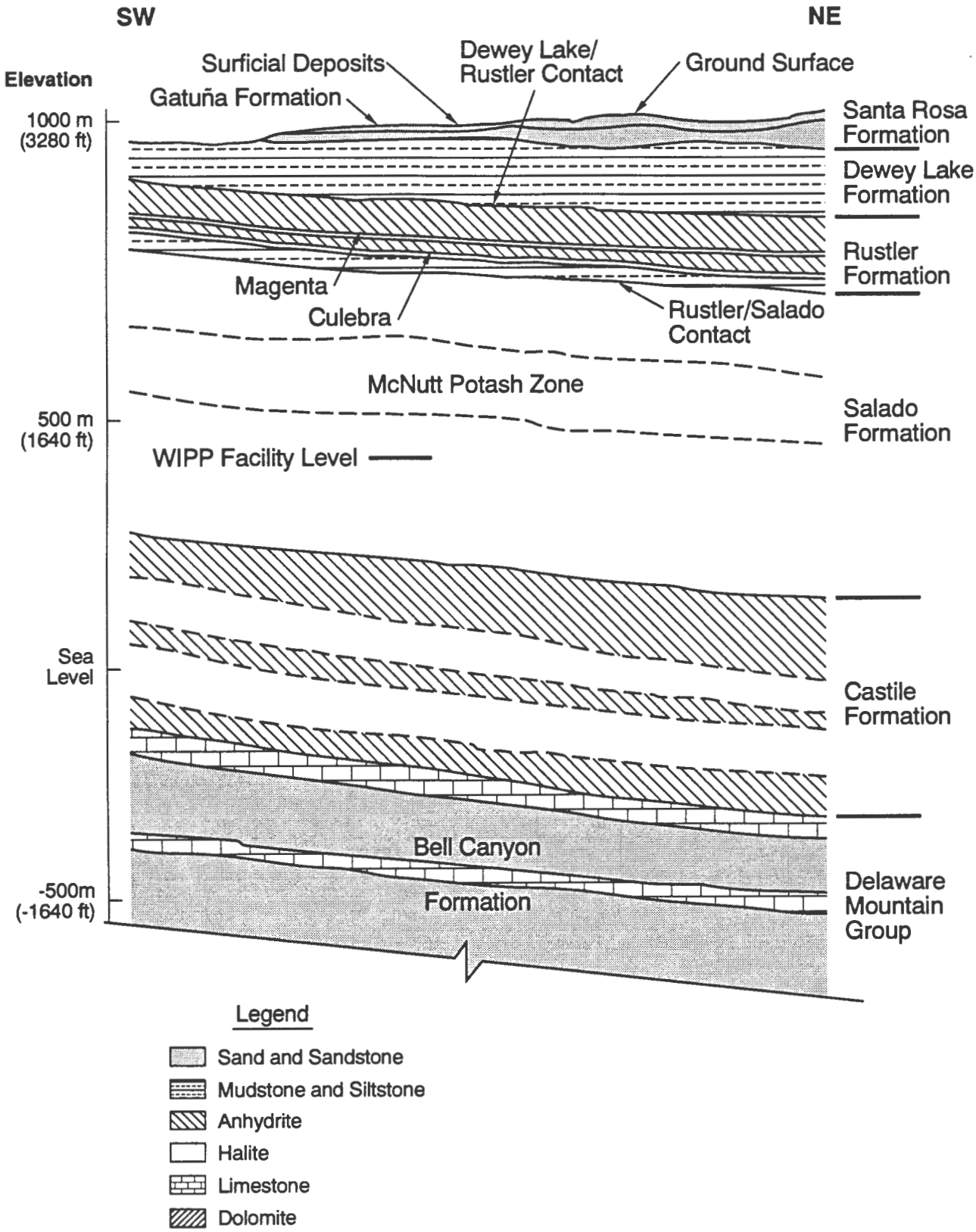

Figure E1-4
Generalized Stratigraphic Cross Section of the WIPP Vicinity

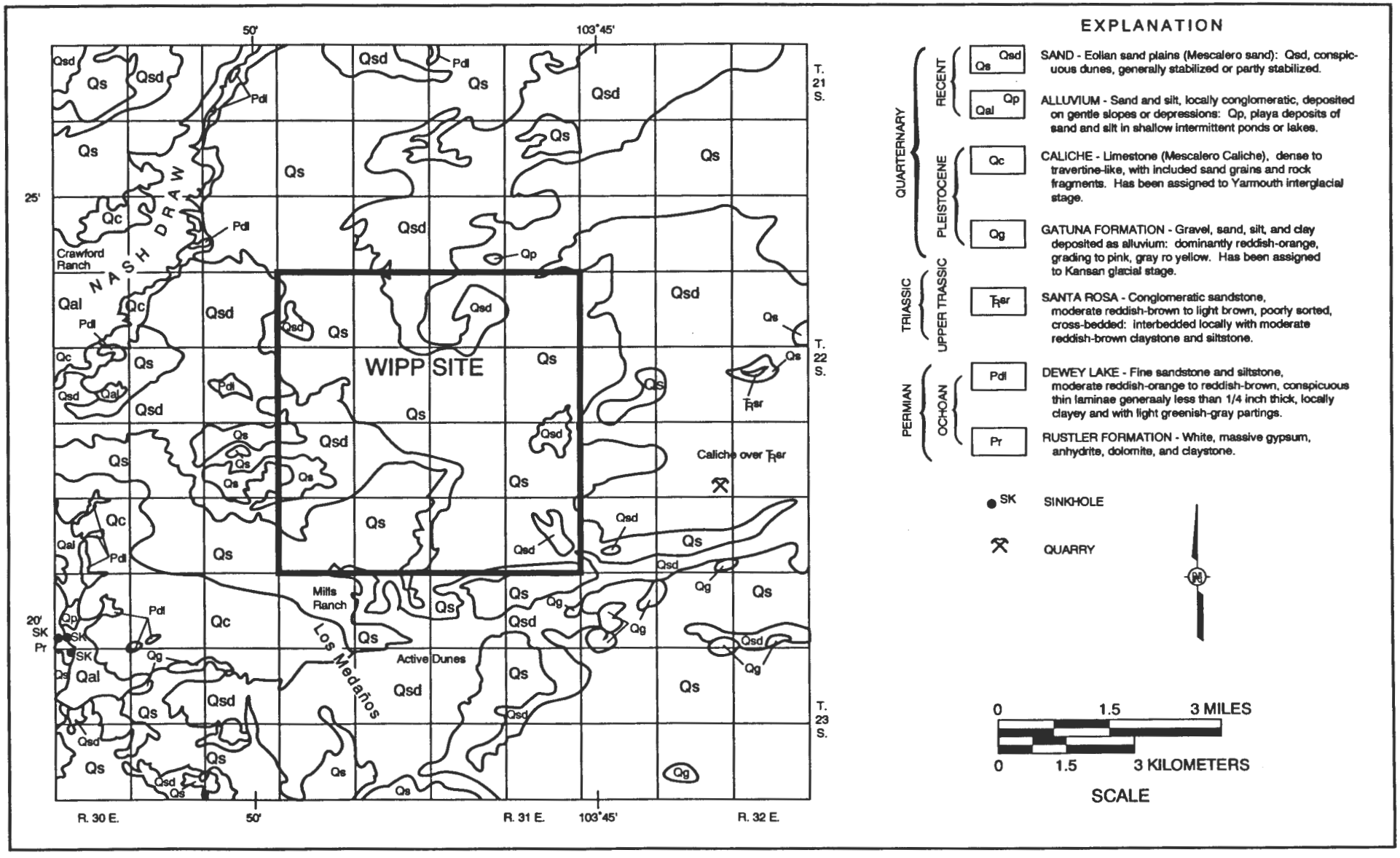

Figure E1-5
Map Of Surfical Geology

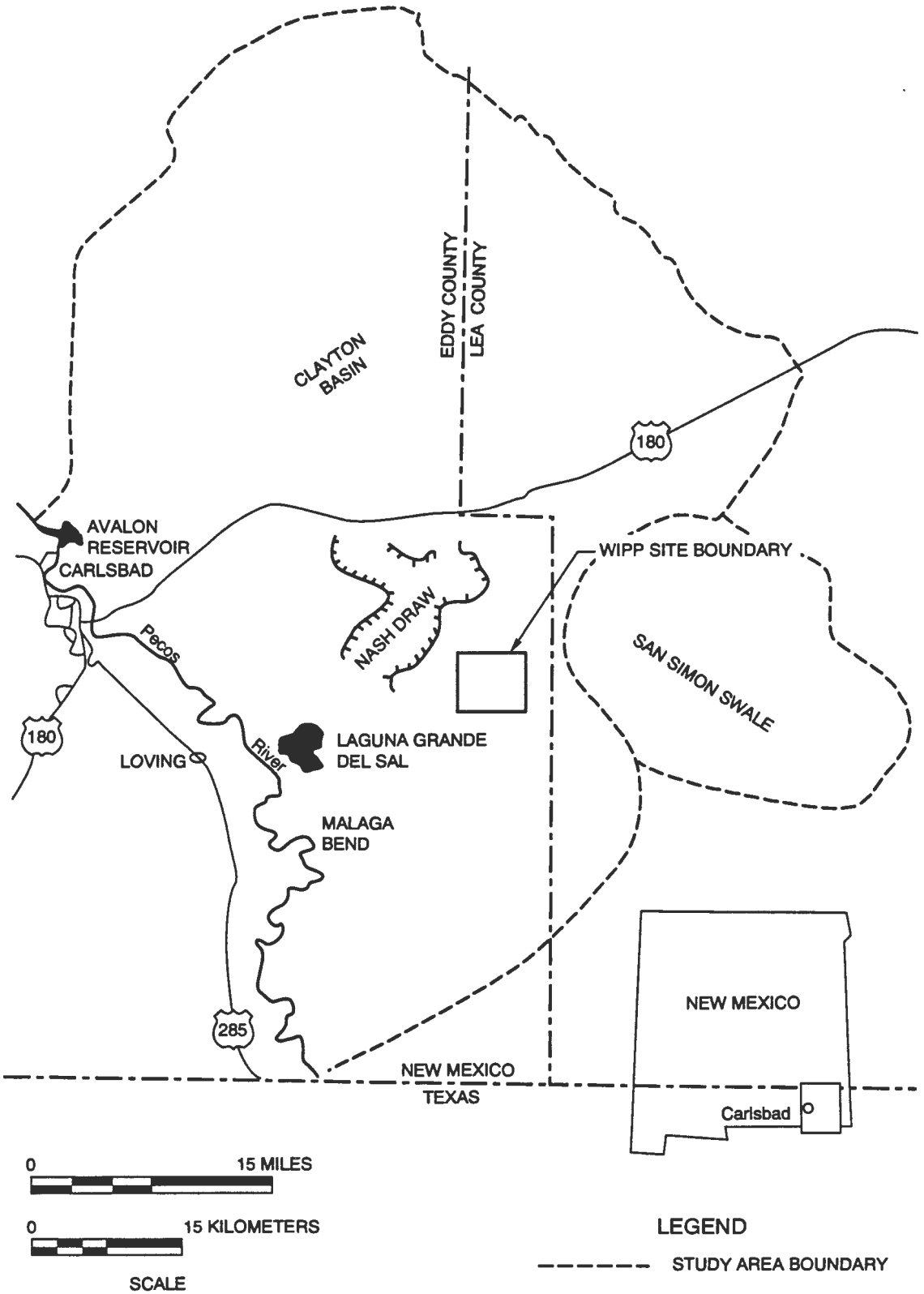

Figure E1-6
Study Area for the WIPP Water-Balance Study

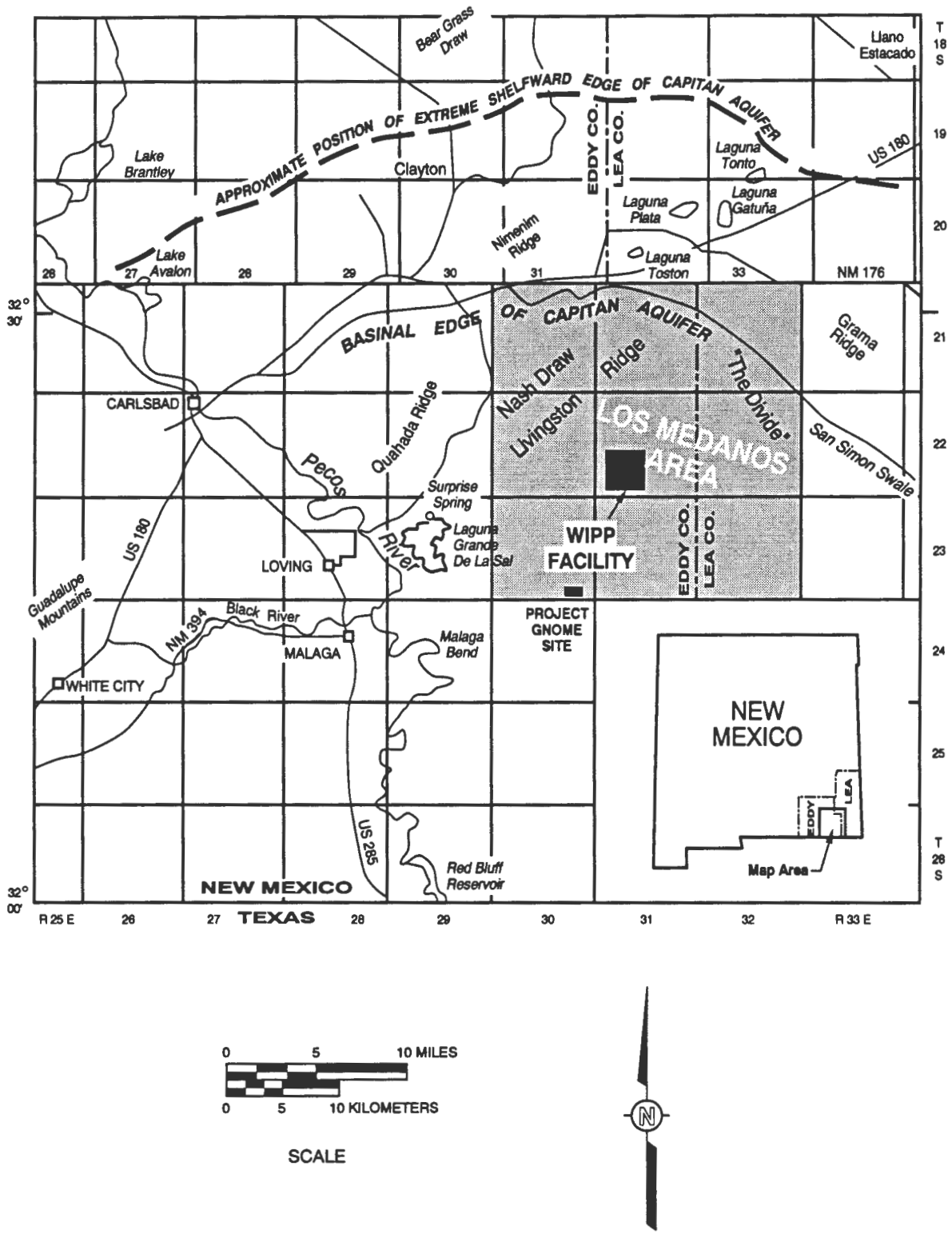

Figure E1-7
WIPP Location And Surrounding Features Contributing To WIPP Water Balance

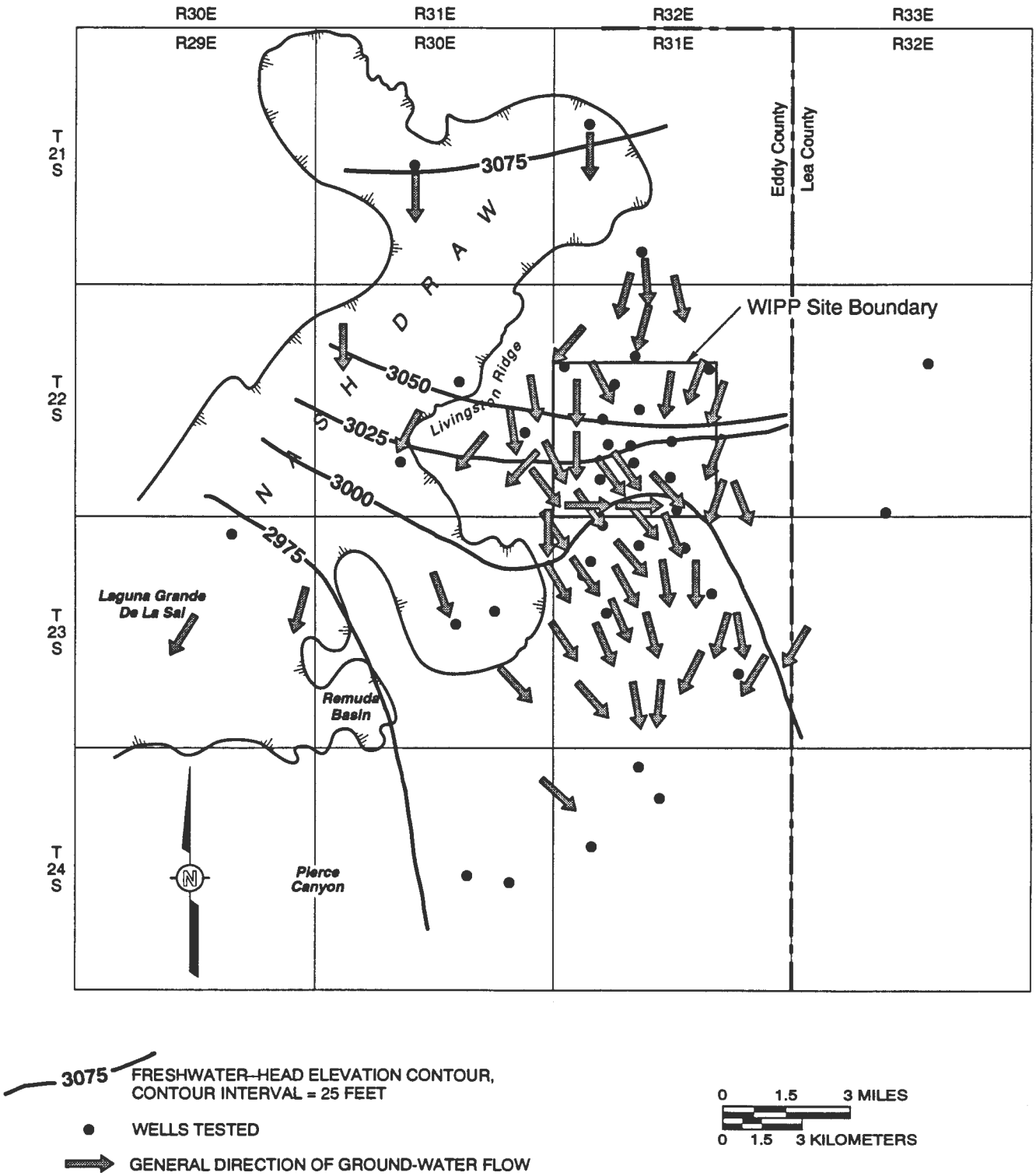

Figure E1-8
Calculated Groundwater-Flow Directions
Culebra Member of The Rustler Formation

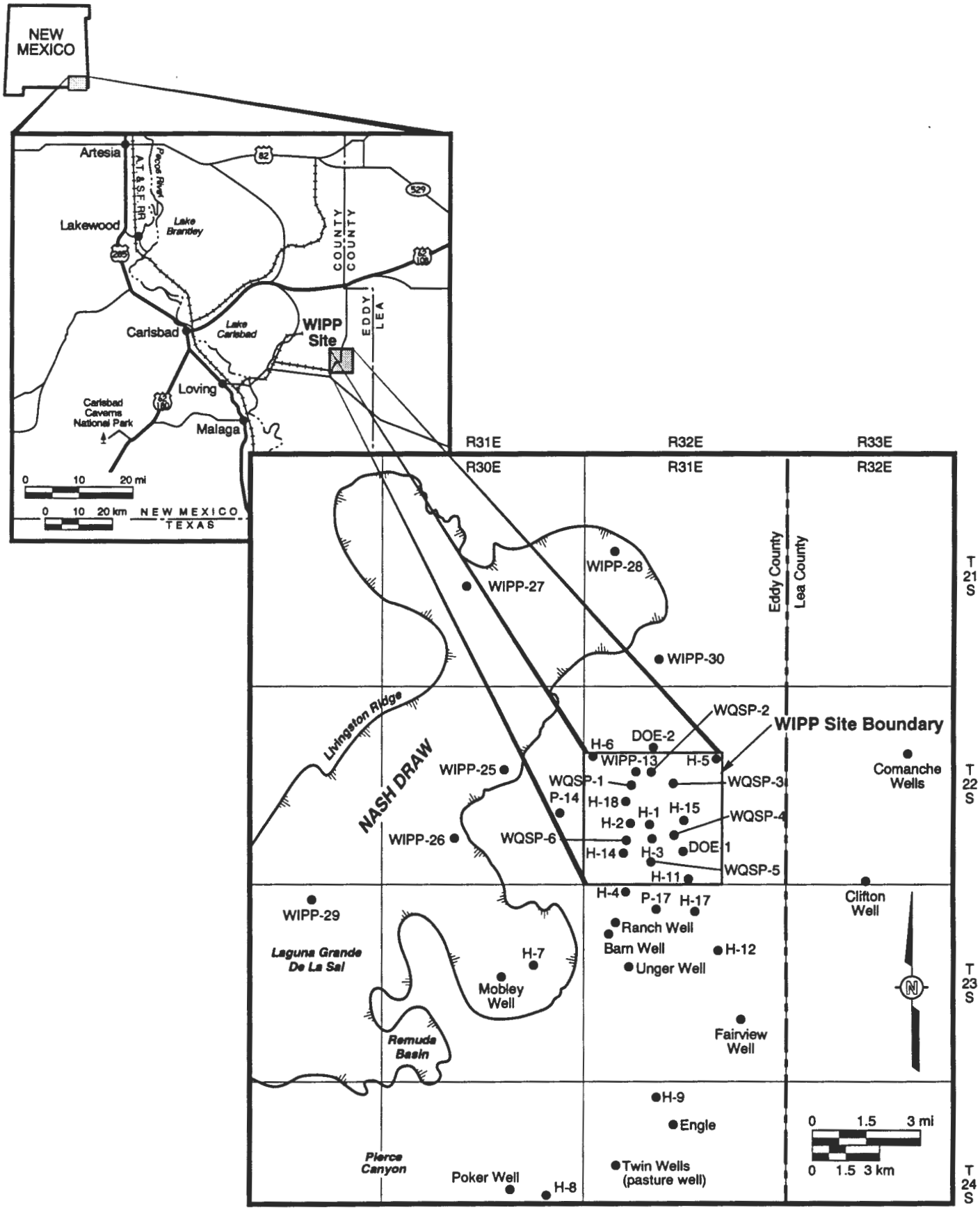

Figure E1-9
Groundwater Sampling And Private Well Locations

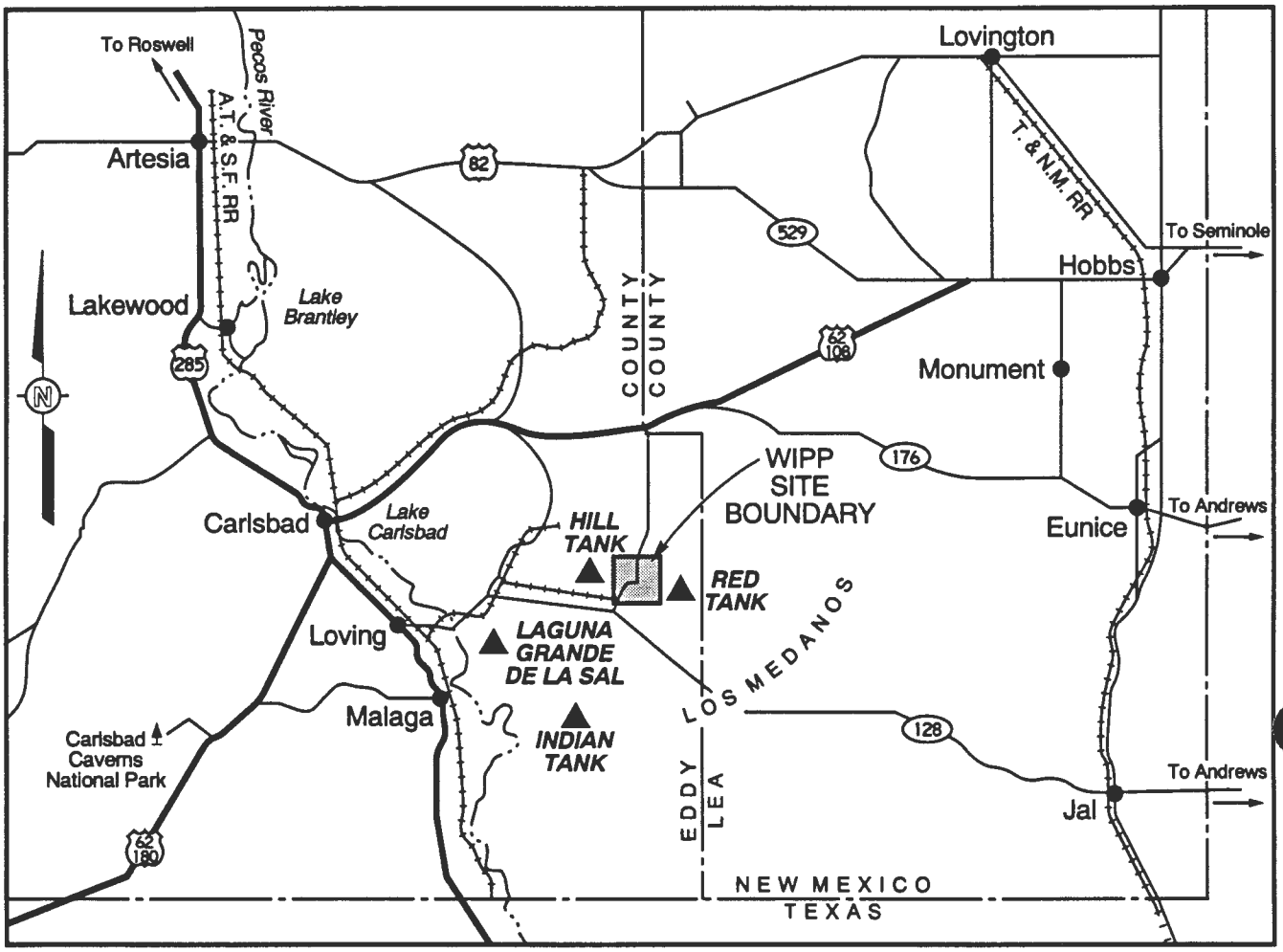

Figure E1-10
Surface-Water And Sediment Sampling Locations

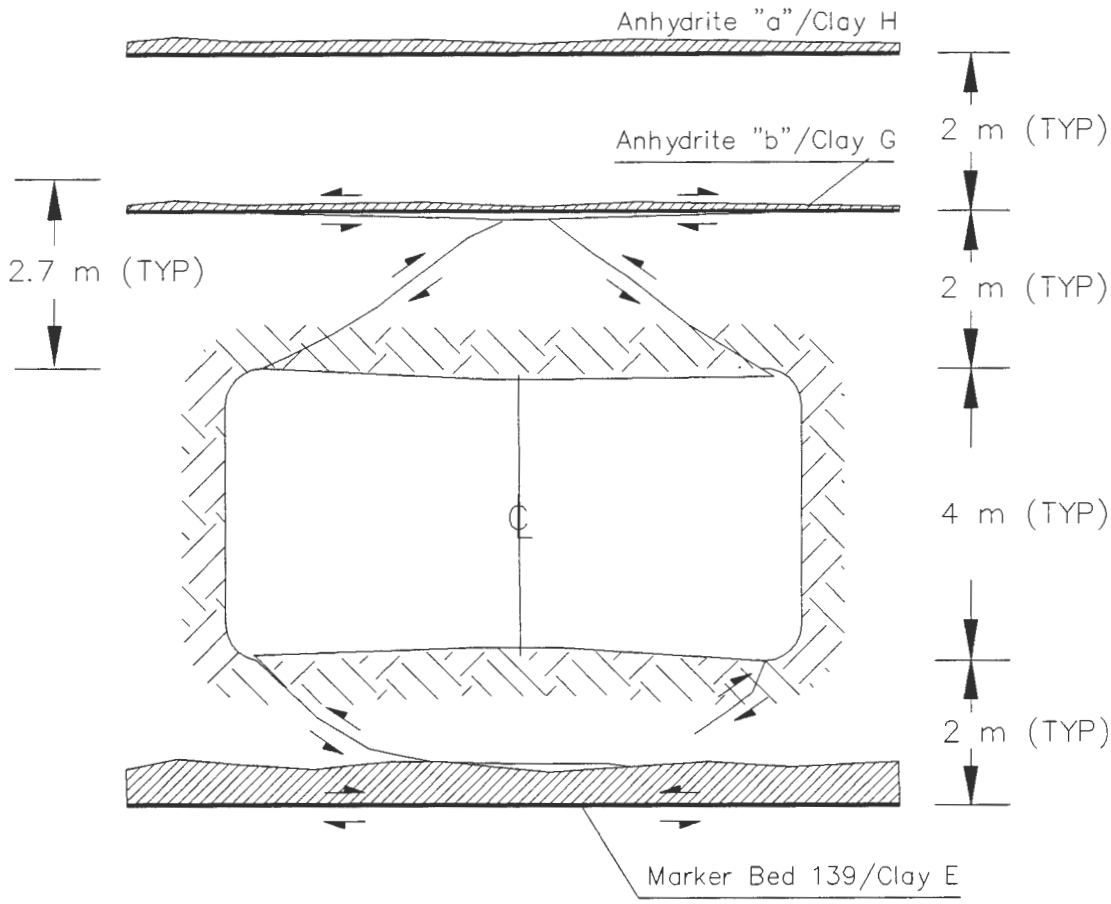

Figure E1-11
Typical Fracture Development in WIPP Excavation

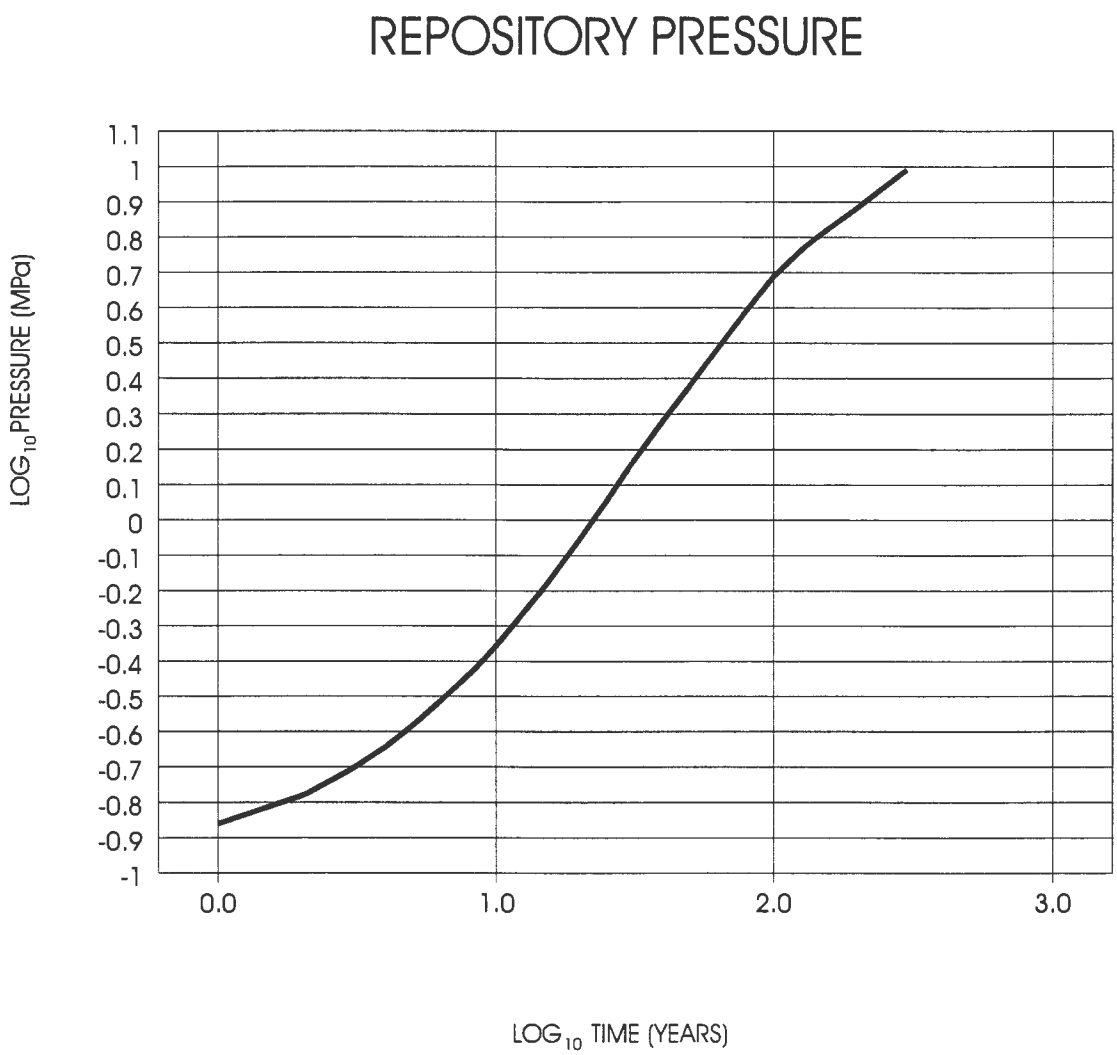

Figure E1-12

Predicted Change in Disposal Region Pressure Following Shaft Sealing

RCRAE112

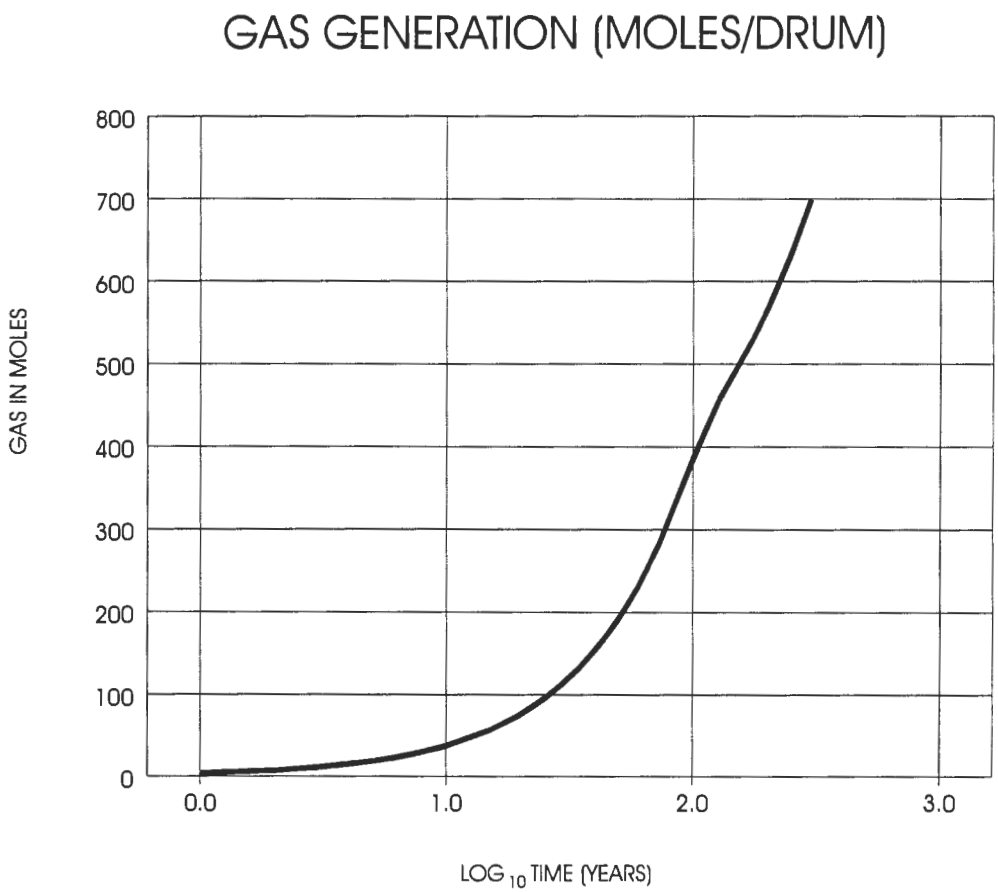

Figure E1-13

Predicted Cumulative Volume of Gas Generated Per Drum of Waste

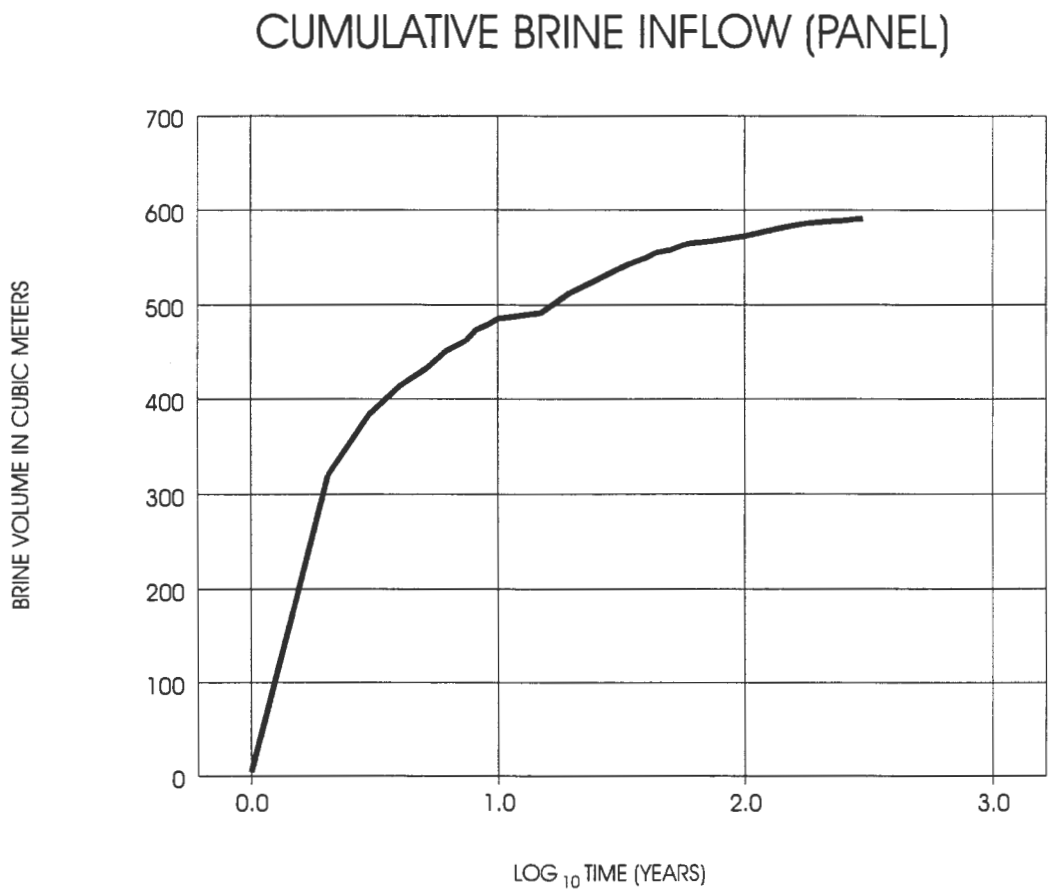

Figure E1-14

Predicted Cumulative Brine Inflow into a Closed Waste Panel

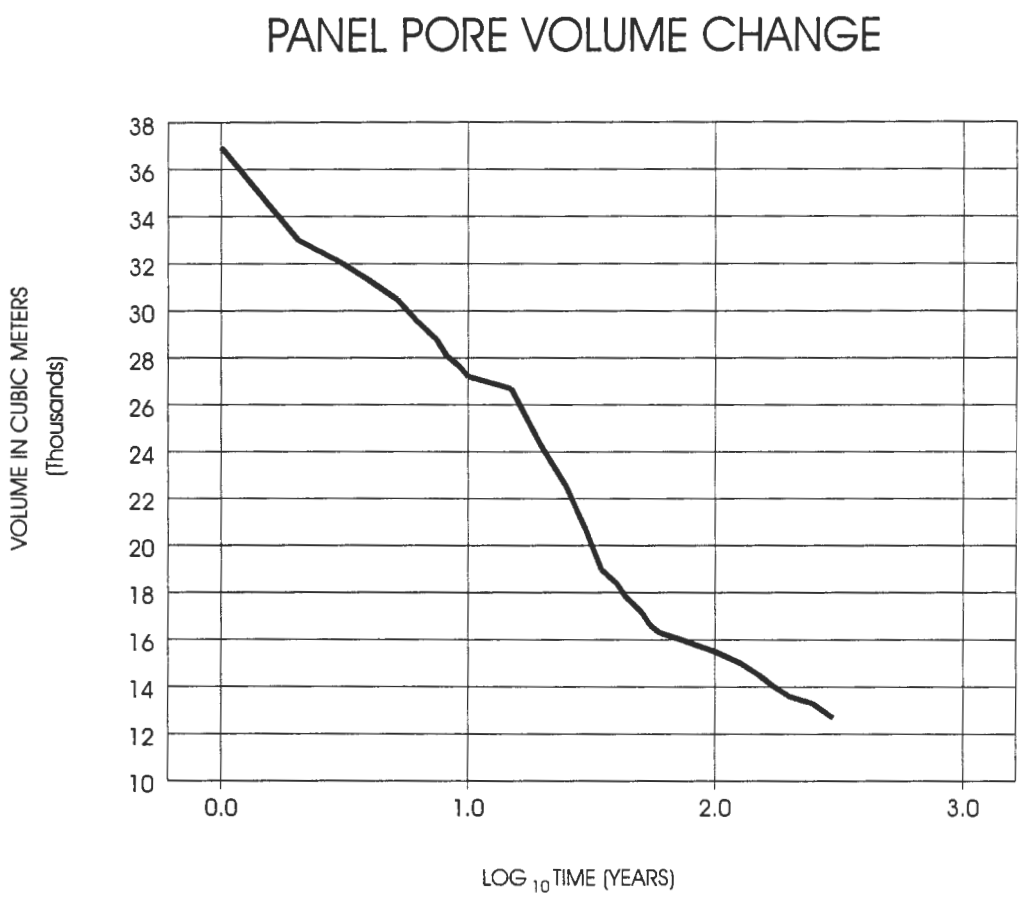

Figure E1-15

Predicted Change in Panel Pore Volume Due to Creep Closure

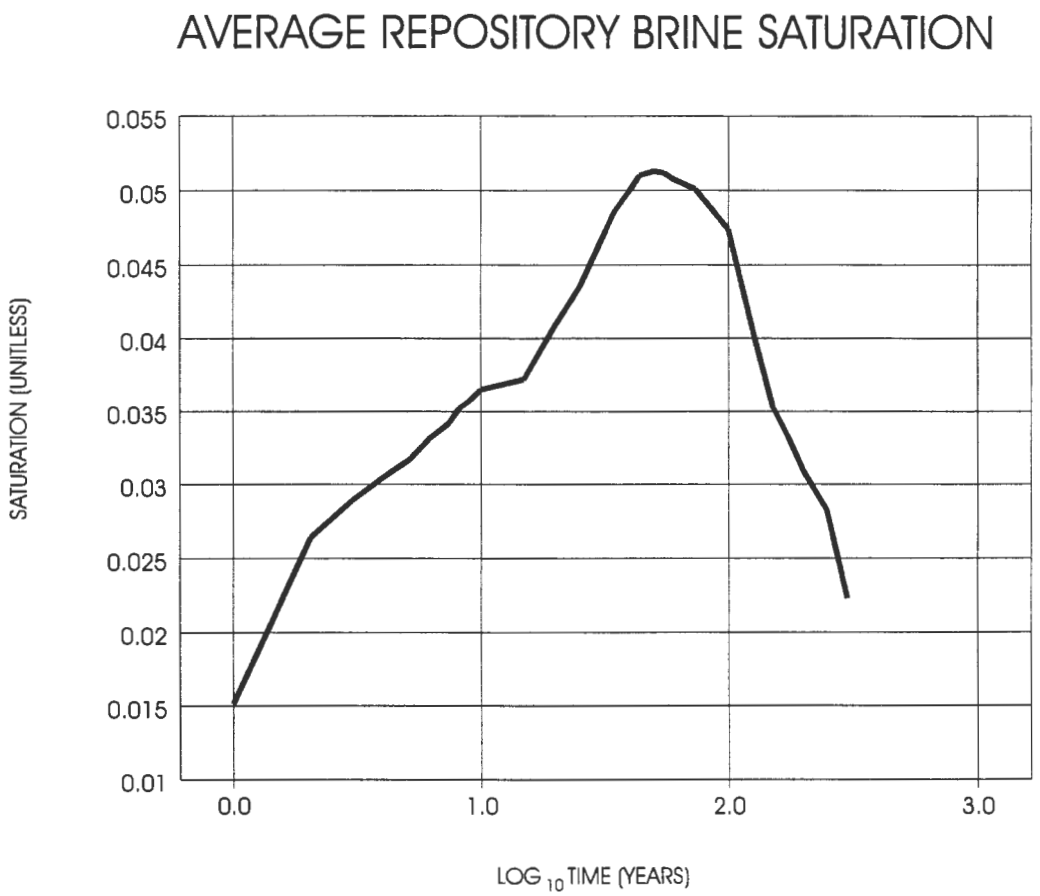

Figure E1-16

Predicted Average Brine Saturation Within the Repository

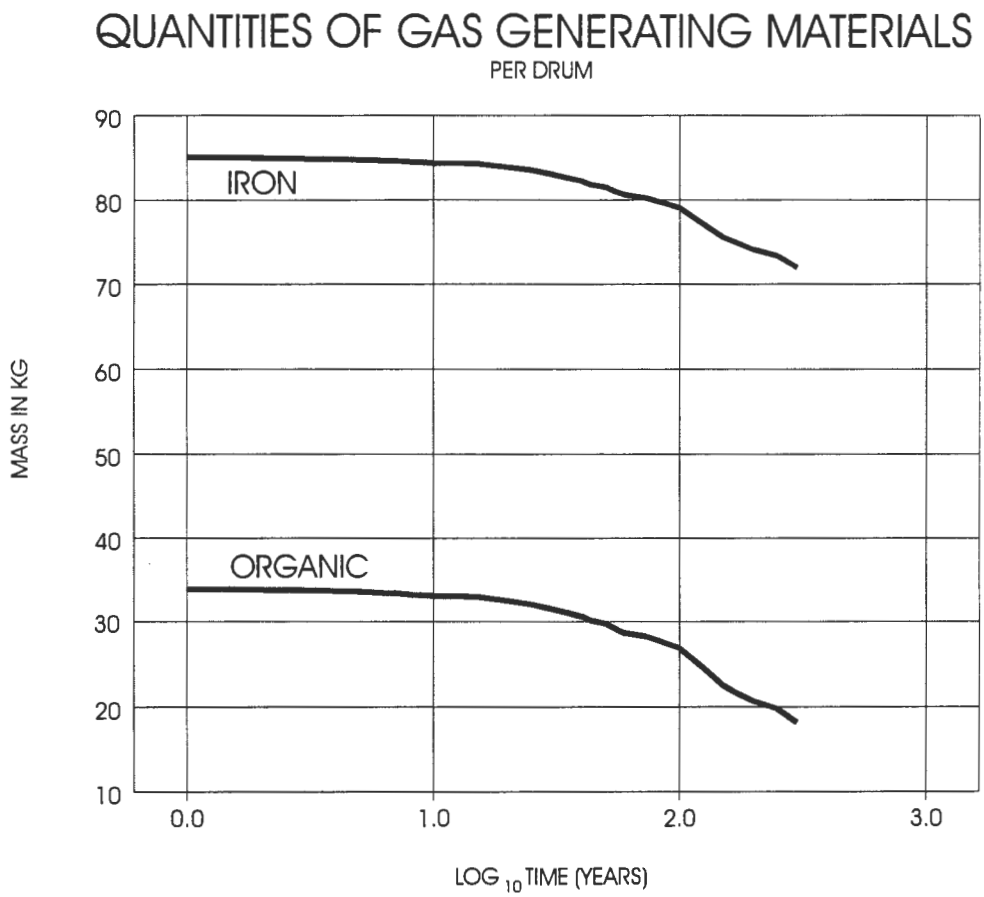

Figure E1-17

Predicted Change in the Quantity of Gas Generating Material In Each Drum

APPENDIX F1

APPENDIX F1
TABLE OF CONTENTS

CH TRU Waste Handling
Air-Intake Shaft Hoist
Ambulances and Related Emergency Supplies and Equipment
- Surface Ambulance
- Underground Ambulances

Adjustable Center of Gravity Lift Fixture
Standby/Emergency Power Backup Diesel Generators
Facility Inspections
CH TRU Underground Transporter
Conveyance Loading Car
Exhaust Shaft
Eye Wash and Shower Equipment
Fire Detection and Alarm System
Fire Extinguishers
Fire Hose Inspection Record
Fire Hydrants
Fire Pumps
Fire Sprinkler Systems
Fire Trucks
Fork Lifts Used for Waste Handling
Hazardous Material Response Equipment
Miners First Aid Station
Mine Pager Phones
Perimeter Fence, Gates, and Signs
Personal Protective Equipment
Public Address
Radiation Monitoring Equipment
Radio Equipment
Rescue Truck
- Surface R.T.
- Underground R.T.

Salt-Handling Shaft
Self Rescuers
Surface TRU Mixed Waste Handling Area
TRU Mixed Waste Decontamination Equipment
Underground Openings, Roofbolts, Travelways
Underground Geomechanical Instrumentation System (GIS)
Underground TRU Mixed Waste Disposal Area
Uninterruptible Power Supply (Central UPS)
Vehicle Siren
Ventilation Exhaust
Waste Handling Cranes
Waste Shaft Hoist

TABLE OF CONTENTS *(CONTINUED)*

Water Tank Level
Brudi
Trailer Jockey

RH-TRU Waste Handling
Canister Shuttle
Facility Cask
Facility Cask Transfer Car
Facility Cask Turntable
Facility Grapple
Fifteen-Ton Bridge Crane
Grapple Hoist—6¼ Ton
Hook and Rope on 140/25-Ton Bridge Crane
Manipulator
RH Emplacement Machine
RH Hot Cell
Road Cask Transfer Car
Twenty-Ton Fork Lift

CH-TRU WASTE HANDLING

AIR INTAKE SHAFT HOIST

AIS HOIST OPERATOR'S LOG

DATE _____

NIGHT SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.
I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____
I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____
The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

AIS HOIST INSPECTION		TIME	COMMENTARY
1. Brake Paths – Clean	☐		
2. Hoist Bearings – Oil Flow	☐		
3. Pump Reservoir – Oil Level	☐		
4. Lilly Controller	☐		
5. Hoist General	☐		
Comments: _____			
Hoistman _____ Time _____			
COLLAR INSPECTION			
1. Rope Connection	☐		
2. Cage Latches & Hinges	☐		
3. Cage Welds – No Cracks	☐		
4. Cage Phone or Radio	☐		
5. Mine Phone	☐		
6. Collar Doors	☐		
Comments: _____			
Toplander _____ Time _____			
STATION INSPECTION			
1. Ground Control & Sta. Steel	☐		
2. Station Housekeeping	☐		
3. Safety Gates – No Damage	☐		
4. Shaft Water – Tanks	☐		
5. Mine Phone	☐		
Comments: _____			
Bottomlander _____ Time _____			
GALLOWAY INSPECTION			
1. All Communications	☐		
2. Rope Connections	☐		
3. Structure Welds – No Cracks	☐		
4. Trap Doors & Wings	☐		
5. Fire Extinguisher – Charged	☐		
6. First Aid Kit – Usable	☐		
Comments: _____			
Operator _____ Time _____			

DAY SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.
I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____
I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____
The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

AIS HOIST INSPECTION		TIME	COMMENTARY
1. Brake Paths – Clean	☐		
2. Hoist Bearings – Oil Flow	☐		
3. Pump Reservoir – Oil Level	☐		
4. Lilly Controller	☐		
5. Hoist General	☐		
Comments: _____			
Hoistman _____ Time _____			
COLLAR INSPECTION			
1. Rope Connection	☐		
2. Cage Latches & Hinges	☐		
3. Cage Welds – No Cracks	☐		
4. Cage Phone or Radio	☐		
5. Mine Phone	☐		
6. Collar Doors	☐		
Comments: _____			
Toplander _____ Time _____			
STATION INSPECTION			
1. Ground Control & Sta. Steel	☐		
2. Station Housekeeping	☐		
3. Safety Gates – No Damage	☐		
4. Shaft Water – Tanks	☐		
5. Mine Phone	☐		
Comments: _____			
Bottomlander _____ Time _____			
GALLOWAY INSPECTION			
1. All Communications	☐		
2. Rope Connections	☐		
3. Structure Welds – No Cracks	☐		
4. Trap Doors & Wings	☐		
5. Fire Extinguisher – Charged	☐		
6. First Aid Kit – Usable	☐		
Comments: _____			
Operator _____ Time _____			

SWING SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.
I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____
I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____
The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

AIS HOIST INSPECTION		TIME	COMMENTARY
1. Brake Paths – Clean	☐		
2. Hoist Bearings – Oil Flow	☐		
3. Pump Reservoir – Oil Level	☐		
4. Lilly Controller	☐		
5. Hoist General	☐		
Comments: _____			
Hoistman _____ Time _____			
COLLAR INSPECTION			
1. Rope Connection	☐		
2. Cage Latches & Hinges	☐		
3. Cage Welds – No Cracks	☐		
4. Cage Phone or Radio	☐		
5. Mine Phone	☐		
6. Collar Doors	☐		
Comments: _____			
Toplander _____ Time _____			
STATION INSPECTION			
1. Ground Control & Sta. Steel	☐		
2. Station Housekeeping	☐		
3. Safety Gates – No Damage	☐		
4. Shaft Water – Tanks	☐		
5. Mine Phone	☐		
Comments: _____			
Bottomlander _____ Time _____			
GALLOWAY INSPECTION			
1. All Communications	☐		
2. Rope Connections	☐		
3. Structure Welds – No Cracks	☐		
4. Trap Doors & Wings	☐		
5. Fire Extinguisher – Charged	☐		
6. First Aid Kit – Usable	☐		
Comments: _____			
Operator _____ Time _____			

SPECIAL INSTRUCTIONS

Requires Time, Date & Authorized Signature

_____

SHAFT INSPECTION RECORD

Date _____ MAINT. PIC _____

INSTRUCTIONS

W-Weekly B-Bi-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

CIRCLE THE PM# PERFORMED & THE INTERVAL.

ITEM EXAMINED	OK	SEE COMMENTS
33-H-001 AIS SHAFT	W – – Q	– A
33-H-007 AIS WIRE ROPES	– BW – –	SA –
GALLOWAY		
SHAFT LINER		
WATER RINGS & DRAINS		
WALL ROCK & BROW		
CONVEYANCE		
CABLES, PIPES & SUPPORTS		
TRACK LIMIT SWITCH		

SIGN OR INITIAL THESE COLUMNS

COMMENTS

SIGNATURE SHAFTS SUPERVISOR (OPS) _____

WP Form 1758; 03/26/93

Page 2 of 2

HOISTING MACHINERY RECORD

MECHANICAL

Date _____ MAINT. PIC _____

INSTRUCTIONS

W-Weekly B-Bi-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

CIRCLE THE PM# PERFORMED & THE INTERVAL.

PM#	DESCRIPTION	INTERVAL
33-G-001	AIR COMP.	W M – Q – –
33-H-001	AIS HOIST	W – – – – –
33-H-002	AIS HEADFRAME	W – – – – –
33-H-006	HYDE WINCH-EAST	– M – – – –
33-H-009	LILLY CONTROLLER	– M – – – –
33-H-010	NEW ERA WINCH-WEST	– M – Q – A
33-H-011	NEW ERA WINCH-EAST	– M – Q – A

COMMENTS

SIGNATURE HOIST SUPERVISOR (OPS) _____

ELECTRICAL HOISTING EQUIPMENT RECORD

Date _____ PIC (Maint) _____

INSTRUCTIONS

W-Weekly B-Bi-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

CIRCLE THE PM# PERFORMED & THE INTERVAL.

PM#	DESCRIPTION	INTERVAL
33-HM-001	AIS HOIST MOTOR	– – – – S –
33-H-006	HYDE WINCH-EAST	– – – – S –
33-HS-011A	M/S-EAST GALLOWAY WINCH	– – – – S A
33-HS-010A	M/S-WEST GALLOWAY WINCH	– – – – S A
33P-CP-04/1	GALLOWAY CONTROL PANEL	– – – – S –
33P-RB-04/1	HOIST CONTROLLER	– – – – S –
33P-CP-03/1	DYNAMIC BRAKE CONTROLLER	– – – – S –

COMMENTS

SIGNATURE HOIST SUPERVISOR (OPS) _____

AMBULANCE AND RELATED EMERGENCY SUPPLIES AND EQUIPMENT

SURFACE AMBULANCE

WEEKLY CHECK LIST

Ambulance #1 (Surface)

Date:_____

Ambulance

_✓_ OK _X_ Adjustment made _O_ Repairs required

A/R written _____ A/R number _____

(check appropriate information)

ITEM	Condition	Min. #	Current #	Remedial Actions
Seat Belts		N/A	N/A	
Headlights		N/A	N/A	
Emergency Warning Lights		N/A	N/A	
Brake Lights		N/A	N/A	
Back Alarm		N/A	N/A	
Horn		N/A	N/A	
Brake Fluid Level		N/A	N/A	
Emergency Brake		N/A	N/A	
Fire Extinguisher		N/A	N/A	
Test Drive		N/A	N/A	
Forward		N/A	N/A	
Reverse		N/A	N/A	
Handling		N/A	N/A	
Braking		N/A	N/A	
Vehicle Sirens		N/A	N/A	
Battery Terminals		N/A	N/A	
Cellular Phone		N/A	N/A	
Radio		N/A	N/A	
Body Condition		N/A	N/A	

WEEKLY CHECK LIST (cont.)
Ambulance #1 (Surface)

Date:_____

ITEMS	Condition	Min. #	Current #	Remedial Actions
TIRE PRESSURE (60 psi)				
Right Front Tire		N/A	N/A	
Right Rear Tire		N/A	N/A	
Left Rear Tire		N/A	N/A	
Left Front Tire		N/A	N/A	
M.A.S.T. (antishock trousers)		1 pr.		
monitor/defibrillator		1		
Oxygen: Size "D" cylinders		2		
Oxygen: Size "M" cylinder		1		
Resuscitators (Bag): Adult		2		
Resuscitator (Bag): Child		1		
Adult traction splint, lower extremity, with limb supporting slings, padded ankle hitch and traction device		1		
Rigid splint device (board) or equivalent for lower extremities		2		
Rigid splint device (board) or equivalent for upper extremities		2		
Stretcher or scoop		2		
Airsplint: Set of 6		2		

WEEKLY CHECK LIST (cont.)
Ambulance #1 (Surface)

Date:_____

ITEM	Condition	Min. #	Current #	Remedial Actions
Gurney		1		
Spine Board; short (K.E.D/CPR board)		1		
Spine Board; long		1		
Portable suction unit		1		
Blankets		2		
Transfer Sheets	N/A	2		
Trauma Kit: includes the following:		1		
Adult Blood Pressure Cuff and Stethoscope		1		
Penlight		1		
Oropharyngeal Airway		1		
Soft Roller Bandages	N/A	4		
Triangular Bandages	N/A	3		
Band-aids	N/A	1 pkg.		
4x4 Sponges	N/A	25		
Roll Adhesive tape	N/A	1		
Bite Stick	N/A	1		
Trauma Dressing	N/A	2		
Sterile Burn Sheet	N/A	1		
Glucose Substance	N/A	1		
Sterile Gauze Dressings	N/A	2		

WEEKLY CHECK LIST (cont.)
Ambulance #1 (Surface)

Date:_____

ITEMS	Condition	Min. #	Current #	Remedial Actions
First Aid Supplies in addition to Trauma Kit				
Soft Roller Bandages	N/A	12		
Triangular bandages, 40"	N/A	6		
Box band-aids	N/A	1		
Bandage Shears	N/A	1pr.		
Trauma Dressings, 30" x 10"	N/A	6		
Trauma Dressings, 5" x 7"	N/A	6		
4" x 4" Sponges	N/A	50		
Rolls Adhesive Tape	N/A	2		
Penlight		1		
Sterile Burn Sheets	N/A	2		
Oropharyngeal Airway; Adult		2		
Oropharyngeal Airway; Child		2		
Oropharyngeal Airway; Infant		2		
Occlusive Dressings	N/A	3		
Roll Aluminum Foil	N/A	3		
Rigid Cervical Collars; Small		2		
Rigid Cervical Collars; Medium		2		
Rigid Cervical Collars; Large		2		

WEEKLY CHECK LIST (cont.)
Ambulance #1 (Surface)

ITEMS	Condition	Min. #	Current #	Remedial Action
Test strip expiration		5		
Cold Packs	N/A	4		
Heat Packs	N/A	4		
Bite Sticks	N/A	2		
IV Start Kits	N/A	2		
#16 g Angiosets	N/A	2		
#18 g Angiosets	N/A	2		
#20 g Angiosets	N/A	2		
1000cc LR IV Fluid	N/A	1		
500cc NS IV Fluid	N/A	1		

Inspected by:_____ time:_____ date:_____

Reviewed by:_____

Nature of repairs:_____

_____

UNDERGROUND AMBULANCE

WEEKLY CHECK LIST
Ambulance (Underground)

Date:_____

Ambulance (underground)

_✓_ OK _X_ Adjustment made _O_ Repairs required

A/R written _____ A/R number _____
(check appropriate information)

ITEM	Condition	Min. #	Current #	Remedial Actions
Seat Belts		N/A	N/A	
Headlights		N/A	N/A	
Emergency Warning Lights		N/A	N/A	
Brake Lights		N/A	N/A	
Back Alarm		N/A	N/A	
Horn		N/A	N/A	
Brake Fluid Level		N/A	N/A	
Emergency Brake		N/A	N/A	
Fire Extinguisher		N/A	N/A	
Test Drive		N/A	N/A	
Forward		N/A	N/A	
Reverse		N/A	N/A	
Handling		N/A	N/A	
Braking		N/A	N/A	
Unit Clean		N/A	N/A	
Body Condition		N/A	N/A	
Battery Terminals		N/A	N/A	
TIRE PRESSURES (60 psi)				
Left front tire		N/A	N/A	
Left rear tire		N/A	N/A	
Right front tire		N/A	N/A	
Right rear tire		N/A	N/A	

WEEKLY CHECK LIST (cont.)
Ambulance (Underground)

Date:_____

ITEM	Condition	Min. #	Current #	Remedial Action
EQUIPMENT				
M.A.S.T (antishock trousers)		1 pr.		
Monitor/Defibrillator		1		
Oxygen: Size "D" cylinders		2		
Oxygen: Size "E" cylinder		2		
Resuscitators (Bag): Adult		2		
Adult traction splint, lower extremity, with limb supporting slings, padded ankle hitch and traction device		1		
Rigid splint device (board) for upper extremities		2		
Rigid splint device (board) for lower extremities		2		
Airsplints: Set of 6		1		
Spine Board; long		1		
Stretcher or scoop		2		
Portable suction unit		1		
Blankets		2		
Transfer Sheets	N/A	2		
IV Start Kits	N/A	2		
#16 g Angiosets	N/A	2		
#18 g Angiosets	N/A	2		
#20 g Angiosets	N/A	2		
1000cc LR IV Fluid	N/A	1		
500cc NS IV Fluid	N/A	1		

WEEKLY CHECK LIST (cont.)
Ambulance (Underground)

Date:_____

ITEMS	Condition	Min. #	Current #	Remedial Action
Rigid cervical collars		2		
Test strip expiration		5		
Cold packs	N/A	4		
Heat packs	N/A	4		
Trauma Kit: includes the following	N/A	1		
Trauma Dressings	N/A	2		
4x4 sponges	N/A	25		
Roll Adhesive tape	N/A	1		
Bite Stick	N/A	1		
Sterile Burn Sheet	N/A	1		
Glucose Substance	N/A	1		
Sterile Gauze Dressings	N/A	2		
Triangular bandages	N/A	3		
band-aids	N/A	1 pkg.		
Soft Roller Bandages	N/A	4		
Penlight		1		
Oropharyngeal Airway		1		
Adult blood pressure cuff and stethoscope		1		

Inspected by:_____ time:_____ date:_____

Reviewed by:_____

Nature of repairs:_____

_____

ADJUSTABLE CENTER OF GRAVITY LIFT FIXTURE

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ATTACHMENT 1

ACGLF Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding Deficiencies and PWRs.

2.0 Inspect the following for tightness, wear, or damage:

[] • Shackles

[] • Bolts

[] • Kellum Grips

[] • Cables

[] 3.0 Inspect the gears for obstructions.

4.0 Verify the counterweights are in the following positions:

[] 4.1 Counterweight No. 1 is at 180°.

[] 4.2 Counterweight No. 2 is at 360°.

[] 5.0 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, **THEN** record the Load Test Due and the Due Date in the Equipment Logbook.

6.0 Energize the ACGLF as follows:

[] 6.1 Verify the electric power supply cord is connected to the ACGLF Control Panel.

[] 6.2 Verify the electric power supply cord is plugged into the electrical receptacle.

[] 6.3 Verify both cables from the Lift Fixture are connected to the Control Panel.

[] 6.4 Perform the following as applicable:

6.4.1 For 41-T-177, turn the red POWER switch to ON and verify the switch backlights.

6.4.2 For ACGLF 41-T-170, verify the green POWER light is on.

[] 7.0 Raise the ACGLF off the floor to test lifting legs.

ACGLF Preoperational Checks (Continued)

[] 8.0 Hold LIFTING LEGS, NO. 1, 2 and 3 switch in LOCK.

[] 8.1 Verify LOCK 1 indicator illuminates.

[] 8.2 Verify LOCK 2 indicator illuminates.

[] 8.3 Verify LOCK 3 indicator illuminates.

[] 8.4 Verify Lifting Legs rotate to the LOCKED position.

[] 9.0 Hold LIFTING LEGS, UNLOCK ENABLE switch in ON **AND** hold LIFTING LEGS, NO. 1, 2 and 3 switch in UNLOCK.

[] 9.1 Verify UNLOCK 1 indicator illuminates.

[] 9.2 Verify UNLOCK 2 indicator illuminates.

[] 9.3 Verify UNLOCK 3 indicator illuminates.

[] 9.4 Verify Lifting Legs rotate to UNLOCKED position.

[] 10.0 Lower the ACGLF to the floor to test the counterweights.

[] 11.0 Test Counterweight No. 1 rotation and indication as follows:

[] 11.1 Hold BALANCE ROTATION NO. 1 switch in CW (Clockwise).

[] 11.2 Verify the counterweight moves clockwise.

[] 11.3 Verify the BALANCE POSITION indicates the change in weight position.

[] 11.4 Hold BALANCE ROTATION NO. 1 switch in CCW (Counter-clockwise).

[] 11.5 Verify the counterweight moves counter-clockwise.

[] 11.6 Verify the BALANCE POSITION indicates the change in weight position.

[] 11.7 Position the weight at 180°, using the BALANCE ROTATION NO. 1 switch.

ACGLF Preoperational Checks (Continued)

[] 12.0 Test Counterweight No. 2 rotation and indication as follows:

[] 12.1 Hold the BALANCE ROTATION NO. 2 switch in CW.

[] 12.2 Verify the counterweight moves clockwise.

[] 12.3 Verify the BALANCE POSITION indicates the change in weight position.

[] 12.4- Hold the BALANCE ROTATION NO. 2 switch in CCW.

[] 12.5 Verify the counterweight moves counter-clockwise.

[] 12.6 Verify the BALANCE POSITION indicates the change in weight position.

[] 12.7 Position the weight at 360°, using BALANCE the ROTATION NO. 2 switch.

[] 13.0 Initiate PWRs to address any deficiencies that CANNOT be corrected by Waste Handling Operations.

[] 14.0 Notify the WHS of deficiencies discovered during checks and their status (corrected, PWR generated, etc.).

15.0 Record the following information in the Equipment Logbook:

[] 15.1 Checks satisfactory or unsatisfactory.

[] 15.2 Any discovered deficiencies **NOT** corrected.

[] 15.3 Any outstanding/newly generated PWRs.

[] 16.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

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STANDBY/EMERGENCY POWER BACKUP DIESEL GENERATORS

Work Order : 9509129 Type : P PLANNED
Status : 70 SCHEDULED

Description: 25PE504 MNG DIESEL GEN OPS TEST (RCRA)

Priority : 4 SCORE - 40 ON RISK CHART
Class : 4M4

Project :
Account : P15230201
Department : FACOP
Assigned To :
Contact :
Requested : PROCTOL
Requested Date: 11/30/95
Requested Time: 0905
Task Id : WP04-ED-1301
Reference Id : WP04-ED-1301

Equipment : 25P-E-504
Name : BACKUP POWER SUPPLY DG #2
Design Class: IIIA
System : ED09
Parent :
Building : 255.2
Floor :
Room :

Work Description

WORKING COPY
[✓] Revision Checked
[✓] Page Checked
NAME Lwade
SIGN
DATE 12/12/95

********** Work Order Line Item **********

Step : 001 Seq : 000 Status : 20 SCHEDULED
Need Date : 12/09/95 Crew: FO Shift : D Trade: FOTEC
Schedule Date: 12/09/95
Department : FACOP NoteBook:

Short Description: 25PE504 MNG DIESEL GEN OPS TEST

Long Description
25PE504 MNG DIESEL GEN OPS TEST

ORIGINAL

Tagout/Lockout Y (N) No.	
Release/Date RWA 12/9/95	Work Group Supv Release/Date NA
Work Performed: REPAIRED CB-11 sub 3 12/11/95. OPERABILITY CHECK SAT 12/12/95 #2 OPERABILITY Test Failed when CB-11 sub 3 unable to Remain closed to continue. AR written. Test Will BE Rescheduled.	
Man Hours:	Craft Signature:
WORK COMP/DATE OPS RWA 12/12/95	RETEST COMP/DATE NA
OPS CANCELLATION/DATE NA	WORK COMP/DATE WGS NA

DIESEL GENERATOR # _____ LOG

DATE:		GENERATOR PARAMETERS				ENGINE PARAMETER									
		ALTERNATING CURRENT (A)				TEMPERATURES			PRESSURES (B)		DIFFERENTIALS (B)		RPM	LEVELS (B)	
TAKEN BY (INITIALS)	TIME: 24hr CLOCK	KILOWATTS	VOLTS	AMPERES	HERTZ	JACKET WTR (F°)	OIL TEMP IN (F°)	OIL TEMP OUT (F°)	ENG OIL (PSI)	FUEL (PSI)	FUEL FLT (PSID)	OIL FLTR (PSID)	TACH-OMETER	FUEL LEVEL	COOLANT LEVEL
	LOGS TAKEN 1/2 HOUR	< 1100	470-490 ~~460-500~~	< 1700	58-62	200 < ~~203~~	< 230		> 50	50 70	5 < ~~15~~	< 15	1790 - 1850 ~~< 1800~~	> 1/4	> 1/4

NOTES: (A) - GENERATOR READINGS SHALL BE TAKEN ONLY WHEN D/G IS OPERATING UP TO SPEED AND EXCITED. (B) Check for fuel, oil, and coolant leaks or spills. Note Discrepancies in the comment section.

COMMENTS:

REVIEWER:

FOM REVIEW:

SIGNATURE AND DATE IN THIS BLOCK BY A FOSS CONSTITUTES VALIDATION OF THIS RECORD.

PRINTED NAME SIGNATURE DATE

FACILITY INSPECTIONS

Attachment 2 - Facility Inspection Report

FACILITY INSPECTION REPORT

DATE: _____

BUILDING/FACILITY NO: _____ BUILDING/FACILITY NAME: _____

INSPECTION TEAM MEMBERS
(List by Name and Organization)

I. COMPONENT CONDITION/DEFICIENCIES

TYPE OF DEFICIENCY	CONDITION [1]		
	FAIL/POOR	ADQ/FAIR	GOOD/EXC
A. STRUCTURAL			
FOUNDATION			
ROOF			
EXTERIOR CLOSURES			
INTERIOR CONSTRUCTION			
FLOORS			
DOORS			
STAIRS			
B. ELECTRICAL			
WIRING			
EXPOSED CONDUITS			
EXPOSED GROUNDING CONNECTIONS			
03 CONTROLS			
SWITCHES			
OUTLETS			
POLARITY/ GROUND CONTINUITY TESTS			
PANEL SCHEDULE AVAILABLE (located inside panels)			Y N

[1] Serious structural, mechanical, and electrical deficiencies noted during the Facility inspection are to be followed up with a complete Condition Assessment Survey (CAS) inspection, as specified by DOE Order 4320.2(A), Capital Asset Management Process. A systematically applied CAS assesses the condition of one capital asset or a group of capital assets, and determines that asset's remaining useful life to facilitate time-phased budgeting of maintenance, repair, rehabilitation or repair to facilities.

Attachment 2 - Facility Inspection Report

FACILITY INSPECTION REPORT

DATE: _____

BUILDING/FACILITY NO: BUILDING/FACILITY NAME:

I. COMPONENT CONDITION/DEFICIENCIES (continued)

TYPE OF DEFICIENCY	CONDITION		
	FAIL/POOR	ADQ/FAIR	GOOD/EXC
C. MECHANICAL			
HEATING			
AIR CONDITIONING			
PIPING			
VENTILATION			
DOOR CONTROLS			
D. SITEWORK			
ROAD SURFACE			
WALKWAYS			
ROAD SHOULDERS			
CULVERTS			
CATTLEGUARDS			
BERMS[2]			
E. OTHER			
LIGHTING			
CARPET			
PAINT FININSH			
CEILING			
OTHER			

2 As part of the Resource Conservation and Recovery Act (RCRA) Part B Permit Application, the site's water diversion berms, located outside the site's secured area, are required to be inspected on an annual basis. Berm locations are shown in Figure 1.

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Attachment 2 - Facility Inspection Report

II. OVERALL CONDITION SUMMARY

Inspector's Name | Inspector's Signature

VERIFICATION

Name | Signature

III. DEFICIENCIES REQUIRING IMMEDIATE CORRECTION

WORK REQUIRED	WORK REQUEST ~~No~~ ISSUED

02

IV. OTHER DEFICIENCIES

WORK REQUIRED	WORK REQUEST ~~No~~ ISSUED

02

Attachment ~~2~~ 1 - Facility Inspection Report Instructions

Instructions for completing the Facility Inspection Report:

1. CAMP personnel, provide the following information:

   - Date
   - Building/Facility Name
   - Building/Facility No: (As determined from the Preventive Maintenance Schedule.)
   - Component Condition/Deficiencies: (Conditions are determined for different types of deficiencies by corresponding departments.)
   - Overall Condition Summary: (General condition of facility based on condition/deficiency information.)
   - Inspector's name
   - ~~Action Request Numbers for Deficiencies Requiring Immediate Correction, and Other Deficiencies. (The type of deficiency is determined by the appropriate Work Control Zone and concurred with by the Facility Inspection Coordinator.)~~ See * below

2. Cognizant ~~Manager~~ Supervisor or Team Leader, complete the Verification section of the Report.

3. Inspection team members, affix signatures to the Facility Inspection Report as evidence of concurrance with findings.

* INDICATE TYPE OF Work Request initiated

CH TRU UNDERGROUND TRANSPORTER

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ATTACHMENT 1

CH TRU Underground Transporter Preoperational Checks

[] 1.0 Prior to operation of the U/G Transporter, contact the CMRO or the U/G FOSS to determine IF the status of U/G ventilation will allow operation of the Transporter.

[] 2.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 3.0 Record the Engine Revolution (x 100,000) Meter reading in the Equipment Logbook.

[] 4.0 Inspect the area around the Transporter for the following:

- Obstacles that may be damaged by transporter
- Obstacles that could cause damage to Transporter

5.0 Inspect the following prior to starting the engine:

[] 5.1 Engine oil level is in the COLD LEVEL range on the dipstick.

[] 5.2 Transmission oil level is in the COLD LEVEL range on the dipstick.

5.3 Hydraulic tank level should be as follows:

[] 5.3.1 Above the lower sightgage.

[] 5.3.2 Below the upper sightgage.

[] 5.4 Battery Compartment is free from acid spills and has no loose or missing caps or cables.

[] 5.5 Air Cleaner Indicator is Yellow.

[] 5.5.1 Clean the dust collector discharge slot.

[] 5.5.2 IF the Filter Indicator locks in RED, notify Maintenance to service the air filter.

[] 5.6 Belts NOT loose, worn, cracked, or gouged.

[] 5.7 Seat Belts in good condition.

CH TRU Underground Transporter Preoperational Checks (Continued)

5.8 General Condition is as follows:

[] • NO damage or loose parts

[] • NO oil leaks, grease, oil, or trash

5.9 General condition of tires are as follows:

[] • NOT excessively worn or cracked and inflated to the proper pressure

[] • All wheel lugs tightened

[] 6.0 Turn the Battery Disconnect Switch to ON and inspect the following:

[] 6.1 Sufficient fuel for intended operations.

[] 6.2 Pedals and Levers are NOT loose or sticking.

[] 6.3 Fire suppression system test is satisfactory.

CAUTION

This caution applies to Step 6.4. Do NOT use brake fluid in Brake System. Fill reservoir with mineral-based oil only.

[] 6.4 Brake actuator fluid level is within the HI and LOW level marks.

[] 6.5 Horn sounds when operated.

[] 7.0 Verify the Frame Joint Safety Bar is NOT connected.

8.0 Verify proper operation of lights by placing the Light Switch in the following positions:

[] Position 2: Engine end lights and red tail lights illuminate

[] Position 3: All utility end lights illuminate

[] Position 4: All lights illuminate

[] Position 1: All lights are off

CH TRU Underground Transporter Preoperational Checks (Continued)

9.0 Start the engine as follows:

[] 9.1 Shift the transmission to "N" (Neutral).

[] 9.2 Push in the Parking/Emergency Brake Button to engage the parking brake.

[] 9.3 Push in the Engine Start Knob.

[] 9.4 For cold starts, turn the Start Switch to "1" and hold until the Preheat Indicator glows.

[] 9.5 Turn the Start Switch to "2", and hold until the engine starts.

[] 9.6 Allow the engine to idle at low rpm for about 2 minutes.

9.7 Verify the following:

[] • Engine oil pressure: 25 - 35 psi

[] • Voltmeter: indicates 24 - 30 volts

[] • Overheat Indicator "STOP" Light NOT on

[] • Air Pressure: 90 - 105 psi

[] 9.8 IF indications are NOT within normal range, stop the engine immediately by pulling out the Engine Stop Knob.

[] 9.9 Verify the Horn sounds when operated.

10.0 Test the parking brake as follows:

[] 10.1 Push in the Parking/Emergency Brake Button to engage the parking brake.

[] 10.2 Shift the transmission to "F" (Forward) or "R" (reverse).

[] 10.3 Shift the gear lever to "2" (Second gear).

[] 10.4 Press the accelerator and apply full engine power (2300 rpm).

[] 10.5 Verify the Transporter does NOT move.

ATTACHMENT 1

CH TRU Underground Transporter Preoperational Checks (Continued)

[] 10.6 Shift the transmission to "N" (Neutral).

11.0 Perform the following to complete tests:

[] 11.1 Turn the Light Switch to "4" (all lights are illuminated).

[] 11.2 Press and hold down the brake pedal.

[] 11.3 Check the Air Pressure Gage and Low Pressure Warning Lights.

[] 11.4 Shift the transmission to "F" (Forward).

[] 11.5 Shift the gear lever to "1" (Low gear).

[] 11.6 Release the parking brake by pulling out the Parking/Emergency Brake Button.

[] 11.7 Drive the Transporter in forward and reverse, and test the following:

[] 11.7.1 Steering operates smoothly and does NOT pull to either right or left.

[] 11.7.2 Brakes appear to be in good condition and DO NOT drag when operated.

[] 11.8 Stop the Transporter.

[] 11.9 Shift the transmission to "N" (Neutral).

[] 11.10 Push in the Parking/Emergency Brake Button to engage the parking brake.

[] 11.11 Pull out the Engine Stop Knob.

[] 11.12 **WHEN** the engine has stopped, **THEN** push in the Engine Stop Knob.

[] 11.13 Turn the Battery Disconnect Switch to OFF.

CH TRU Underground Transporter Preoperational Checks (Continued)

[] 12.0 Initiate PWRs to address any deficiencies that CANNOT be corrected by Waste Handling Operations.

[] 13.0 Notify the WHS of any deficiencies discovered during the preoperational checks and their status (corrected, PWR generated, etc.).

14.0 Record the following in the Equipment Logbook:

[] 14.1 Check satisfactory or unsatisfactory.

[] 14.2 Addition of oil, water or other fluids and the amount added.

[] 14.3 Identified deficiencies that were NOT corrected.

[] 14.4 Outstanding/newly generated PWRs.

[] 15.0 Enter the date and time, then sign the Equipment Logbook to document the last performance of the preoperational checks.

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CONVEYANCE LOADING CAR

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CONVEYANCE LOADING CAR PREOPERATIONAL CHECKS

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

2.0 Prior to moving the Car verify the following:

[] 2.1 General Condition: No damage, loose parts, oil leaks, grease, oil, or trash.

[] 2.2 Gear Box Oil Level: Level is above the LOWER LEVEL mark.

[] 2.3 Power cable on POWER REEL 411-CP04/20 is properly wound on the cable wheel.

[] 2.4 Tracks are clear of obstacles.

[] 2.5 All guards are in their proper place.

3.0 Start the Car at CONTROL PANEL 411-CP04/20, located on the wall in the Loading Room, as follows:

[] 3.1 Verify Circuit Breaker CABLE REEL 41-P-004C POWER FOR 41-HM-018A CONVEYANCE LOADING CAR MOTOR VIA 41P-SW04/39 & 411-CP04/20, on 41P-MCC04/1 GROUND VESTIBULE, is in the ON position.

[] 3.2 <u>IF</u> the power cable is NOT connected to the Car, perform the following:

[] 3.2.1 Verify 480V DISC. SW. 41P-SW04/39 is in the OFF position.

[] 3.2.2 Connect the power cable to the Car.

3.3 Verify Reflectors are attached to the following:

[] • Facility Pallet

[] • Door #140

[] • Facility Pallet Support Stands in the Hoist Cage

CONVEYANCE LOADING CAR PREOPERATIONAL CHECKS (Continued)

[] 3.4 Verify both Light Transmitters are attached to the Car.

[] 3.5 Place 480V DISC. SW. 41P-SW04/39 in the ON position.

[] 3.6 Turn the SYSTEM ON-OFF KEY SWITCH to the ON position.

[] 3.7 Momentarily press SYSTEM START PUSHBUTTON.

[] 3.8 Verify the red POWER Light illuminates.

4.0 Perform the following operational checks:

[] 4.1 Move the UP-DOWN joystick to UP.

[] 4.1.1 Verify the RAISE Light illuminates.

[] 4.1.2 Check the upper limit.

[] 4.2 Move the UP-DOWN joystick to DOWN.

[] 4.2.1 Verify the LOWER Light illuminates.

[] 4.2.2 Check the lower limit.

[] 4.3 Verify the SENSOR SELECTOR is in TRAM.

[] 4.4 Hold in SENSOR BYPASS PUSHBUTTON while moving the FWD-REV joystick to the FWD position.

[] 4.5 Release the SENSOR BYPASS PUSHBUTTON.

[] 4.5.1 Verify the FWD Light illuminates.

[] 4.5.2 Confirm the forward tram.

[] 4.6 Hold in the SENSOR BYPASS PUSHBUTTON, while moving the FWD-REV joystick to the REV position.

[] 4.7 Release the SENSOR BYPASS PUSHBUTTON.

[] 4.7.1 Verify the REV Light illuminates.

[] 4.7.2 Confirm the reverse tram.

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CONVEYANCE LOADING CAR PREOPERATIONAL CHECKS (Continued)

[] 5.0 IF the System is to be shut down, perform the following:

[] 5.1 Turn the SYSTEM ON-OFF KEY SWITCH to the OFF position.

[] 5.2 Place 480V DISC. SW. 41P-SW04/39 in the OFF position.

[] 6.0 Initiate PWRs to resolve any deficiencies which CANNOT be corrected by Waste Operations.

[] 7.0 Notify the WHS of any deficiencies discovered during the checks and their status (such as deficiencies corrected and Plant Work Request generated).

[] 8.0 Record the following information in the Equipment Logbook:

[] 8.1 Preoperational Checks satisfactory or unsatisfactory.

[] 8.2 Identified deficiencies NOT corrected.

[] 8.3 Outstanding/newly generated PWRs.

[] 9.0 Record the date and time, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

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EXHAUST SHAFT

INFORMATION ONLY

DATE: 05/18/95 ***** C H A M P S *****
TIME: 11:09 A.M. Work Order Step/Text Master
****

Work Order : 9503765 Type : P PLANNED
Status : ~~60~~ 70 READY FOR SCHED

Description: 351FAC EXHAUST SHAFT (FAC 351) INSPECT

Priority : 2 SCORE - 20 ON RISK CHART
Class : 4M2

Project :
Account :
Department : UGOPS

Assigned To :
Contact :
Requested : POTTERD
Requested Date: 05/18/95
Requested Time: 1108

Task Id : PM041099
Reference Id : PM041099

RCRA

Equipment : FAC 351
Name : EXHAUST SHAFT
Design Class:
System : UH08
Parent :

Building :
Floor :
Room :

Work Description
MO

********** Work Order Line Item **********

Step : 001 Seq : 000 Status : 60 READY FOR SCHEDULING
Need Date : 06/19/95 Crew: Z5 Shift : D Trade: HMECH
Schedule Date:
Department : UGOPS Notebook:

Short Description: 351 FAC EXHAUST SHAFT INSPECTION

Long Description
351 FAC EXHAUST SHAFT INSPECTION

Tagout/Lockout Y N No.	
Release/Date T. [illegible] 5-19-95	Work Group Supv Release/Date T. [illegible] 5-19-95
Work Performed: performed Exhaust shaft inspection no changes from the last inspection	
Man Hours: 6hr x 4men Craft Signature: Robby Mudrall	
WORK COMP/DATE OPS T. [illegible] 5-19-95	RETEST COMP/DATE N/A
OPS CANCELLATION/DATE	WORK COMP/DATE WGS T. [illegible] 5-19-95

RECORD

4

INFORMATION ONLY

WASTE ISOLATION PILOT PLANT

MAINTENANCE PROCEDURE

CONTROLLED COPY NUMBER: _____

PROCEDURE NUMBER: PM041099 REVISION: 0F3

DATE OF ISSUE: 12/04/92

APPLICABLE TO: EXHAUST SHAFT DISCIPLINE: MINE OPS

SYSTEM: UH08

EXHAUST SHAFT INSPECTION

NON LCO/OSR

TEMPORARY PROCEDURE
Approved for use from
12/04/92
UNTIL
RECEIPT OF WASTE

PREPARED BY: Original signed by Chuck Druce DATE: 10/20/92

VALIDATED BY: Original signed by Curtis McAvoy DATE: 10/21/92

APPROVED BY: Original signed by Fred Ashford DATE: 10/07/92

LIST OF EFFECTIVE PAGES

PAGE	REVISION
1-16	0F3

CHANGE HISTORY

This procedure supersedes FAC 351 E06C

MFCN	PAGE
PM041099.0F1	4, 11, 15
PM041099.0F2	5, 11, 12
PM041099.0F3	7, 14

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1.0 TITLE

QUARTERLY EXHAUST SHAFT INSPECTION

2.0 PURPOSE

This procedure provides the steps required to perform the QUARTERLY Exhaust Shaft Inspection, using a remotely operated camera. This procedure is to be used during the start up phase of WIPP and may be used until the receipt of waste.

3.0 REFERENCES

3.1 Procedures

WP 10-WC3004, Preventive Maintenance Administration

WP 12-1, WIPP Site Safety Manual

WP 13-003, Non-Conformance Item Control

3.2 Manufacturer's Manuals

Laval O&M Manual

3.3 Drawings

NONE

4.0 PREREQUISITES

4.1 Notify CMR Operator prior to entry and upon exit.

4.2 Notify FAC OPS of intent to perform inspection.

4.3 Underground Supervisor shall ensure Exhaust Shaft Station is clear.

4.4 Contact Ventilation Engineer if Weather Instrumentation is present.

4.5 Notify QA of Shaft Inspection.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

5.1.1 There is no work allowed around, or under bottom of exhaust shaft, during the performance of this inspection.

5.1.2 Safety belts and lanyards shall be worn when working around open hatch covers.

5.1.3 The photography van shall have the parking brake set AND wheels chocked.

5.2 Limitations

5.2.1 This procedure does not provide any steps for the correction of discrepancies.

5.2.2 Non-Conforming items shall be controlled per WP 10-WC3004 and WP 13-003.

6.0 TOOLS, EQUIPMENT, AND MATERIALS

6.1 Tools

a. 1/2 inch socket set

6.2 Equipment

a. Safety belt with lanyards (1 per Person)

b. 75 foot hand-line (min. 1/4 inch)

c. 10 foot step ladder

d. Photography van (equipment number 35-C-001)

e. Two-way radio (2 reqd.)

6.3 Materials

a. Blank VCR tape (VHS) (Must be ordered)

b. Polaroid film (type 339) (Must be ordered)

c. Glass cleaner WIPP S/N X-51-05001

d. Petroleum jelly WIPP S/N 12-01478

e. Paper towels WIPP S/N 38-01227

7.0 ACCEPTANCE CRITERIA

This is an objective inspection, the only applicable standards are; discernable photographs and video.

8.0 PROCEDURES

8.1 Preparation

[]SO	8.1.1	Notify CMR of intent to perform exhaust shaft inspection and obtain concurrence.
[]	8.1.2	Notify Cog Engineer of intent to perform inspection.
[]SO	8.1.3	Request that Underground Supervisor ensure there is no personnel in the Exhaust Shaft Station.
[]SO	8.1.4	Record Date and Time on Data Sheet.
[]	8.1.5	Park van on south side of Station "A" building in line with top sheave.
[]	8.1.6	Set van parking brake, leave transmission in neutral and engine running.
[]	8.1.7	Chock all 4 wheels.
[]	8.1.8	Position van davit (boom) to rear of van. Do not tighten set screw at this time.
[]	8.1.9	Connect van to 120 VAC site power (instrument room at base of stairwell).
[]	8.1.10	Set selector switch to "EXTERNAL AC".
[]	8.1.11	Activate hydraulic valve on driver side below seat by pulling knob out.

8.2 Setup

NOTE 8.2

1. If weather instrumentation is being used, contact Ventilation Engineer prior to proceeding with this inspection.

2. DO NOT allow the cable drum to free reel. Maintain controlled pay out of cable.

WARNING

Safety belts and lanyards are required when working around shaft openings. Tie off to Tripod or substantial approved anchor.

[]	8.2.1	Transport video camera and hand-line to roof of Station "A".
[]	8.2.2	Pay out cable and connect to hand line from roof of Station "A".
[]	8.2.3	Loosen set screw on davit (boom) at top of Station "A" building.
[]	8.2.4	Route cable through davit and tripod sheaves.
[]	8.2.5	Remove bolts securing upper hatch cover.
[]	8.2.6	Remove retaining plate from hatch cable bushing and replace bolts.
[]	8.2.7	Open hatch cover.
[]	8.2.8	Apply a light film of petroleum jelly to "o" rings on cable connector.
[]	8.2.9	Attach camera to cable connector by rotating camera, not cable.
[]	8.2.10	Connect camera safety chain to kellum grip on cable.
[]	8.2.11	Turn on video system and perform functional test of camera, (lights, picture, tilt and pan etc.).

[] 8.2.12 Lower kellum grip on cable next to top of connector.

[] 8.2.13 Slowly lower camera into duct until upper hatch can be closed.

[] 8.2.14 Close upper hatch ensuring cable is positioned into travel slot bushing.

[] 8.2.15 Loosen set screw located at "t" handle inside Station "A" house.

[] 8.2.16 Open lower hatch cover and tighten set screw.

[] 8.2.17 Set mechanical and digital depth indicators to zero.

[] 8.2.18 Insert tape into VCR, add logo, job number and date.

8.3 Inspection

NOTE 8.3

1. Record observations for all items inspected.

2. If any indications of questionable integrity are observed, they SHALL be recorded whether or not they are a required inspection item.

3. Record observations for all required inspection items.

4. Positioning of the camera for inspection and traversing is to be accomplished at the discretion of the operator

[]SO 8.3.1 Begin lowering camera and inspect the following items for:

a. cracks
b. corrosion
c. salt buildup
d. dirt
e. debris
f. leaks
g. anchors pulling away from shaft wall
h. sagging
i. bending

	Approx. Location (in feet)		ITEM (System, component)
[]	0-Brow	a.	13.8Kv Feeder on West wall
[]	0-Brow	b.	4 inch air line on East wall
[]	0-933	c.	2 inch water line on East wall
[]	0-Brow	d.	Instrumentation cables located on the North wall
[]	30-32	e.	Guide pipe supporting brackets (4) each

	Approx. Location (in feet)		ITEM (System, component)
[]	32-34	f.	Guide pipe supporting brackets (4) each
[]	43-45	g.	Guide pipe supporting brackets (4) each
[]	59-60	h.	Radiation Intake Probe (East)
[]	59-60	i.	Radiation Intake Probe (South)
[]	59-60	j.	Radiation Intake Probe (West)
[]	59-60	k.	Air Velocity Tube (North)
[]	630-665	l.	Magenta Aquifer (and Water Ring)
[]	745-780	m.	Culebra Aquifer
[]	890-920	n.	Tell-tale Pipes (8) each
[]	875-940	o.	Key and Water Ring
[]	938-940	p.	Concrete-salt interface

8.4 Restore/Restow

NOTE 8.4

Video camera should be left on while exiting the shaft to aid in safely retrieving it around obstacles. Recording is not required.

[] 8.4.1 Upon completion of inspection carefully raise camera until clear of the lower hatch.

[] 8.4.2 Close lower hatch cover and tighten set screw.

[] 8.4.3 Open upper hatch.

[] 8.4.4 Raise camera clear of upper hatch cover.

[] 8.4.5 Turn off all video equipment.

[] 8.4.6 Close upper hatch cover and install the four retaining bolts.

[] 8.4.7 Replace the cable bushing retainer plate.

[] 8.4.8 Remove camera from cable and maintain control of cable.

[] 8.4.9 Place in camera container.

[] 8.4.10 Remove cable from tripod sheave and davit (boom) sheave.

[] 8.4.11 Attach hand-line to cable and guide cable as it is being taken up by the winch.

[] 8.4.12 After cable has been winched in rotate van davit (boom) to front of van and tighten set screw.

[] 8.4.13 Stow roof davit (boom) and tighten set screw.

[] 8.4.14 Identify on tape purpose, date, job number and footage counter indication and rewind video tape.

[] 8.4.15 Secure van by:

a. Turn off engine.
b. Remove and store external 120 vac extension cord.
c. De-activate hydraulics in van by pushing knob by driver's seat down.
d. Remove wheel chocks.

[] 8.4.16 Return 10 ft. Step Ladder to tool room.

[] 8.4.17 Notify CMR operator shaft inspection complete.

[]SO 8.4.18 Turn over video tape to Work Control for archive storage in accordance with DOE order 1324.2, "Records disposition", chapters I, II, III and V.

9.0 TASK VERIFICATION (RETEST)

NONE

10.0 ATTACHMENTS

10.1 Tagout/Lockout Recommendations

NONE

10.2 Data Sheets

ATTACHMENT 10.2
DATA SHEETS
Page 1 of 3

STEP	ACTION	INITLS
8.1.1	Notify CMR of intent to perform inspection.	_____
8.1.2	U/G Supervisor ensure Exhaust Shaft Station is clear.	_____ U/G SUP Sign
8.1.4	Procedure performed Date_____ Time_____	

STEP	ITEM	OBSERVATION
8.3.1	a. 13.8Kv feeder (0'-Brow) (West)	_____
	b. 4 Inch air line (0'-Brow) (East)	_____
	c. 2 Inch water line (0'-933') (East)	_____
	d. Instrumentation cable (0'-Brow) (North)	_____
	e. Guide pipe supporting brackets (30'-32' 4ea)	_____
	f. Guide pipe supporting brackets (32'-34' 4ea)	_____
	g. Guide pipe supporting brackets (43'-45' 4ea)	_____

ATTACHMENT 10.2
DATA SHEETS
Page 2 of 3

STEP	ITEM	OBSERVATION
8.3.1	h. Radiation Intake Probe (59'-60') (East)	
	i. Radiation Intake Probe (59'-60') (South)	
	j. Radiation Intake Probe (59'-60') (West)	
	k. Air Velocity Tube (59'-60') (North)	
	l. Magenta Aquifer and Water Ring (630'-665')	
	m. Culebra Aquifer (745'-780')	
	n. Key and Water Ring (875-940)	
	o. Tell-tale Pipes (890-920)	
	p. Concrete-salt interface (938-940)	

LAST PAGE

ATTACHMENT 10.2
DATA SHEETS
Page 3 of 3

STEP	ACTION	INITLS
8.4.18	Turnover video to Work Control for archive storage.	

_____
Mine Ops Sign

_____
Work control Sign

SIGN-OFF

MAINTENANCE TECH_____ / _____ / _____
SIGNATURE PRINTED NAME INITIALS

MAINTENANCE TECH_____ / _____ / _____
SIGNATURE PRINTED NAME INITIALS

MAINTENANCE TECH_____ / _____ / _____
SIGNATURE PRINTED NAME INITIALS

COMMENTS:_____

Reviewed by:_____ Date_____

EYE WASH AND SHOWER EQUIPMENT

EYEWASH INSPECTION RECORD

ACTIVATE UNIT WEEKLY TO VERIFY PROPER OPERATION AND SIGN BELOW. NOTIFY LANDLORD IF UNIT IS INOPERABLE.

DATE/TIME	SIGNED

(over)

EYEWASH INSPECTION RECORD

ACTIVATE UNIT WEEKLY TO VERIFY PROPER OPERATION AND SIGN BELOW. NOTIFY LANDLORD IF UNIT IS INOPERABLE.

DATE/TIME	SIGNED

(Return to Industrial Safety when complete, and replace)

EMERGENCY EYEWASH AND SHOWER
REPORT OF INADEQUACY

INDIVIDUAL REPORTING _____

STATION BEING REPORTED _____

DESCRIPTION OF INADEQUACY _____

_____

_____

_____

_____

_____

_____

_____

DESCRIPTION OF REQUIRED CORRECTIVE ACTION _____

_____

_____

_____

_____

_____

_____

RESPONSIBLE PARTY _____

DATE OF COMPLETION _____

INDUSTRIAL SAFETY CONFIRMATION _____

FIRE DETECTION AND ALARM SYSTEM

FIRE/SAFETY INSPECTION REPORT

Date:_____ Time:_____

BUILDING:_____ LOCATION:_____

[ ]MONTHLY [ ]QUARTERLY [ ]SEMI-ANNUAL [ ]ANNUAL

__✓__ OK __X__ Adjustment made __O__ Repairs required

A/R written _____ A/R number _____ FR initiated_____

(check or complete the appropriate information)

SPRINKLER SYSTEM N/A[ ]

O.S.&Y. VALVE

POSITION: [ ]OPEN [ ]CLOSED

[ ]LOCKED [ ]SEALED

SUPERVISORY VALVE

POSITION: [ ]OPEN [ ]CLOSED

GAUGE READINGS: T_____ B_____

SPRINKLER OBSTRUCTIONS: [ ]YES [ ]NO

HOSE REELS N/A[ ]

ACCESSIBILITY: [ ] Yes [ ] No

HOSE & NOZZLE CONDITION:_____

	OPEN	CLOSED
POSITION OF VALVE	[ ]	[ ]
POSITION OF NOZZLE	[ ]	[ ]

DETECTOR N/A[ ]

TYPE:_____

CONDITION:_____

FUNCTIONAL TEST: [ ]YES [ ]NO

HORN/BELL N/A[ ]

CONDITION:_____

FUNCTIONAL TEST: [ ]YES [ ]NO

EMERGENCY LIGHTING N/A[ ]

PROPER LOCATION: [ ]YES [ ]NO

CONDITION:_____

FUNCTIONAL TEST: [ ]YES [ ]NO

PULL BOXES N/A[ ]

CONDITION:_____

ACCESSIBILITY:_____

FUNCTIONAL TEST: [ ]YES [ ]NO

FIRE ALARM PANEL N/A[ ]

TYPE:_____

POWER ON @ PANEL: [ ]YES [ ]NO

VISIBLE DAMAGE: [ ]YES [ ]NO

OTHER LIGHTS ON @ PANEL:[ ]YES [ ]NO

IF YES EXPLAIN:_____

FUNCTIONAL TEST: [ ]YES [ ]NO

SPECIAL FIRE EQUIPMENT N/A[ ]

TYPE:_____

POWER ON @ PANEL: [ ] Yes [ ] No

OTHER LIGHTS ON @ PANEL: [ ] Yes [ ] No

If yes explain:_____

CONDITION:_____

FUNCTIONAL TEST: [ ] YES [ ]No

Inspected by:_____

F.P.E. or Designee_____date:_____

*EM Manager:_____date:_____

Comments:_____

*NOTE: EM Manager review required only if deficiencies are found.

FIRE HOSE INSPECTION RECORD

FIRE HOSE RECORD FORM

Identification #:_____ **Size (dia.):**_____ **Length:**_____ **ft.** **Coupling size:**_____/_____

Type of hose:_____

Construction:_____

MFG.:_____

Date in service:_____

HOSE TEST RECORDS

DATE	TIME	P.S.I.	RESULTS	REASON FOR FAILURE	CORRECTIVE ACTIONS	INSPECTED BY

FIRE EXTINGUISHERS

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WESTINGHOUSE ELECTRIC CORP (WID_
PROTRAC FIRE & SAFETY MANAGEMENT SYSTEM 6.3

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DAILY ACTIVITY REPORT
FOR
BOLTON E003

* = Manual Entry

Date	Time	Location	Flr	Description Station	Type	Serial No.	Inspection	Code
*04/06	13:50	E TRAILER CITY		ROUTE START				R00008
04/06	14:22	911F/EAST SIDE	001	EXIT	HALON 1211 10			000689
04/06	14:22			EXTINGUISHER	HALON 1211 10	B-281569		A000709
04/06	14:22						MONTHLY	I0001
04/06	14:22	911F/WEST SIDE	001	EXIT	HALON 1211 10			000688
04/06	14:22			EXTINGUISHER	HALON 1211 10	E-340218		A000710
04/06	14:22						MONTHLY	I0001
04/06	14:23	911B/INTERIOR	001	SW EXIT	DRY CHEM ABC 10			000696
04/06	14:23			EXTINGUISHER	DRY CHEM ABC 10	FR-957387		A000600
04/06	14:23						MONTHLY	I0001
04/06	14:27	911A/LOCKSHOP	001	SE EXIT	DRY CHEM ABC 10			000687
04/06	14:27			EXTINGUISHER	DRY CHEM ABC 10	FL-413406		A000681
04/06	14:27						MONTHLY	I0001
04/06	14:28	911A/LOCKSHOP	001	SW EXIT	DRY CHEM ABC 20			000686
04/06	14:28			EXTINGUISHER	DRY CHEM ABC 20	HC-926120		A000682
04/06	14:28						MONTHLY	I0001
04/06	14:33	991/INTERIOR	001	SE EXIT	DRY CHEM ABC 10			000684
04/06	14:33			EXTINGUISHER	DRY CHEM ABC 10	DE-529186		A000593
04/06	14:33						MONTHLY	I0001
04/06	14:33	991/INTERIOR	001	SW EXIT	HALON 1211 10			000685
04/06	14:33			EXTINGUISHER	HALON 1211 10	C-125004		A000592
04/06	14:33						MONTHLY	I0001
04/06	14:34	994/MO 112 QA TRLR	001	SE EXIT	DRY CHEM ABC 10			000699
04/06	14:34			EXTINGUISHER	DRY CHEM ABC 10	HL-169635		A000594
04/06	14:34						MONTHLY	I0001
04/06	14:36	992/INTERIOR	001	SE EXIT	DRY CHEM ABC 10			000702
04/06	14:36			EXTINGUISHER	DRY CHEM ABC 10	JG-852203		A000599
04/06	14:36						MONTHLY	I0001
04/06	14:37	992/INTERIOR	001	CENTER AREA	DRY CHEM ABC 20			000701
04/06	14:37			EXTINGUISHER	DRY CHEM ABC 20	EM-158252		A000598
04/06	14:37						MONTHLY	I0001
04/06	14:37	992/INTERIOR	001	NE EXIT	DRY CHEM ABC 10			000700
04/06	14:37			EXTINGUISHER	DRY CHEM ABC 10	JG-852196		A000597
04/06	14:37						MONTHLY	I0001
04/06	14:38	993/INTERIOR	001	SW EXIT	DRY CHEM ABC 20			000703
04/06	14:38			EXTINGUISHER	DRY CHEM ABC 20	EM-158795		A000627
04/06	14:38						MONTHLY	I0001
04/06	14:39	993/INTERIOR	001	NW EXIT	DRY CHEM ABC 10			000704
04/06	14:39			EXTINGUISHER	DRY CHEM ABC 20	KD-35189		A000629
04/06	14:39						MONTHLY	I0001
04/06	14:40	252/UTILITY SUB	001	WEST SIDE FENCE	DRY CHEM ABC 20			000706
04/06	14:40			EXTINGUISHER	DRY CHEM ABC 20	DY 812828		A000603
04/06	14:40						MONTHLY	I0001
04/06	14:42	253/SUBSTAION	001	INTERIOR	DRY CHEM ABC 20			000004
04/06	14:43			EXTINGUISHER	DRY CHEM ABC 20	JY-92558		A000820
04/06	14:43						MONTHLY	I0001
04/06	14:44	911F/SE EXTERIOR	001	GENERATOR AREA	DRY CHEM ABC 20			000695

4-1.2 The procedure for inspection and maintenance of fire extinguishers varies considerably. Minimal knowledge is necessary to perform a monthly "quick check" or inspection in order to follow the inspection procedure as outlined in Section 4-3. A trained person who has undergone the instructions necessary to reliably perform maintenance and has the manufacturer's service manual shall service the fire extinguishers not more than one year apart, as outlined in Section 4-4.

4-1.3 The owner or designated agent or occupant of a property in which fire extinguishers are located shall be responsible for such inspection, maintenance, and recharging.

4-1.4* Maintenance, servicing, and recharging shall be performed by trained persons having available the appropriate servicing manual(s), the proper types of tools, recharge materials, lubricants, and manufacturer's recommended replacement parts or parts specifically listed for use in the fire extinguisher.

4-1.5 Tags or labels shall not be placed on the front of the fire extinguisher.

Exception: Labels indicating fire extinguisher use or classification, or both.

4-2 Definitions.

4-2.1 Inspection. Inspection is a "quick check" that an fire extinguisher is available and will operate. It is intended to give reasonable assurance that the fire extinguisher is fully charged and operable. This is done by verifying that it is in its designated place, that it has not been actuated or tampered with, and that there is no obvious physical damage or condition to prevent operation.

4-2.2 Maintenance. Maintenance is a thorough examination of the fire extinguisher. It is intended to give maximum assurance that an fire extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair or replacement. It will normally reveal if hydrostatic testing is required.

4-2.3 Recharging. Recharging is the replacement of the extinguishing agent and also includes the expellant for certain types of fire extinguishers.

4-3 Inspection.

4-3.1* Frequency. Fire extinguishers shall be inspected when initially placed in service and thereafter at approximately 30-day intervals. Fire extinguishers shall be inspected at more frequent intervals when circumstances require.

4-3.2* Procedures. Periodic inspection of fire extinguishers shall include a check of at least the following items:

(a) Located in designated place.

(b) No obstruction to access or visibility.

(c) Operating instructions on nameplate legible and facing outward.

(d)* Safety seals and tamper indicators not broken or missing.

(e) Fullness determined by weighing or "hefting."

(f) Examined for obvious physical damage, corrosion, leakage, or clogged nozzle.

(g) Pressure gauge reading or indicator in the operabl range or position.

(h) For wheeled units, the condition of the tires, wheels, carriage, hose, and nozzle checked.

4-3.3 Corrective Action. When an inspection of any fire extinguisher reveals a deficiency in any of the conditi listed in (a), (b), and (h) of 4-3.2, immediate correct action shall be taken.

4-3.3.1 Rechargeable Fire Extinguishers. When inspection of any rechargeable fire extinguisher revea deficiency in any of the conditions listed in (c), (d), (e), and (g) of 4-3.2, it shall be subjected to applicable main nance procedures.

4-3.3.2 Nonrechargeable Dry Chemical Fire Extinguis When an inspection of any nonrechargeable dry chemical extinguisher reveals a deficiency in any of the condit listed in (c), (e), (f), and (g) of 4-3.2, it shall be removed fr further use, discharged, and destroyed at the direction of owner or returned to the manufacturer.

4-3.3.3 Nonrechargeable Halogenated Agent Fire Ext guisher. When an inspection of any nonrechargeable extinguisher containing a halon agent reveals a deficie in any of the conditions listed in (c), (e), (f), and (g) of 4-, it shall be removed from service, not discharged, a returned to the manufacturer.

If the fire extinguisher is not returned to the manuf turer, it shall be returned to a fire equipment dealer o distributor to permit recovery of the halon.

4-3.4 Inspection Recordkeeping.

4-3.4.1 Personnel making inspections shall keep reco of all fire extinguishers inspected, including those founc require corrective action.

4-3.4.2 At least monthly, the date the inspection was pe formed and the initials of the person performing inspection shall be recorded.

4-3.4.3 Records shall be kept on a tag or label attached the fire extinguisher or in an electronic system (e.g., coding) that provides a permanent record.

4-4* Maintenance.

4-4.1 Frequency. Fire extinguishers shall be subjected maintenance not more than 1 year apart, at the time hydrostatic test, or when specifically indicated by inspection.

4-4.1.1 Stored pressure types containing a loaded stre agent shall be disassembled on an annual basis and su jected to complete maintenance. Prior to disassembly, t fire extinguisher shall be fully discharged to check t operation of the discharge valve and pressure gauge. T loaded stream charge may be recovered and re-used pr vided it is subjected to agent analysis in accordance w manufacturer's instructions.

4-4.1.2* A conductivity test shall be conducted annua on all carbon dioxide hose assemblies. Hose assemblie found to be nonconductive shall be replaced.

PROTRAC - INSPECTION COMPLETE

MONTHLY 1001	QUARTERLY 1002	SEMI-ANNUAL 1003	ANNUAL 1004
RECHARGE 1005	6-YEAR 1006	HYDRO 1007	WEEKLY 1008
BROKEN SEAL 1101	NOT MOUNTED 1102	MISSING 1103	BAD GAUGE 1104
LOW PRESSURE 1105	WEIGHT 1106	BLOCKED 1107	DAMAGED 1108

TISCOR 11225 W. Bernardo Ct. - San Diego, CA 92127 - (619)451-3710

PROTRAC - INSPECTION COMPLETE

NEEDS REPLACING

I109

AR WRITTEN

I110

LOOSE BRACKET

I111

MISSING PIN

I112

MISSING TAG

I113

I114

I115

I116

I117

I118

I119

I120

REMOVED FOR SERVICE

REMOVED FROM USE

IMPAIRED

NOT ACCESSIBLE

FIRE HYDRANTS

HYDRANT INSPECTIONS

Date:_____ Monthly [ ] Quarterly [ ]

_✓_ OK _X_ Adjustment made _O_ Repairs required

A/R written _____ A/R number _____ FR initiated_____

(check or complete the appropriate information)

#	TIME	CONDITION	REMEDIAL ACTIONS
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			

Inspected by:_____ Date:_____

FPE or Designee:_____ Date:_____

*EM Manager:_____ Date:_____

Comments:_____

_____

*NOTE: EM Manager review required only if deficiencies are found.

FIRE PUMPS

WEEKLY FIRE PUMP INSPECTION

Date:_____ Time:_____

✓ OK X Adjustment made O Repairs Required

AR written _____ AR number _____ FR written [ ] Yes [ ] No

(check or complete the appropriate information)

FIRE ALARM PANEL

POWER LIGHT	[ ] On	[ ] Off
TROUBLE LIGHT	[ ] On	[ ] Off
ALARM LIGHTS	[ ] On	[ ] Off
ALARM DISABLE	[ ] On	[ ] Off
ALARM SIGNAL TRANSMITTED	[ ] No	[ ] Yes

WATER TANK LEVELS

NORTH_____ SOUTH_____

JOCKEY PUMP

Breaker Switch [ ]ON [ ]OFF
Controller Switch [ ]HAND [ ]OFF [ ]AUTO
Comments:_____

CONTROL VALVES

NO.	OPEN	CLOSED	LOCKED
1	☐	☐	☐
2	☐	☐	☐
3	☐	☐	☐
4	☐	☐	☐
5	☐	☐	☐
6	☐	☐	☐
7	☐	☐	☐
12	☐	☐	☐
13	☐	☐	☐
14	☐	☐	☐
15	☐	☐	☐
16	☐	☐	☐
17	☐	☐	☐
19	☐	☐	☐
20	☐	☐	☐
21	☐	☐	☐
36	☐	☐	☐

CONTROLLERS

Electric

Breaker Switch [ ]ON [ ]OFF

Power Light [ ]ON [ ]OFF

Diesel

Main Switch Auto [ ]NO [ ]YES

Shut Down Mode Manual [ ]NO [ ]YES

Comments:_____

DIESEL FUEL

Valve Positions [ ]OPEN [ ]CLOSED

Fill cap in place [ ]YES [ ]NO

Tank level E_____F
¼ ½ ¾

FIRE PUMPS

ELECTRIC PUMP
Weekly Test Performed [ ]No [ ]Yes
Comments:_____

DIESEL PUMP
Weekly Test Performed [ ]No [ ]Yes
Comments:_____

Tachometer Reading (RPM):_____
Hourmeter Reading (prior to test):_____

Visible Leaks	NO	YES
Water	☐	☐
Oil	☐	☐
Fuel	☐	☐
Oil Level Checked	☐	☐
Coolant Level Checked	☐	☐

Ground Wire Connection Tight [ ]NO [ ]YES
(from starter motor to diesel engine block)

Speed Control Locknuts [ ]TIGHT [ ]LOOSE

Condition/Comments:_____

Inspected by: _____

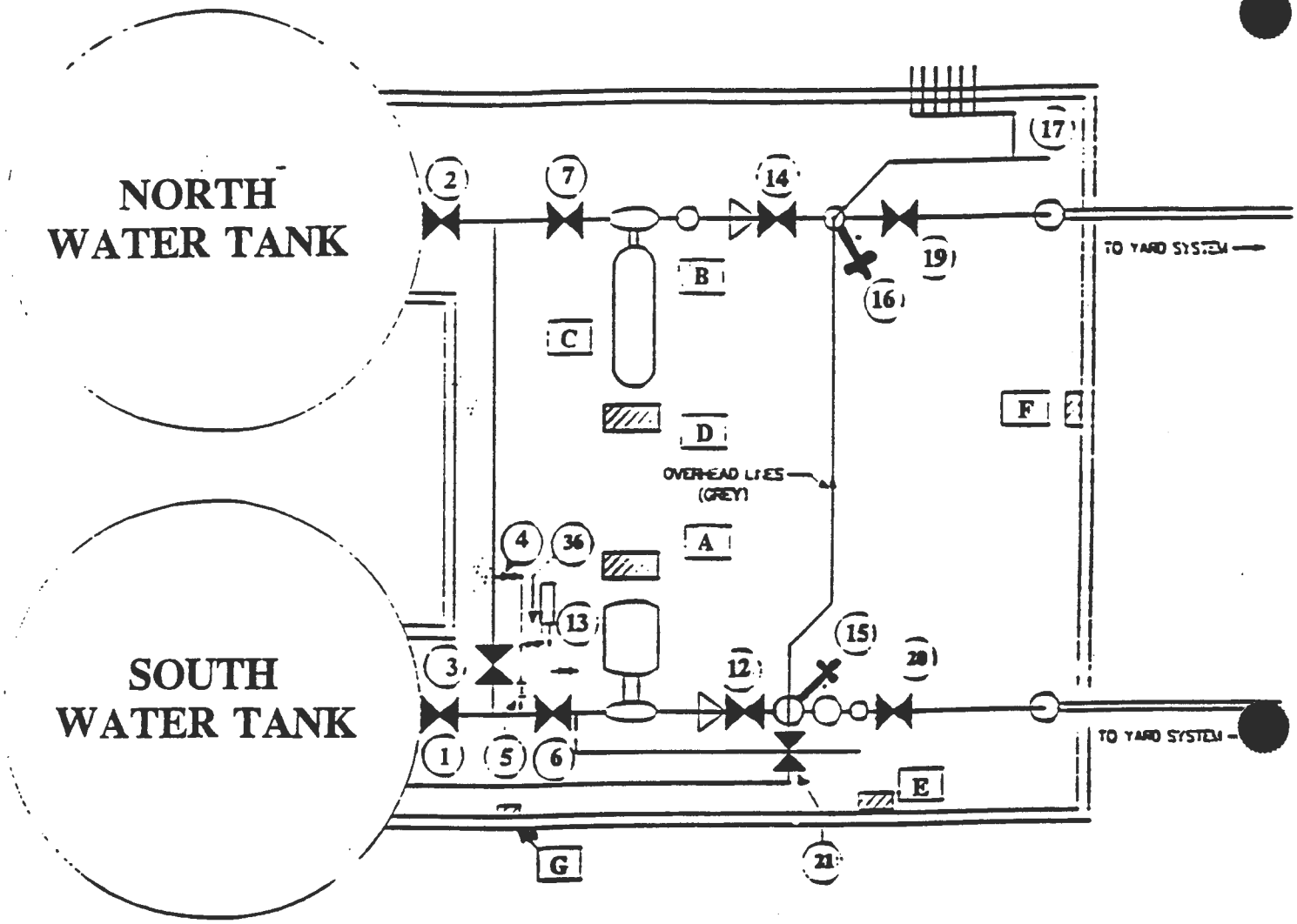
FPE or Designee:_____ DATE:_____

*EM MGR_____ DATE:_____

Comments:_____

*NOTE: Review by EM Manager required only if deficiencies are found.

WEEKLY FIRE PUMP INSPECTION



LEGEND

1	FW-456-V-1	N.O.	20	FW-456-V-20	N.O.
2	FW-456-V-2	N.O.	21	FW-456-V-21	N.C.
3	FW-456-V-3	N.O.	36	FW-456-V-36	N.O.
4	FW-456-V-4	N.O.	A	ELECTRIC PUMP CONTROLLER	
5	FW-456-V-5	M.O.	B	DIESEL ENGINE CRANK LEVERS	
6	FW-456-V-6	N.O.	C	DIESEL ENGINE MANUAL THROTTLE	
7	FW-456-V-7	N.O.	D	DIESEL PUMP CONTROLLER	
12	FW-456-V-12	N.O.	E	JOCKEY PUMP CONTROLLER	
13	FW-456-V-13	N.O.	F	FIRE ALARM CONTROL PANEL	
14	FW-456-V-14	N.O.	G	TEST FLOW METER GAUGE	
15	FW-456-V-15	N.O.			
16	FW-456-V-16	N.O.			
17	FW-456-V-17	N.C.			
19	FW-456-V-19	N.O.			

FIRE SPRINKLER SYSTEMS

QUARTERLY SPRINKLER SYSTEM TEST REPORT

Date:_____ Time:_____

_✓_ OK _X_ Adjustment made _O_ Repairs Required

AR written: [ ] Yes [ ] No AR number:_____

(check or complete the appropriate information)

Building:_____

STATIC PRESSURES (With Calibrated Gauges)

Calibration Due Date:_____ Gauge #:_____ System Upper Gauge:_____

Calibration Due Date:_____ Gauge #:_____ Supply Lower Gauge:_____

INSPECTOR'S TEST

Accessible	[ ] Yes	[ ] No	
Alarm control valve open & sealed	[ ] Yes	[ ] No	
Lapsed time for alarm:_____			
Water motor gong activated:	[ ] Yes	[ ] No	[ ] N/A
Pressure switch and alarm panel activated:	[ ] Yes	[ ] No	[ ] N/A
CMR signal receipt:	[ ] Yes	[ ] No	[ ] N/A
Valve closed after test:	[ ] Yes	[ ] No	[ ] N/A
Visible leaks:	[ ] Yes	[ ] No	[ ] N/A

MAIN DRAIN TEST

Residual pressure with valve fully open and fire pump running:

Supply gauge:_____ System gauge:_____

LINE STRAINERS [ ] N/A

Removable strainers:

Removed:	[ ] Yes	[ ] No
Cleaned:	[ ] Yes	[ ] No
Replaced:	[ ] Yes	[ ] No

SYSTEM RETURN TO NORMAL OPERATING CONDITION [ ] Yes [ ] No

Performed by:_____

FPE or Designee:_____ Date:_____

*EM Manager:_____ Date:_____

Comments:_____

*NOTE: EM Manager review required only if deficiencies are found.

FIRE TRUCKS

WEEKLY CHECK LIST
Seargraves Fire Apparatus

Date:_____

Seagraves

_✓_ OK _X_ Adjustment made _O_ Repairs Required

AR written _____ AR number _____

(check or complete the appropriate information)

ITEM	CONDITION	REMEDIAL ACTIONS
Fuel level (fill if < ¾ full)		
Oil level		
Radiator level		
Automatic transmission fluid level		
Power steering fluid level		
Oil pressure (>60 psi)		
Engine temperature (Degrees F.)		
Tachometer (rpm at idle)		
Brake fluid level		
Emergency brake		
Battery (terminals clean/system charging)		
Fan belts		
Test drive		
Windshield wiper/washer		
Vehicle lights (head, marker, turn signals, back-up, interior, fog, & dash)		
Emergency lights (light bar, grill, side, & rear rotators)		
Accessory lights (compartment, panel, spot, flood, & hand)		
Sirens, horn, & back-up alarm (functional test)		
Inspect SCBAs (fill if < 3600 psi)		

WEEKLY CHECK LIST (cont.)
Seagraves Apparatus

ITEMS	CONDITION	REMEDIAL ACTIONS
Cellular phone (make sure it's plugged in)		
Pump primer & oil level		
Booster tank level		
Pump at 150 psi		
Operate all valves/check gauges		
Operate relief valve/check light		
Heat pump indicator		
Large leaks around pump pumping?		
Hose & equipment		
Clean (inside and outside)		
Odometer reading after test		
Operate hydraulic ladder rack		
Start & run generator 5 minutes		
Test 110 volt lights & outlets		
Check foam tank capacity		
TIRES (120 psi)		
Right front		
Right rear outside		
Right rear inside		
Left front		
Left rear outside		
Left rear inside		

Inspected by:_____ time:_____ date:_____

F.P.E. or Designee:_____

Comments:_____

_____

WEEKLY CHECK LIST
Emergency One Apparatus

Date:_____

EMERGENCY ONE

_✓_ OK _X_ Adjustment made _O_ Repairs Required

AR written _____ AR number _____

(check or complete the appropriate information)

ITEM	CONDITION	REMEDIAL ACTIONS
Fuel level (fill if < ¾ full)		
Oil level		
Radiator level		
Automatic transmission fluid level		
Power steering fluid level		
Oil pressure (>60 psi)		
Engine temperature (Degrees F.)		
Tachometer (rpm at idle)		
Brake fluid level		
Emergency brake		
Battery (terminals clean/system charging)		
Fan belts		
Test drive: 2 wheel drive		
Test drive: 4 wheel drive		
Windshield wiper/washer		
Vehicle lights (head, marker, turn signals, back-up, interior, fog, & dash)		
Emergency lights (light bar, grill, side, & rear rotators)		
Accessory lights (compartment, panel, spot, flood, & hand)		
Sirens, horn, & back-up alarm (functional test)		

WEEKLY CHECK LIST (cont.)
Emergency One Apparatus

ITEMS	CONDITION	REMEDIAL ACTIONS
Inspect SCBAs (fill if < 3600 psi)		
Cellular phone (make sure it's plugged in)		
Pump primer & oil level		
Booster tank level		
Pump at 150 psi		
Operate all valves/check gauges		
Operate relief valve/check light		
Heat pump indicator		
Large leaks around pump pumping?		
Hose & equipment		
Clean (inside and outside)		
Foam (4 five gallon pails)		
Odometer reading after test		
TIRES		
Right front (80 psi)		
Right rear outside (70 psi)		
Right rear inside (70 psi)		
Left front (80 psi)		
Left rear outside (70 psi)		
Left rear inside (70 psi)		

Inspected by:_____ time:_____ date:_____

F.P.E. or Designee:_____

Comments:_____

_____

FORKLIFTS

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3 TON ELECTRIC FORKLIFT PREOPERATIONAL CHECKS

1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Record the Hour Meter reading in the Equipment Logbook.

3.0 Prior to starting the forklift, inspect the following:

[] 3.1 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 3.2 General Condition: No damage, loose parts, oil leaks, grease, oil, or trash.

[] 3.3 Seat Belts - In good condition.

3.4 Tires:

[] 3.4.1 In good condition, NOT excessively worn or cracked.

[] 3.4.2 All wheel lugs tight.

3.5 Service Brake:

[] 3.5.1 Brake pedal has approximately 2 to 3 inches of "free play" which can be felt readily by hand.

[] 3.5.2 Brake Pedal should NOT be "springy or spongy" **OR** "stick or bind" when pressed.

[] 3.6 Parking Brake: Does NOT bind when set or released.

3.7 Battery Compartment:

[] 3.7.1 Free from acid spills.

[] 3.7.2 NO loose or missing caps or cables.

[] 3.8 Horn sounds when pressed.

3-TON ELECTRIC FORKLIFT PREOPERATIONAL CHECKS (Continued)

[] 3.9 Front lights illuminate when activated.

[] 3.10 Back lights illuminate when activated.

[] 3.11 Fire Extinguisher: Inspection is current and seal is intact.

[] 3.12 Battery Electrolyte Level (odd colored cap): is half-way between the element protector and bottom of cell cover vent well.

3.12.1 Electrolyte level **SHALL NOT** be below element protector.

3.12.2 Electrolyte level **SHALL NOT** be higher than bottom of cover vent well.

3.12.3 **IF** electrolyte level is NOT within the required band, contact Maintenance Department to adjust electrolyte level.

3.13 Forks (if applicable):

[] 3.13.1 NO obvious cracks, breaks, bending, twisting, and wear.

3.13.2 Verify forks are correctly installed and locked in the proper position.

3.14 Upright and lift chains:

[] 3.14.1 No obvious wear.

[] 3.14.2 No obvious damaged or missing parts.

[] 3.14.3 No slack or broken chains.

[] 4.0 Turn the key to ON, to start forklift.

[] 5.0 Investigate any unusual noises immediately.

3-TON ELECTRIC FORKLIFT PREOPERATIONAL CHECKS (Continued)

6.0 After the forklift is started, verify the following:

[] 6.1 Hydraulic System Reservoir: Level is above the LOW mark.

[] 6.2 Hydraulic System: No visible leakage from hoses, couplings, or fittings.

[] 6.3 Battery Charge Meter: In the GREEN BAND.

[] 6.3.1 IF the Charge Meter indicates in the RED BAND, schedule the battery for a DAILY charge.

6.4 Test the Hoist Controls by operating in the following positions:

[] • Raise

[] • Lower

[] • Tilt Forward

[] • Tilt Backward

6.5 Test the Fork Position Control by operating in the following positions:

[] • In

[] • Out

6.6 Test the Fork Sideshift Control by operating in the following positions:

[] • Left

[] • Right

[] 6.7 Engage the parking brake.

[] 6.7.1 Attempt to move the forklift to verify the forklift does NOT move in either forward or reverse.

3-TON ELECTRIC FORKLIFT PREOPERATIONAL CHECKS (Continued)

[] 6.8 Release the parking brake.

[] 6.9 Using the Directional Control Lever, select the direction to travel.

[] 6.10 Press the accelerator pedal, and move the forklift.

6.11 While the forklift is moving, verify the following:

[] 6.11.1 Steering operates smoothly and does NOT pull to either the right or left.

[] 6.11.2 Brakes are in good condition and do NOT drag.

[] 6.11.3 Backup Alarm operates while moving in reverse.

[] 7.0 Stop the forklift, and engage the parking break.

[] 8.0 Turn the key to OFF.

[] 9.0 Initiate PWRs to resolve any deficiencies which CANNOT be corrected by Waste Operations.

[] 10.0 Notify the WHS of any deficiencies discovered during the checks and their status (such as deficiencies corrected and Plant Work Request generated).

[] 11.0 Record the following information in the Equipment Logbook:

[] 11.1 Preoperational Checks satisfactory or unsatisfactory.

[] 11.2 Identified deficiencies NOT corrected.

[] 11.3 Outstanding/newly generated PWRs.

12.0 Document performance of the Preoperational Checks by makeing the following entries in Equipment Logbook:

[] 12.1 The time and date the Checks were performed.

[] 12.2 Signature of the person who performed the Checks.

ATTACHMENT 1

13 Ton Electric Forklift Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Record the Hour Meter reading in the Equipment Logbook.

[] 3.0 Inspect the following prior to starting the forklift:

[] 3.1 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 3.2 General Condition: No damage, loose parts, oil leaks, grease, oil or trash.

[] 3.3 Seat Belts - In good condition.

[] 3.4 Tires: In good condition, NOT excessively worn or cracked and all wheel lugs tight.

[] 3.5 Forks: Check for general condition of forks. Check for cracks, breaks and noticeable bending, twisting and wear.

[] 3.6 Mast: No obvious wear, damaged or missing parts, slack or broken chains.

[] 3.7 Service Brake:

[] 3.7.1 Pedal has approximately 2 to 3 inches of free play, which can be felt readily by hand.

[] 3.7.2 Pedal should NOT be springy or spongy when depressed, and should NOT stick or bind.

[] 3.8 Battery Compartment: Free from acid spills, no loose or missing caps or cables.

[] 3.9 Horn: Sounds.

[] 3.10 Front lights: Illuminate.

[] 3.11 Rear lights: Illuminate.

13 Ton Electric Forklift Preoperational Checks (Continued)

[] 3.12 Fire Extinguisher: Inspection is current and seal is intact.

[] 3.13 Hydraulic System Reservoir: Normal.

[] 3.14 Battery Electrolyte Level (odd colored cap): Half way between element protector and bottom of cell cover vent well.

3.14.1 Level **SHALL NOT** be below the element protector.

3.14.2 Level **SHALL NOT** be higher than the bottom of the cover vent well.

3.14.3 **IF** electrolyte level is NOT within the required band, contact the Maintenance Department to adjust electrolyte level.

NOTE: This note applies to Step 3.15. The 13 Ton Forklifts have different types of Charge Meters. "A" forklift has a green/yellow/red band type indicator, and "B" forklift has a meter indicating in % Charge.

[] 3.15 Battery Charge Meter: > 75% charge **OR** in the green band.

[] 3.15.1 **IF** the Charge Meter indicates < 75% charge or in the yellow band, perform a DAILY charge at the end of the shift per Section 7.5, Daily Battery Charge.

[] 4.0 Turn the key to ON to start the forklift. Any unusual noises detected **SHALL** be investigated immediately.

13 Ton Electric Forklift Preoperational Checks (Continued)

[] 5.0 Perform the following checks after the forklift is started.

NOTE: This Note applies to Step 5.1. Test the hydraulic system with the mast fully lowered and tilted full back. Forks should be centered and completely together.

[] 5.1 Hydraulic System Reservoir: Level above LOW mark.

[] 5.2 Hydraulic System: No visible leakage from hoses, couplings or fittings.

[] 5.3 Operate the hoist controls:

[] • Raise
[] • Lower
[] • Tilt Forward
[] • Tilt Backward

[] 5.4 Test the fork controls:

[] 5.4.1 Fork position:

[] • IN
[] • OUT

[] 5.4.2 Fork sideshift:

[] • Left
[] • Right

[] 5.5 Move the forklift. Test the following while the Forklift is moving:

[] 5.5.1 Steering operates smoothly without binding and does NOT pull in either direction.

[] 5.5.2 Brakes are in good condition and DO NOT drag.

[] 5.5.3 Stand up. Verify the seat brake stops the forklift.

[] 5.5.4 Backup Alarm operates while moving in reverse.

13 Ton Electric Forklift Preoperational Checks (Continued)

[] 6.0 Initiate Work Requests to address any deficiencies which cannot be corrected by Waste Operations.

[] 7.0 Notify the WHS of deficiencies discovered during checks, and the status (corrected, PWR generated, etc.).

[] 8.0 Record the following in the Equipment Logbook:

[] 8.1 Preop Check satisfactory or unsatisfactory.

[] 8.2 Addition of oil, water or other fluids and amount added.

[] 8.3 Identified deficiencies which were NOT corrected.

[] 8.4 Outstanding/newly generated PWRs.

[] 9.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

CONTROLLED COPY

ATTACHMENT 1

6-Ton Electric Forklift Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding Deficiencies and PWRs.

[] 2.0 Record the Hour Meter reading in the Equipment Logbook.

[] 3.0 Inspect the following prior to starting the forklift:

[] 3.1 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
<u>IF</u> the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 3.2 General Condition: No damage, loose parts, oil leaks, grease, oil, or trash.

[] 3.3 Seat belts in good condition.

[] 3.4 Tires: In good condition, not excessively worn or cracked and all wheel lugs tight.

[] 3.5 Forks: Check for general condition of forks. Check for cracks, breaks and noticeable bending, twisting and wear.

[] 3.6 Upright/Lift Chains: No obvious wear, damaged or missing parts, slack or broken chains.

[] 3.7 Service Brake Pedal:

- Approximately 1-2 inches of free play, which can be felt by hand

[] - NOT springy or spongy when depressed, and does NOT stick or bind

[] 3.8 Parking Brake: Does not bind when set or released.

[] 3.9 Steering Mechanism: Operates freely without binding.

[] 3.10 Battery Compartment: Free from acid spills, no loose or missing caps or cables.

[] 3.11 Horn: Sounds.

6-Ton Electric Forklift Preoperational Checks (Continued)

[] 3.12 Front and rear lights: Illuminate.

[] 3.13 Fire Extinguisher: Inspection is current and seal is intact.

[] 3.14 Battery Electrolyte Level (odd colored cap): Half way between the element protector and the bottom of the cell cover vent well.

3.14.1 **SHALL NOT** be below element protector.

3.14.2 **SHALL NOT** be higher than the bottom of the cover vent well.

3.14.3 **IF** electrolyte level is NOT within required band, contact the Maintenance Department to adjust electrolyte level.

[] 3.15 Battery Charge Meter - > 75% full scale.

[] • **IF** the Charge Meter indicates < 75% of full scale, schedule the battery for a DAILY charge at the end of the shift

[] 3.16 Hydraulic System Reservoir: Level above LOW mark.

[] 3.17 Hydraulic System: No leakage from hoses, couplings, or fittings.

[] 4.0 Turn the key to ON to start the forklift. Any unusual noises **SHALL** be investigated immediately.

[] 4.1 Operate Hoist Controls:

[] • Raise
[] • Lower
[] • Tilt Forward
[] • Tilt Backward

[] 4.2 **IF** the forklift is equipped with fork controls, test the following:

[] 4.2.1 Fork position:

[] • IN
[] • OUT

6-Ton Electric Forklift Preoperational Checks (Continued)

[] 4.2.2 Fork sideshift:

[] • Left
[] • Right

[] 4.3 Verify the parking brake is engaged and attempt to move the forklift. The Forklift should not move in forward or reverse.

[] 4.4 Release the brake and move the forklift. Test following while the Forklift is moving:

[] • Steering operates smoothly and does NOT pull to either direction

[] • Brakes in good condition and do NOT drag

[] • Stand up. Verify the seat brake stops the forklift

[] • Backup Alarm operates while moving in reverse

[] 5.0 Initiate PWRs to address any deficiencies which cannot be corrected by Waste Operations.

[] 6.0 Notify the WHS of deficiencies discovered during checks and the status (corrected, PWR generated, etc.).

[] 7.0 Record the following in the Equipment Logbook:

[] 7.1 Check satisfactory or unsatisfactory.

[] 7.2 Addition of oil, water, or other fluids and the amount added.

[] 7.3 Identified deficiencies which were not corrected.

[] 7.4 Outstanding/newly generated PWRs.

[] 8.0 Enter the time and date, then sign the Equipment Logbook to document the performance of the Preoperational Checks.

20 Ton Diesel Forklift Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Record Hour Meter reading in the Equipment Logbook.

[] 3.0 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.

- **IF** the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

4.0 Verify the following prior to starting the engine:

[] 4.1 Engine oil level is in the normal range on the dipstick.

[] 4.2 Transmission oil level is above the full mark on the dipstick.

[] 4.3 Hydraulic tank level is within the normal range on the dipstick.

[] 4.4 Battery compartment is free from acid spills and has NO loose or missing caps or cables.

[] 4.5 Air cleaner indicator is Green.

[] 4.6 Belts NOT obviously loose, worn, or cracked.

[] 4.7 Forks DO NOT have any noticeable cracks, breaks, bending, twisting, and/or wear.

[] 4.8 Upright DOES NOT have any signs of obvious wear **OR** damaged or missing parts.

[] 4.9 General Condition: NO damage, loose parts, major oil leaks, grease, or trash.

[] 4.10 Seat belts in good condition.

[] 4.11 Tires are NOT excessively worn or cracked AND all wheel lugs are present.

[] 4.12 Pedals/control levers NOT loose or sticking.

[] 4.13 Fire suppression system test satisfactory.

20 Ton Diesel Forklift Preoperational Checks (Continued)

[] 4.14 Adjust the seat to a position that provides easy access to all controls.

5.0 Start the forklift as follows:

NOTE: This note applies to Step 5.1. The engine will NOT start unless the transmission is in the NEUTRAL position.

5.1 Verify the following controls are in NEUTRAL:

[] • Transmission
[] • Lift control lever
[] • Tilt control lever
[] • Right fork position lever
[] • Left fork position lever
[] • Fork sideshift lever
[] • Auxiliary control lever

[] 5.2 Verify the parking brake is engaged.

[] 5.3 Turn the battery disconnect switch to ON.

[] 5.4 Push the PULL TO STOP control all the way in.

CAUTION

This Caution applies to Step 5.5.
DO NOT use starting fluid.

[] 5.5 Start the engine by turning the ignition key to START.

5.6 **IF** the engine FAILS to start within 20 seconds, perform the following:

[] 5.6.1 Release the ignition key.

[] 5.6.2 Allow the starter to cool for 3 to 5 minutes before trying another start.

[] 5.6.3 Attempt to start the engine.

[] 5.6.4 **IF** the engine FAILS to start in four (4) attempts, notify WHS and proceed as directed.

20 Ton Diesel Forklift Preoperational Checks (Continued)

[] 5.7 Investigate immediately any unusual noises.

[] 5.8 **IF** engine oil pressure gage DOES NOT indicate oil pressure within 15 seconds, immediately stop the engine.

> **CAUTION**
>
> This Caution applies to Steps 5.9 and 5.10. Avoid revving the engine when it is cold.

[] 5.9 **WHEN** the engine is operating smoothly, decrease the engine speed by letting out on the throttle.

[] 5.10 Allow the engine to warm.

[] 5.11 Verify sufficient fuel for intended operations.

6.0 Verify the following:

[] 6.1 Engine oil pressure within NORMAL range.

[] 6.2 Transmission oil pressure within NORMAL range.

[] 6.3 Transmission oil temperature within NORMAL range.

[] 6.4 Hydraulic oil filter indicator is Green.

[] 6.5 Hydraulic system has NO visible leakage from the hoses, couplings, or fittings.

[] 6.6 Head temperature within NORMAL range.

[] 6.7 Ammeter indicates a positive charge.

[] 6.8 Voltage reading 26 to 28 volts.

[] 6.9 Air pressure reading 90 to 120 psi.

[] 6.10 Horn sounds when activated.

[] 6.11 Front and rear lights illuminate when turned on.

20 Ton Diesel Forklift Preoperational Checks (Continued)

7.0 Perform the following to test hoist and fork controls:

[] 7.1 Operate the Lift Control Lever in the RAISE position and verify the hoist rises.

[] 7.2 Operate the Lift Control Lever in the LOWER position and verify the hoist lowers.

[] 7.3 Operate the Tilt Control Lever in the FORWARD position and verify the mast tilts forward.

[] 7.4 Operate the Tilt Control Lever in the TILT BACKWARD position and verify the mast tilts backwards.

[] 7.5 Operate Right Fork Position Lever in the IN direction and verify the forks move inward.

[] 7.6 Operate Right Fork Position Lever in the OUT direction and verify the forks move outward.

[] 7.7 Operate Left Fork Position Lever in the IN direction and verify the forks move inward.

[] 7.8 Operate Left Fork Position Lever in the OUT direction and verify the forks move outward.

[] 7.9 Operate Fork Sideshift Control in the LEFT position and verify the forks move left.

[] 7.10 Operate Fork Sideshift Control in the RIGHT position and verify the forks move right.

CAUTION

This Caution applies to the remainder of this Attachment. DO NOT release the brakes or attempt to move the machine if air pressure is < 60 psi.

[] 8.0 Release the spotting brake.

[] 9.0 Release the emergency brake control.

20 Ton Diesel Forklift Preoperational Checks (Continued)

10.0 Perform the following with the parking brake applied:

[] 10.1 Shift the transmission into DRIVE gear.

[] 10.2 Verify the forklift does NOT move.

[] 10.3 Shift the transmission into NEUTRAL gear.

[] 11.0 Release the parking brake.

[] 12.0 Apply the spotting brake and perform the following:

[] 12.1 Shift the transmission into DRIVE gear.

[] 12.2 Verify the forklift DOES NOT move.

[] 12.3 Shift the transmission into NEUTRAL gear.

[] 13.0 Release the spotting brake and shift the transmission into DRIVE gear.

[] 14.0 Verify the steering operates smoothly and DOES NOT pull in either direction while moving.

[] 15.0 Verify the back-up alarm operates while moving in the reverse direction.

[] 16.0 Apply the service brakes. Verify the service brakes respond properly and DO NOT drag.

17.0 Perform the following to test the inching pedal:

[] 17.1 Press the inching pedal to the floorboard.

[] 17.2 Release the inching pedal slowly.

[] 17.3 Verify the forklift moves very slowly in the direction of travel (i.e., "creeps" along).

18.0 **IF** desired, shut down the forklift as follows:

[] 18.1 Verify the forklift is clear of exits, access to stairways, and fire equipment.

[] 18.2 Apply the parking brake.

[] 18.3 Apply the spotting brake.

20 Ton Diesel Forklift Preoperational Checks (Continued)

[] 18.4 Fully lower the lifting mechanism.

[] 18.5 Place the following controls in NEUTRAL:

[] • Transmission
[] • Lift control lever
[] • Tilt control lever
[] • Right fork position lever
[] • Left fork position lever
[] • Fork sideshift lever
[] • Auxiliary control lever

[] 18.6 Allow the engine to idle for 1 to 2 minutes.

[] 18.7 Turn the ignition key to the OFF position.

[] 18.8 Pull PULL TO STOP control all the way out.

[] 18.9 Place the battery disconnect switch in OFF:

[] 18.10 Place chocks under the wheels.

[] 19.0 Initiate PWRs to address any deficiencies that CANNOT be corrected by Waste Operations.

[] 20.0 Notify the WHS of any deficiencies discovered during the preoperational checks and their status (such as deficiencies corrected, PWRs generated).

21.0 Record the following in the Equipment Logbook:

[] 21.1 Checks satisfactory or unsatisfactory.

[] 21.2 Addition of fluids and amount added.

[] 21.3 Any discovered deficiencies NOT corrected.

[] 21.4 Any outstanding/newly generated PWRs.

[] 22.0 Enter the time and date, then sign the Equipment Logbook to document the performance of the Preoperational Checks.

41 Ton Diesel Forklift Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Record Hour Meter reading in the Equipment Logbook.

[] 3.0 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.

- **IF** the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook

4.0 Verify the following prior to starting the engine:

[] 4.1 Engine oil level is in the normal range on the dipstick.

[] 4.2 Transmission oil level is above the full mark on the dipstick.

[] 4.3 Hydraulic tank level is within the normal range on the dipstick.

[] 4.4 Battery compartment is free from acid spills and has NO loose or missing caps or cables.

[] 4.5 Air cleaner indicator is Green.

[] 4.6 Belts NOT obviously loose, worn, or cracked.

[] 4.7 Forks DO NOT have any noticeable cracks, breaks, bending, twisting, and/or wear.

[] 4.8 Upright DOES NOT have any signs of obvious wear **OR** damaged or missing parts.

[] 4.9 General Condition: NO damage, loose parts, major oil leaks, grease, or trash.

[] 4.10 Seat belts in good condition.

[] 4.11 Tires are NOT excessively worn or cracked AND all wheel lugs are present.

[] 4.12 Pedals/control levers NOT loose or sticking.

[] 4.13 Fire suppression system test satisfactory.

41 Ton Diesel Forklift Preoperational Checks (Continued)

[] 4.14 Adjust the seat to a position that provides easy access to all controls.

5.0 Start the forklift as follows:

NOTE: This note applies to Step 5.1. The engine will NOT start unless the transmission is in the NEUTRAL position.

5.1 Verify the following controls are in NEUTRAL:

[] • Transmission
[] • Lift control lever
[] • Tilt control lever
[] • Right fork position lever
[] • Left fork position lever
[] • Fork sideshift lever
[] • Auxiliary control lever

[] 5.2 Verify the parking brake is engaged.

[] 5.3 Turn the battery disconnect switch to ON.

[] 5.4 Push the PULL TO STOP control all the way in.

CAUTION

This Caution applies to Step 5.5.
DO NOT use starting fluid.

[] 5.5 Start the engine by turning the ignition key to START.

5.6 **IF** the engine FAILS to start within 20 seconds, perform the following:

[] 5.6.1 Release the ignition key.

[] 5.6.2 Allow the starter to cool for 3 to 5 minutes before trying another start.

[] 5.6.3 Attempt to start the engine.

[] 5.6.4 **IF** the engine FAILS to start in four (4) attempts, notify WHS and proceed as directed.

41 Ton Diesel Forklift Preoperational Checks (Continued)

[] 5.7 Investigate immediately any unusual noises.

[] 5.8 **IF** engine oil pressure gage DOES NOT indicate oil pressure within 15 seconds, immediately stop the engine.

> **CAUTION**
>
> This Caution applies to Steps 5.9 and 5.10. Avoid revving the engine when it is cold.

[] 5.9 **WHEN** the engine is operating smoothly, decrease the engine speed by letting out on the throttle.

[] 5.10 Allow the engine to warm.

[] 5.11 Verify sufficient fuel for intended operations.

6.0 Verify the following:

[] 6.1 Engine oil pressure within NORMAL range.

[] 6.2 Transmission oil pressure within NORMAL range.

[] 6.3 Transmission oil temperature within NORMAL range.

[] 6.4 Hydraulic oil filter indicator is Green.

[] 6.5 Hydraulic system has NO visible leakage from the hoses, couplings, or fittings.

[] 6.6 Head temperature within NORMAL range.

[] 6.7 Ammeter indicates a positive charge.

[] 6.8 Voltage reading 26 to 28 volts.

[] 6.9 Air pressure reading 90 to 120 psi.

[] 6.10 Horn sounds when activated.

[] 6.11 Front and rear lights illuminate when turned on.

41 Ton Diesel Forklift Preoperational Checks (Continued)

7.0 Perform the following to test hoist and fork controls:

[] 7.1 Operate the Lift Control Lever in the RAISE position and verify the hoist rises.

[] 7.2 Operate the Lift Control Lever in the LOWER position and verify the hoist lowers.

[] 7.3 Operate the Tilt Control Lever in the FORWARD position and verify the mast tilts forward.

[] 7.4 Operate the Tilt Control Lever in the TILT BACKWARD position and verify the mast tilts backwards.

[] 7.5 Operate the Right Fork Position Lever in the IN direction and verify the forks move inward.

[] 7.6 Operate the Right Fork Position Lever in the OUT direction and verify the forks move outward.

[] 7.7 Operate the Left Fork Position Lever in the IN direction and verify the forks move inward.

[] 7.8 Operate the Left Fork Position Lever in the OUT direction and verify the forks move outward.

[] 7.9 Operate Fork Sideshift Control in the LEFT position and verify the forks move left.

[] 7.10 Operate Fork Sideshift Control in the RIGHT position and verify the forks move right.

CAUTION

This Caution applies to the remainder of this Attachment. DO NOT release the brakes or attempt to move the machine IF air pressure < 60 psi.

[] 8.0 Release the spotting brake.

[] 9.0 Release the emergency brake control.

41 Ton Diesel Forklift Preoperational Checks (Continued)

10.0 Perform the following with the parking brake applied:

[] 10.1 Shift the transmission into DRIVE gear.

[] 10.2 Verify the forklift does NOT move.

[] 10.3 Shift the transmission into NEUTRAL gear.

[] 11.0 Release the parking brake.

[] 12.0 Apply the spotting brake, and perform the following:

[] 12.1 Shift the transmission into DRIVE gear.

[] 12.2 Verify the forklift DOES NOT move.

[] 12.3 Shift the transmission into NEUTRAL gear.

[] 13.0 Release the spotting brake and shift the transmission into DRIVE gear.

[] 14.0 Verify the steering operates smoothly and DOES NOT pull in either direction while moving.

[] 15.0 Verify the back-up alarm operates while moving in the reverse direction.

[] 16.0 Apply the service brakes. Verify the service brakes respond properly and DO NOT drag.

17.0 Perform the following to test de-clutch pedal:

[] 17.1 Press the De-clutch pedal.

[] 17.2 Verify De-clutch disengages the Transmission.

[] 17.3 Verify the De-clutch sets the brake.

18.0 IF desired, shut down the forklift as follows:

[] 18.1 Verify the forklift is clear of exits, access to stairways, and fire equipment.

[] 18.2 Apply the parking brake.

[] 18.3 Apply the spotting brake.

[] 18.4 Fully lower the lifting mechanism.

41 Ton Diesel Forklift Preoperational Checks (Continued)

[] 18.5 Place the following controls in NEUTRAL:

[] • Transmission
[] • Lift control lever
[] • Tilt control lever
[] • Right fork position lever
[] • Left fork position lever
[] • Fork sideshift lever
[] • Auxiliary control lever

[] 18.6 Allow the engine to idle for 1 to 2 minutes.

[] 18.7 Turn the ignition key to the OFF position.

[] 18.8 Pull PULL TO STOP control all the way out.

[] 18.9 Place the battery disconnect switch in OFF:

[] 18.10 Place chocks under the wheels.

[] 19.0 Initiate PWRs to address any deficiencies that CANNOT be corrected by Waste Operations.

[] 20.0 Notify the WHS of any deficiencies discovered during the preoperational checks and their status (such as deficiencies corrected, PWRs generated).

21.0 Record the following in the Equipment Logbook:

[] 21.1 Checks satisfactory or unsatisfactory.

[] 21.2 Addition of fluids and amount added.

[] 21.3 Any discovered deficiencies NOT corrected.

[] 21.4 Any outstanding/newly generated PWRs.

[] 22.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

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HAZARDOUS MATERIAL RESPONSE EQUIPMENT

WEEKLY CHECK LIST

Hazardous Material Response Equipment

Date:_____

HAZMAT TRAILER

__✓__ OK __X__ Adjustment made __O__ Repairs required

A/R written _____ A/R number _____

(check appropriate information)

ITEM	Min. #	Current #	Remedial Actions
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)	1		
Absorbent sheets 3' X 100'	1		
Grab and Go container: spill control bucket; For solvents and neutralizing absorbent; 5 gallon bucket	1		
Grab and Go container: spill control bucket; For acids/caustics; 5 gallon bucket	1		
100 ft. rolled "Pig" for general liquid'	1		
100 ft. rolled "Pig" for oil	1		
Drum spreader	1		
Hand operated pump for chemical transfer	1		
Hand operated pump for petroleum transfer	1		
Floor squeegee, nonwood handle	1		
Gas cylinder leak control kit	1		
1-gallon plastic jugs	4		

WEEKLY CHECK LIST (cont.)
Hazardous Material Response Equipment

ITEM	MIN. #	Current #	Remedial Actions
5-gallon plastic pail with lids	3		
Portable lighting unit	1		
Patching kit, series A Hazardous Response Kit; Class A	1		
Scoop, plastic	1		
Shovel, plastic	3		
Fully encapsulated Level A suits	4		
Level B suits	4		
Acid suits, green	4		
Chemical and Chemical-Support gloves			
inner-cloth gloves	12 pair		
outer-pvc gloves	12 pair		
outer-viton gloves	5 pair		
HAND TOOLS			
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	1		

Inspected by:_____ time:_____ date:_____

Reviewed by:_____

Nature of repairs:_____

_____

MINERS FIRST AID STATION

REQUIREMENTS FOR MINERS FIRST AID STATION

One Folding Stretcher	One Wool Blanket	One Fire Blanket	One 24-36 Unit First Aid Kit	One Set of Air Splints	One Oxygen Ball With Mask	Initial and Date

Comments

Place and "X" in the box if items checked are o.k.
Contact your supervisor if discrepancy is found.

MINE PAGER PHONES

INFORMATION ONLY

DATE: 11/13/95 ***** C H A M P S ***** P[redacted]1
TIME: 11:54 A.M. Work Order Step/Text Master

****

Work Order : 9508597 Type : P PLANNED
Status : 70 SCHEDULED

Description: 73P006 MNG FO PLANT COMMUNICATIONS SYSTEM TESTING

Priority : 2 SCORE - 20 ON RISK CHART
Class : 4Q2

Project :
Account : P15230201
Department : FACOP

Assigned To :
Contact :
Requested : PROCTOL
Requested Date: 11/13/95
Requested Time: 0900

Task Id : WP 04-PC3017
Reference Id : WP 04-PC3017

Equipment : 73-P-006
Name : ANNOUNCING PANEL PA & INTERCOM SYSTEM
Design Class: IIIB
System : PC03
Parent :

Building : 451
Floor : 02
Room : 230

Work Description

********** Work Order Line Item **********

Step : 001 Seq : 000 Status : 70 SCHEDULED
Need Date : 11/24/95 Crew: FO Shift : D Trade: FOTEC
Schedule Date: 11/24/95
Department : FACOP Notebook:

Short Description: 73P006 MNG FO PLANT COMMUNICATIONS SYSTEM TESTING

Long Description
73P006 MNG FO PLANT COMMUNICATIONS SYSTEM TESTING

Tagout/Lockout Y N No

Release/Date RWAke 11/20/95	Work Group Supv Release/Date NA
Work Performed: Per attachment	
Man Hours: 2 Craft Signature: NA	
WORK COMP/DATE OPS RWAke 11/20/95	RETEST COMP/DATE RDie 11/20/95
OPS CANCELLATION/DATE	WORK COMP/DATE WGS NA

ATTACHMENT 1 - ESSENTIAL PLANT COMMUNICATION SYSTEMS TEST RECORD

03 FOR ANY MAINTENANCE PERFORMED ON THIS SYSTEM THAT ALLOWS OR REQUIRES THIS PROCEDURE TO BE PERFORMED, RECORD THE DATE MAINTENANCE WAS COMPLETED, THE NATURE OF THE REPAIRS, AND THE PWR NUMBER. ENTER N/A IF NOT APPPLICABLE.

DATE	NATURE OF REPAIR	PWR NO.

5.1.17	PA Alarm System test announcements made.	____/____ Initials / Time
5.2.5	Underground Evacuation Alarm System test announcements made.	____/____ Initials / Time

5.3.1	Essential Underground Mine Phone Test - Check if satisfactory.			
Mine Phone Location	Underground to CMR Page	Voice Communication Understandable	CMR to Underground Page	Initials / Time
05 ~~S300 Assembly Area~~ DELETE				
S1000 Assembly Area				
S1950 Assembly Area				
S550 Watch Station				
WH Shaft Station Assembly Area				
SH Shaft Station Assembly Area				
Barricade in Room G				

5.3.2	Essential Surface Mine Phone Test - Check if satisfactory.			
Mine Phone Location	Surface to CMR Page	Voice Communication Understandable	CMR to Surface Page	____/____ Initials / Time
Lamp Room				
EOC				

5.4.2	SNS test announcement made.	____/____ Initials / Time

PERSONS INITIALING FOR STEP COMPLETION IN THIS PROCEDURE, COMPLETE THE FOLLOWING:

_____ / _____ / _____
PRINT NAME / INITIALS / DATE

_____ / _____ / _____
PRINT NAME / INITIALS / DATE

RECORD VALIDATION:

_____ / _____ / _____
PRINT NAME / INITIALS / DATE

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PERIMETER FENCE, GATES, AND SIGNS

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FACILITY FENCES, GATES, AND SIGNS INSPECTION CHECKLIST

Daily - to be completed by Security personnel by the end of Swing Shift EACH Day

LOCATION OF FENCE OR GATE	CLEAR ZONE*		FENCE		SIGNS		COMMENTS/CORRECTIVE ACTIONS	DATE (MO/DAY /YR)	TIME (MILITARY NOTATION)	SIGNATURE OF INSPECTOR
	PASS	FAIL	PASS	FAIL	PASS	FAIL				
Perimeter/Daily										
Plant Substation										
Burned out Perimeter Lights/Swing Shift Daily										
Portacomp Storage Areas										
Stabilization Lagoon										
Sanitary Landfill										
Main Site Entrance										
Emergency Exits										
Railroad Tracks										

Additional Comments _____

* Applies only to the perimeter fence.

Copies of all inspection records must be submitted, as they are completed, the Environmental and Strategic Planning department for inclusion in the operating record in accordance with WP 02-703, RCRA Record Keeping.

ATTACHMENT 2
PFO-011
Page 1 of 1

3/5

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PERSONAL PROTECTIVE EQUIPMENT

SCBA CYLINDER/BACKPACK COMPONENT QUARTERLY INSPECTION

SCBA #	BRAND	DATE:	SCBA #	BRAND
		TIME:		
CYLINDER #	CAPACITY	LOCATION:	CYLINDER #	CAPACITY
		INSPECTED BY:		
PASS	FAIL	INSPECTION ITEMS	PASS	FAIL
		HYDRO DATE WITHIN 3 YEARS		
		AIR PRESSURE AT LEAST 80%		
		HOSES AND CONNECTIONS		
		BACKPACK COMPONENTS		
		STRAPS AND BELT EXTENDED		
		GAGES (REGULATOR & CYLINDER)		
		CYLINDER CONDITION		
		BY-PASS VALVE CLOSED		
		MAIN-LINE VALVE CLOSED		
		GASKET & AIR LEAK TEST		
		REGULATOR WORKING PROPERLY		
		LOW PRESSURE ALARM CHECK		
		PRESSURE OFF REGULATOR		
		PASS ALARM CHECK		

REMARKS AND DEFICIENCIES: _____

_____

_____

CORRECTIVE ACTIONS TAKEN: _____

_____

_____

Internal ESH Form RESP-001 (121595)

WEEKLY SCBA INSPECTION

Date:_____ Time:_____

SCBA number:_____ Brand:_____ Location:_____

_✓_ OK _X_ Adjustment made _O_ Repairs required
(check or complete the appropriate information)

ITEM/REQUIREMENT	CONDITION	REMEDIAL ACTIONS
Air pressure not less than 80 percent (3600 psi)		
Hoses and hose connectors		
Gasket and airleak test		
Facepiece (clean/facepieces are cleaned and inspected by Industrial Hygiene)		
Backpack components		
Gauges (regulator and cylinder)		
Cylinder (condition)		
Cylinder hydro date		
By-pass valve closed		
Main-line valve closed		
Regulator		
Pressure off of the regulator		
Straps extended		
Alarm check		
Motion or heat detector alarm test		

Inspected by:_____

F.P.E. or Designee:_____

Comments:_____

_____

PUBLIC ADDRESS

DATE: 11/13/95 ***** C H A M P S ***** P[redacted]
TIME: 11:54 A.M. Work Order Step/Text Master

****

Work Order : 9508597 Type : P PLANNED
Status : 70 SCHEDULED

Description: 73P006 MNG FO PLANT COMMUNICATIONS SYSTEM TESTING

Priority : 2 SCORE - 20 ON RISK CHART
Class : 4Q2

Project :
Account : P15230201
Department : FACOP

Assigned To :
Contact :
Requested : PROCTOL
Requested Date: 11/13/95
Requested Time: 0900
Task Id : WP 04-PC3017 Reference Id : WP 04-PC3017

Equipment : 73-P-006
Name : ANNOUNCING PANEL PA & INTERCOM SYSTEM
Design Class: IIIB
System : PC03
Parent :

Building : 451
Floor : 02
Room : 230

Work Description

********** Work Order Line Item **********

Step : 001 Seq : 000 Status : 70 SCHEDULED
Need Date : 11/24/95 Crew: FO Shift : D Trade: FOTEC
Schedule Date: 11/24/95
Department : FACOP Notebook:

Short Description: 73P006 MNG FO PLANT COMMUNICATIONS SYSTEM TESTING

Long Description
73P006 MNG FO PLANT COMMUNICATIONS SYSTEM TESTING

Tagout/Lockout Y (N) No

Release/Date RWAlle 11/20/95	Work Group Supv Release/Date NA
Work Performed: Per attachment	
Man Hours: 2 Craft Signature: NA	
WORK COMP/DATE OPS RWAlle 11/20/95	RETEST COMP/DATE RWAlle 11/20/95
OPS CANCELLATION/DATE	WORK COMP/DATE WGS NA

ATTACHMENT 1 - ESSENTIAL PLANT COMMUNICATION SYSTEMS TEST RECORD

03 FOR ANY MAINTENANCE PERFORMED ON THIS SYSTEM THAT ALLOWS OR REQUIRES THIS PROCEDURE TO BE PERFORMED, RECORD THE DATE MAINTENANCE WAS COMPLETED, THE NATURE OF THE REPAIRS, AND THE PWR NUMBER. ENTER N/A IF NOT APPPLICABLE.

DATE	NATURE OF REPAIR	PWR NO.

5.1.17	PA Alarm System test announcements made.	____/____ Initials / Time
5.2.5	Underground Evacuation Alarm System test announcements made.	____/____ Initials / Time

5.3.1	Essential Underground Mine Phone Test - Check if satisfactory.			
Mine Phone Location	Underground to CMR Page	Voice Communication Understandable	CMR to Underground Page	Initials / Time
05 ~~E300 Assembly Area~~ DELETE				
S1000 Assembly Area				
S1950 Assembly Area				
S550 Watch Station				
WH Shaft Station Assembly Area				
SH Shaft Station Assembly Area				
Barricade in Room G				

5.3.2	Essential Surface Mine Phone Test - Check if satisfactory.			
Mine Phone Location	Surface to CMR Page	Voice Communication Understandable	CMR to Surface Page	____/____ Initials / Time
Lamp Room				
EOC				

5.4.2	SNS test announcement made.	____/____ Initials / Time

PERSONS INITIALING FOR STEP COMPLETION IN THIS PROCEDURE, COMPLETE THE FOLLOWING:

PRINT NAME	INITIALS	DATE

RECORD VALIDATION:

PRINT NAME	INITIALS	DATE

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RADIATION MONITORING EQUIPMENT

ATTACHMENT 1

PORTABLE INSTRUMENT PERFORMANCE CHECK

Instrument 75-HP-####:	Reference Readings at Time of Calibration			
Probe 75-HP-####:	Reading units:			
Instrument/probe model:	Source Type and Serial Number: 1.	Reading: Range (±20%):	Source Type and Serial Number: 2.	Reading: Range (±20%):
Month: Year:	Source Type and Serial Number: 3.	Reading: Range (±20%):	Source Type and Serial Number: 4.	Reading: Range (±20%):
	Source Type and Serial Number: 5.	Reading: Range (±20%):	Calibration Due:	

1	2	3	4	5	6	7
Time	Time	Time	Time	Time	Time	Time
Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.
Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature

8	9	10	11	12	13	14
Time	Time	Time	Time	Time	Time	Time
Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.
Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature

Comments:

CONTROLLED COPY

ATTACHMENT 1

PORTABLE INSTRUMENT PERFORMANCE CHECK (CONT.)

15	16	17	18	19	20	21
Time	Time	Time	Time	Time	Time	Time
Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.
Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature

22	23	24	25	26	27	28
Time	Time	Time	Time	Time	Time	Time
Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading	Meter Reading
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.
Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature	Technician Signature

29	30	31	Comments:
Time	Time	Time	
Meter Reading	Meter Reading	Meter Reading	
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	1. 2. 3. 4. 5.	
Technician Signature	Technician Signature	Technician Signature	Supervisor Signature/Date:

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ATTACHMENT 2

SOURCE CHECK LABEL

Source check completed SAT

Date: _____ Tech. Initials: _____

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ATTACHMENT 4

RMS ~~FILTER~~ LOG SHEET

Equipment type and number:

Location:

Date	Time	Filter Change		Flow (cfm)		Remarks	Signature
		Yes	No	Initial	Final		

ATTACHMENT 2

PORTABLE CAM OPERABILITY DATA SHEET

Shift: 1 2 3

Legend	Checklist
NIS: Not in service	CAM flow: 0.9 to 1.1 cfm
OOC: Out of commission	OK: Operating properly
PWR: Plant work request	Alpha 6 spectrum
	Channel 178 ± 5 channels

A check in the column indicates the condition meets the limit.
Use an asterisk to indicate LCO equipment.

Start time: _____ Stop time: _____ Date: _____

_____ _____ _____
Technician signature Supervisor signature Date

_____ _____
CMS Operator signature Date

Location	Instr. Number	Status	Counts (cpm)	Alpha 6 Channel	Flow / Flow Cal.	Instr. Cal.	PWR # / PWR Date	Remarks

Attachment 5 - Portable Alpha CAM Functional Checklist

Equipment number: _____ Location: _____

Source ID: _____ Source type: _____ Source dpm: _____

05 Start Time:_____ Stop Time:_____

	Yes	No
	(Initial appropriate column)	
^{214}Po peak centered at channel 178±5 channels	____	____
Flow is 0.9 to 1.1 cfm	____	____
Flow alarm actuates	____	____
HI-HI alarm beacon and bell actuate	____	____
^{239}Pu peak in channel 112±5 channels reading _____ cpm	____	____
Efficiency _____(≥15 percent?)	____	____

Comments: _____

_____

_____

_____

_____

Check Appropriate Line

Test satisfactory: _____ Test unsatisfactory: _____

Operator: _____ _____ _____
PRINT NAME SIGNATURE DATE

Supervisor: _____ _____ _____
PRINT NAME SIGNATURE DATE

Attachment 6 - Portable Beta-Gamma CAM Functional Checklist

Equipment number: _____ Location: _____

Source ID: _____
Source type: _____
Source dpm: _____
Decayed value: _____ dpm

05 Start Time:_____ Stop Time:_____

	Yes	No
	(Initial appropriate column)	
Counting lamp illuminated	_____	_____
Background _____(≤1000 cpm?)	_____	_____
Alarm beacon and bell actuate	_____	_____
Acknowledge button extinguishes bell while beacon remains on	_____	_____
Alarm setpoint reset	_____	_____
Efficiency _____(≥20 percent?)	_____	_____

Comments _____

_____

_____

_____

_____

Check Appropriate Line

Test satisfactory: _____ Test unsatisfactory: _____

Operator: _____ _____ _____
PRINT NAME SIGNATURE DATE

Supervisor: _____ _____ _____
PRINT NAME SIGNATURE DATE

CONTROLLED COPY

Attachment 7 - Initial Alarm Setup of the Alpha-6

Prior to or immediately following installation of the Alpha-6 or after an Alpha-6 "load default," the alarm system must be reconfigured for WIPP applications.

Summary

There are parameters associated with each alarm setpoint that may be edited. These parameters are listed in Section III.B.2 of the Alpha-6 technical manual and may be edited with a remote terminal through the remote port using the SET command as described in Appendix B of the technical manual.

The following changes may need to be made if using an Oyster model 80/16s terminal:

Variable	Parameter	Current Setting	Change
ALARM(3)	.N	5	6
ALARM(3)	.OF_M	5	6
ALARM (3) & (4)	.MODE	00000110B	11001000B
ALARM(4)	.N	5	6
ALARM(4)	.OF_M	5	6

Change Region R (ROI.1) to CH [92 . . . 126].

Change CONST(3): Plutonium algorithm constant to 0.6.

Change CONST(4): Detector efficiency (4π) to 0.20.

NOTE: Radiological Control personnel can vary the above settings. For example, excessive oversubtraction of ROI-1 may warrant a change in CONST(3). All changes must be justified by radiological calculation or written documentation.

NOTE: For Alpha-6/6A portable CAMs, set alarm (3) and alarm (4) modes to 11001110B.

Attachment 8 - Minimum and Maximum CAM Alarm Setpoints

	Minimum HI Alarm Setpoint	Minimum HI-HI Alarm Setpoint	Maximum Setpoint
Area Alpha CAMs (1 cfm) CAMs 27, 29, 31, 33, 35, 37, 39, 53, 55, 119, 125, 129	30 cpm	30 cpm	60 cpm
Effluent Alpha CAMs (2 cfm) CAMs 117, 121, 127, 151, 153, 157	40 cpm	40 cpm	1040 cpm
Effluent Alpha CAM (1 cfm) CAM 155	12 cpm, 8 DAC	12 cpm, 8 DAC	60 cpm
Area Beta-Gamma CAMs (1 cfm) CAMs 28, 30, 32, 34, 36, 38, 40, 54, 56, 120, 126, 130	6000 cpm, 8 DAC	7500 cpm, 10 DAC	7500 cpm
Effluent Beta-Gamma CAM (1 cfm) CAM 156	6000 cpm, 8 DAC	7500 cpm, 10 DAC	7500 cpm
Effluent Beta-Gamma (2 cfm) CAMs 118, 122, 128, 152, 154, 158	12,000 cpm, 8 DAC	15,000 cpm, 10 DAC	15,000 cpm
Low Range Area Radiation Monitors (ARMs)	10 mr/hr	50 mr/hr	50 mr/hr

CONTROLLED COPY

Attachment 9 - Setpoint Change Notice

The alarm setpoints on the following instrument have been temporarily reset

INSTRUMENT TYPE	INSTRUMENT NUMBER	INSTRUMENT LOCATION	TEMPORARY SETPOINT	EXPIRATION TIME/DATE

Reason for adjustment : High Radon : _____ Other : _____

If "Other" selected, give reason below :

_____

_____

_____

_____

05 Setpoint Adjusted By : _____ Date/Time: _____

Authorizing Signature : _____ Date : _____

Attachment 10 - RMS Data Sheet

Shift: 1 2 3

Legend	Checklist
NIS: Not in service OOC: Out of commission OK: Operating properly PWR: Plant work request UPS: Uninterruptible power supply	CAM flow: 0.9 to 1.1 cfm Sta. A : 1.8 to 2.2 cfm Alpha 6 spectrum Channel 178±5 channels

A check in the column indicates the condition meets the limit.

Start time: _____ _____ Date: _____
Technician signature

Stop time: _____ _____ Date: _____
Supervisor signature

Ambient Room Temperature : 70 - 90 °C Station A : _____ Station B : _____

Location	Instr. Number	Status	Counts (cpm)	Alpha 6 Channel	Enable	Flow / Flow Cal.	Instr. Cal.	UPS in Run	PWR # / PWR Date	Remarks
WHB/CH	CAM 055									
WHB/CH	CAM 056									
WHB/CH	CAM 153									
WHB/CH	CAM 154									
WHB/CH	CAM 157									
WHB/CH	CAM 158									
GS	SNMM #1									
GS	SNMM #2									
ROOM 1 PANEL 1	CAM 129									
ROOM 1 PANEL 1	CAM 130									

CONTROLLED COPY

Attachment 11 - Chart Recorder Operability Check

Date/Time: _____ / _____

FAS Skid B-2	As Found		As Left	
	Flo-Box (cfm)	Recorder (percent flow)	Flo-Box (cfm)	Recorder (percent flow)
Channel 1-QA				
Channel 2-QB				
Channel 3-QC				
Total Flow				

Flo-Box Input (cfm)	Allowable Tolerance (percent flow)	Chart Recorder Number		
		1	2	3
0.3	10 (5 to 15)			
2.0	67 (52 to 72)			
2.7	90 (85 to 95)			
Self-test	Sat/Unsat			
Op check	Sat/Unsat			

Remarks: _____

_____

_____

_____

Technician: _____ _____ _____
PRINT NAME SIGNATURE DATE

Supervisor: _____ _____ _____
PRINT NAME SIGNATURE DATE

CONTROLLED COPY

Attachment 12 - Air Inleakage Test Data Sheet

Equipment Number: _____ CAM Numbers: _____/_____

CAM Flow Rate Meter Calibration Due Date: _____

Inlet Flow Rate Measuring Device Model Number: _____

Inlet Flow Rate Measuring Device I.D. Number: _____

Inlet Flow Rate Measuring Device Calibration Due Date: _____

CAM Flow Rate Meter Reading: _____ cfm

Inlet Flow Rate Measuring Device Reading: _____ cfm

Difference between readings in cfm: _____ and in %: _____

Were adjustments to the system required? (Check one) No: ____ Yes: ____

If Yes, explain : _____

_____

_____

Test Results (Check one): Satisfactory:_____ Unsatisfactory:_____

If Unsatisfactory, explain reason : _____

_____

_____

05 Start Time:_____ Stop Time:_____

Technician: _____ _____ _____
PRINT NAME SIGNATURE DATE

RC Management: _____ _____ _____
PRINT NAME SIGNATURE DATE

CONTROLLED COPY

Attachment 13 - Omega Datalogger Operability Check Sheet

Date/Time: _____

FAS Skid A-3	As Found		As Left	
	Flow meter (cfm)	Datalogger (cfm)	Flow meter (cfm)	Datalogger (cfm)
Channel 1				
Channel 2				
Channel 3				
Total Flow				

Linearity Check

Flow meter input (cfm)	Allowable Tolerance (cfm)	Datalogger Number		
		1	2	3
0.300	0.296 to 0.304			
2.040	2.036 to 2.044			
2.700	2.696 to 2.704			

Comments: _____

_____

_____

_____

Technician: _____ PRINT NAME _____ SIGNATURE _____ DATE

RC Management: _____ PRINT NAME _____ SIGNATURE _____ DATE

CONTROLLED COPY

02

ATTACHMENT 10

RMS DATA SHEET

Shift: 1 2 3

Legend	Checklist
NIS: Not in service	CAM flow: 0.9 to 1.1 cfm
OOC: Out of commission	Sta. A : 1.8 to 2.2 cfm
OK: Operating properly	
PWR: Plant work request	Alpha 6 spectrum Channel 178 ±5 channels
UPS: Uninterruptible power supply	

A check in the column indicates the condition meets the limit.
An asterisk indicates LCO equipment.

Start time: _____ _____ Date: _____
Technician signature

Stop time: _____ _____ Date: _____
Supervisor signature

03 _____ Date: _____
~~CMR Operator Signature~~

Location	Instr. Number	Status	Counts (cpm)	Alpha 6 Channel	Exceeds	Flow / Flow Cal.	Instr. Cal.	UPS in Run	PWR # / PWR Date	Remarks
WHB/CH	CAM 055									
WHB/CH	CAM 056									
EMS/A	CAM 153									
EMS/A	CAM 154									
EMS/A	CAM 157									
EMS/A	CAM 158									
GS	STORM #1									
GS	STORM #2									

CONTROLLED COPY

RMS DATA SHEET (CONT.)

Shift: 1 2 3

Legend	Checklist
NIS: Not in service OOC: Out of commission OK: Operating properly PWR: Plant work request UPS: Uninterruptible power supply	CAM flow: 0.9 to 1.1 cfm Alpha 6 spectrum Channel 178 ±5 channels

A check in the column indicates the condition meets the limit. An asterisk indicates LCO equipment.

Start time: _____ _____ Date: _____
Technician signature

Stop time: _____ _____ Date: _____
Supervisor signature

03 ~~CMR Operator Signature~~ _____ Date: _____

Location	Instr. Number	Status	Limits (ppm or Rate (mR/h)	Alpha 6 Channel	Enable	Flow / Flow Cal.	Instr. Cal.	UPS in Run	PWR # / PWR Date	Remarks
ROOM 1 PANEL 1	CAM 129									
ROOM 1 PANEL 1	CAM 130			[redacted]						

CONTROLLED COPY

RADIO EQUIPMENT

No forms are used. Radios are operated daily and are repaired upon failure

RESCUE TRUCK

SURFACE RESCUE TRUCK AND EQUIPMENT

WEEKLY CHECK LIST

Surface Rescue Truck and Response Equipment

Date:_____

RESCUE TRUCK

__✓__ OK __X__ Adjustment made __O__ Repairs required

A/R written _____ A/R number _____

(check or complete the appropriate information)

ITEM	Condition	Min. #	Current #	Remedial Actions
Oil level		N/A	N/A	
Radiator level		N/A	N/A	
Fan Belts		N/A	N/A	
Brake Fluid Level		N/A	N/A	
Fuel level		N/A	N/A	
Oil Pressure (psi)		N/A	N/A	
Engine Temperature (normal range)		N/A	N/A	
Emergency Brake		N/A	N/A	
Horn and siren		N/A	N/A	
Lights (head, fog, clearance, and quartz)		N/A	N/A	
Turn signals and hazard lights		N/A	N/A	
Spot lights		N/A	N/A	
Emergency lighting and warning systems		N/A	N/A	
Windshield wipers and washers		N/A	N/A	
Volt Meter		N/A	N/A	
Winch line, control, and motor		N/A	N/A	
VHF Radio		N/A	N/A	
Medical Radio		N/A	N/A	

WEEKLY CHECK LIST (cont.)
Surface Rescue Truck and Response Equipment

Date:_____

ITEM	Condition	Min. #	Current #	Remedial Actions
Cellular Phone (make sure it's plugged in)		N/A	N/A	
Interior light		N/A	N/A	
Tire Pressures (60 psi)				
Right front		N/A	N/A	
Right Rear Inside		N/A	N/A	
Right Rear Outside		N/A	N/A	
Left Rear Inside		N/A	N/A	
Left Rear Outside		N/A	N/A	
Left Front		N/A	N/A	
TOOLS AND EQUIPMENT				
4 ton come-a-long		1		
Portable generator (operational check)		1		
Porta-Power (Operational check)		1		
Air bag system (fill tank if < 1700 psi): 12-ton bag 17-ton bag 21.8 ton bag		1		
air chisel		1		
Oxygen, size E (fill if below 1000 psi)		1		
IV Start Kits	N/A	2		
#16 g Angiosets	N/A	2		
#18 g Angiosets	N/A	2		
#20 g Angiosets	N/A	2		
1000cc LR IV fluid	N/A	1		
500cc NS IV fluid	N/A	1		

WEEKLY CHECK LIST (cont.)
Surface Rescue Truck and Response Equipment

ITEM	Condition	Min. #	Current #	Remedial Actions
TRAUMA KIT				
trauma dressing	N/A	2		
4 x 4 sponges	N/A	25		
roll adhesive tape	N/A	1		
bite stick	N/A	1		
sterile burn sheet	N/A	1		
glucose substance	N/A	1		
sterile gauze dressings	N/A	2		
pkg. band-aids	N/A	1		
soft-roller bandages	N/A	4		
triangular bandages	N/A	3		
adult blood pressure cuff/stethoscope		1		
penlight		1		
adult oropharyngeal airway		1		

Inspected by:_____ time:_____ date:_____

F.P.E. or Designee:_____

Nature of repairs:_____

_____

UNDERGROUND RESCUE TRUCK AND EQUIPMENT

WEEKLY CHECK LIST

Underground Rescue Truck and Response Equipment

Date:_____

UNDERGROUND RESCUE TRUCK

_✓_ OK _X_ Adjustment made _O_ Repairs required

A/R written _____ A/R number _____

(check or complete the appropriate information)

ITEM	Condition	Min. #	Current #	Remedial Actions
engine oil level		N/A	N/A	
fan belts		N/A	N/A	
transmission fluid level		N/A	N/A	
noticeable leaks (engine compartment)		N/A	N/A	
brake fluid level		N/A	N/A	
seat belt		N/A	N/A	
horn		N/A	N/A	
emergency warning lights		N/A	N/A	
siren		N/A	N/A	
headlights (low)		N/A	N/A	
headlights (high)		N/A	N/A	
turn signal switch		N/A	N/A	
left side air pak		N/A	N/A	
left side 10 # ext.		N/A	N/A	
125 # ext. (dry chemical)		N/A	N/A	
150# ext. (foam)		N/A	N/A	
tail lights		N/A	N/A	
stop lights		N/A	N/A	
flashing lights		N/A	N/A	
back up lights		N/A	N/A	

WEEKLY CHECK LIST
Underground Rescue Truck and Response Equipment

Date:_____

ITEM	Condition	Min. #	Current #	Remedial Actions
right side 10# ext.		N/A	N/A	
right side air pack		N/A	N/A	
apparatus clean (dust off)		N/A	N/A	
body condition		N/A	N/A	
START ENGINE				
fuel level		N/A	N/A	
oil pressure (psi)		N/A	N/A	
battery charge		N/A	N/A	
vehicle hour meter reading (after test)		N/A	N/A	
test drive		N/A	N/A	
handling/brakes/ shifting		N/A	N/A	
forward/reverse/ shifting		N/A	N/A	
TIRES PRESSURES (100 psi)				
right front		N/A	N/A	
right rear		N/A	N/A	
left rear		N/A	N/A	
left front		N/A	N/A	
TOOLS AND EQUIPMENT				
500 watt halogen lamp (portable)		2		
Come-a-longs		2		
12 # sledge hammer		1		
6' wrecking bar		1		
bottle jacks		2		
2' pry bar		2		

WEEKLY CHECK LIST
Underground Rescue Truck and Response Equipment

ITEM	Condition	Min. #	Current #	Remedial Actions
5' pry bar		2		
4# hammer		1		
⅜" drive socket set		1		
½" drive socket set		1		
¾" drive socket set		1		
25' ½"" chain		1		
18" crescent wrench		2		
100' extension cords		2		
10' nylon slings		2		
6' nylon slings		2		
4' nylon slings		2		

Inspected by:_____ time:_____ date:_____

F.P.E. or Designee:_____

Nature of repairs:_____

_____

SALT HANDLING SHAFT

SALT HOIST OPERATOR'S LOG

DATE _____

NIGHT SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.

I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____

I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____

The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

SALT HOIST INSPECTION		TIME	COMMENTARY
1. Brake Paths – Clean	☐		
2. Hoist Bearings – Oil Flow	☐		
3. Pump Reservoir – Oil Level	☐		
4. Air Brake Oilers – Oil Level	☐		
5. MG Ground Brush – No Arcing	☐		
6. Lilly Controller – Functional	☐		
7. Drain Receivers/Dryer	☐		
8. Hoist Mtr. Ventilation–Functional	☐		
9. Hoist Gen.–No Loose Connections	☐		

Comments: _____

Hoistman _____ Time _____

SK COLLAR INSPECTION	
1. Rope Connection – No Slippage	☐
2. Safety Gates – No Damage	☐
3. Top Rollers & Shoes – No Damage	☐
4. Conveyance Doors – No Damage	☐
5. Cage Welds – No Cracks	☐
6. Skip Latch – No Damage	☐
7. BTM Rollers & Shoes – No Damage	☐
8. Cage Phone – Functional	☐
9. Safety Dogs – No Damage	☐
10. Bell Signal – Functional	☐

Comments: _____

Toplander _____ Time _____

SK STATION INSPECTION	
1. Ground Control – No Loose Grnd	☐
2. Station Steel – No Damage	☐
3. Safety Gates – No Damage	☐
4. Load Pocket – Oilers & Grease	☐
5. Load Pocket – Drain Air Lines	☐
6. Sump Fan – Functional	☐
7. Mine Phone – Functional	☐
8. Bell Signal – Functional	☐

Comments: _____

Bottomlander _____ Time _____

DAY SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.

I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____

I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____

The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

SALT HOIST INSPECTION		TIME	COMMENTARY
1. Brake Paths – Clean	☐		
2. Hoist Bearings – Oil Flow	☐		
3. Pump Reservoir – Oil Level	☐		
4. Air Brake Oilers – Oil Level	☐		
5. MG Ground Brush – No Arcing	☐		
6. Lilly Controller – Functional	☐		
7. Drain Receivers/Dryer	☐		
8. Hoist Mtr. Ventilation–Functional	☐		
9. Hoist Gen.–No Loose Connections	☐		

Comments: _____

Hoistman _____ Time _____

SK COLLAR INSPECTION	
1. Rope Connection – No Slippage	☐
2. Safety Gates – No Damage	☐
3. Top Rollers & Shoes – No Damage	☐
4. Conveyance Doors – No Damage	☐
5. Cage Welds – No Cracks	☐
6. Skip Latch – No Damage	☐
7. BTM Rollers & Shoes – No Damage	☐
8. Cage Phone – Functional	☐
9. Safety Dogs – No Damage	☐
10. Bell Signal – Functional	☐

Comments: _____

Toplander _____ Time _____

SK STATION INSPECTION	
1. Ground Control – No Loose Grnd	☐
2. Station Steel – No Damage	☐
3. Safety Gates – No Damage	☐
4. Load Pocket – Oilers & Grease	☐
5. Load Pocket – Drain Air Lines	☐
6. Sump Fan – Functional	☐
7. Mine Phone – Functional	☐
8. Bell Signal – Functional	☐

Comments: _____

Bottomlander _____ Time _____

MID SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.

I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____

I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____

The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

SALT HOIST INSPECTION		TIME	COMMENTARY
1. Brake Paths – Clean	☐		
2. Hoist Bearings – Oil Flow	☐		
3. Pump Reservoir – Oil Level	☐		
4. Air Brake Oilers – Oil Level	☐		
5. MG Ground Brush – No Arcing	☐		
6. Lilly Controller – Functional	☐		
7. Drain Receivers/Dryer	☐		
8. Hoist Mtr. Ventilation–Functional	☐		
9. Hoist Gen.–No Loose Connections	☐		

Comments: _____

Hoistman _____ Time _____

SK COLLAR INSPECTION	
1. Rope Connection – No Slippage	☐
2. Safety Gates – No Damage	☐
3. Top Rollers & Shoes – No Damage	☐
4. Conveyance Doors – No Damage	☐
5. Cage Welds – No Cracks	☐
6. Skip Latch – No Damage	☐
7. BTM Rollers & Shoes – No Damage	☐
8. Cage Phone – Functional	☐
9. Safety Dogs – No Damage	☐
10. Bell Signal – Functional	☐

Comments: _____

Toplander _____ Time _____

SK STATION INSPECTION	
1. Ground Control – No Loose Grnd	☐
2. Station Steel – No Damage	☐
3. Safety Gates – No Damage	☐
4. Load Pocket – Oilers & Grease	☐
5. Load Pocket – Drain Air Lines	☐
6. Sump Fan – Functional	☐
7. Mine Phone – Functional	☐
8. Bell Signal – Functional	☐

Comments: _____

Bottomlander _____ Time _____

SPECIAL INSTRUCTIONS
Requires Time, Date & Authorized Signature

_____

_____

SHAFT INSPECTION RECORD

Date _____ MAINT. PIC _____

INSTRUCTIONS

W-Weekly B-Bi-Weekly M-Monthly Q-Quarterly Sb-Semi-Annual A-Annual

CIRCLE THE PM# PERFORMED & THE INTERVAL.

ITEM EXAMINED	OK	SEE COMMENTS
33-H-001 AIS SHAFT	W – – Q – A	
33-H-007 AIS WIRE ROPES	– BW – – SA –	
GALLOWAY		
SHAFT LINER		
WATER RINGS & DRAINS		
WALL ROCK & BROW		
CONVEYANCE		
CABLES, PIPES & SUPPORTS		
TRACK LIMIT SWITCH		

SIGN OR INITIAL THESE COLUMNS

COMMENTS

SIGNATURE SHAFTS SUPERVISOR (OPS) _____

HOISTING MACHINERY RECORD

MECHANICAL

Date _____ MAINT. PIC _____

INSTRUCTIONS

W-Weekly B-Bi-Weekly M-Monthly Q-Quarterly Sb-Semi-Annual A-Annual

CIRCLE THE PM# PERFORMED & THE INTERVAL.

PM#	DESCRIPTION	INTERVAL
33-G-001	AIR COMP.	W M – Q – –
33-H-001	AIS HOIST	W – – – – –
33-H-002	AIS HEADFRAME	W – – – – –
33-H-006	HYDE WINCH-EAST	– M – – – –
33-H-009	LILLY CONTROLLER	– M – – – –
33-H-010	NEW ERA WINCH-WEST	– M – Q – A
33-H-011	NEW ERA WINCH-EAST	– M – Q – A

COMMENTS

SIGNATURE HOIST SUPERVISOR (OPS) _____

ELECTRICAL HOISTING EQUIPMENT RECORD

Date _____ PIC (Maint) _____

INSTRUCTIONS

W-Weekly B-Bi-Weekly M-Monthly Q-Quarterly Sb-Semi-Annual A-Annual

CIRCLE THE PM# PERFORMED & THE INTERVAL.

PM#	DESCRIPTION	INTERVAL
33-HM-001	AIS HOIST MOTOR	– – – – S –
33-H-006	HYDE WINCH-EAST	– – – – S –
33-HS-011A	M/S-EAST GALLOWAY WINCH	– – – – S A
33-HS-010A	M/S-WEST GALLOWAY WINCH	– – – – S A
33P-CP-04/1	GALLOWAY CONTROL PANEL	– – – – S –
33P-RB-04/1	HOIST CONTROLLER	– – – – S –
33P-CP-03/1	DYNAMIC BRAKE CONTROLLER	– – – – S –

COMMENTS

SIGNATURE HOIST SUPERVISOR (OPS) _____

SELF RESCUERS

RECORD OF REVISION

Rev	Reason for Revision
0	New procedure

TECHNICAL REVIEW ORGANIZATIONS	
QUALITY ASSURANCE	MAINTENANCE
HOISTING OPERATIONS	INDUSTRIAL SAFETY
MINING OPERATIONS	EXPERIMENTAL OPERATIONS

	Print Name	Signature	Date
WRITER	Ronnie Rhoades	Ronnie Rhoades	07/13/93
OPSRC APPROVAL	J. J. Cotton		7/13/93
DEPT. APPROVAL	J L Lee		7/13/93

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1.0 PURPOSE AND SCOPE

1.1 The purpose of this procedure is to provide instructions to ensure the functional reliability of the self-rescuer used by personnel accessing the underground at the Waste Isolation Pilot Plant (WIPP).

1.2 This procedure is applicable to the Dräger 810, Dräger 910, and MSA W-65. The procedural steps in this document apply to all self-rescuers in use at the WIPP site. All self-rescuers failing the tests **SHALL** be discarded.

2.0 REFERENCES

2.1 BASELINE DOCUMENTS

30 CFR 57, Safety and Health Standards - Underground Metal and Nonmetal Mines

U.S. Department of Labor Program Information Bulletin No. P92-15

DOE/WIPP 91-005, Resource Conservation and Recovery Act Part B Permit Application

2.2 REFERENCED DOCUMENTS

NONE

3.0 DEFINITIONS

<u>IN SERVICE DATE</u> - Date self-rescuer received <u>on site</u>.

4.0 EQUIPMENT LIST

Dräger 810, Dräger 910, and MSA W-65 Self Rescuers

5.0 PRECAUTIONS AND LIMITATIONS

5.1 As required by 30 CFR 57, manufacturers' recommendations for inspection will be followed during all inspections.

5.2 Self-rescuers shall be checked, and information recorded, by a designated individual who is familiar with the requirements of this procedure and the manufacturers' recommendations.

6.0 INITIAL CONDITIONS

6.1 Self-rescuers **SHALL** be engraved with an in-service date on their labels.

6.2 Self-rescuers whose in-service life exceeds the following criteria **SHALL** be discarded:

6.2.1 Dräger 810 and Dräger 910:

A) The approved service life period for devices distributed on or before November 13, 1991, is five years from the date of manufacture.

B) The approved service life period for devices distributed after November 13, 1991 is the lesser of:

- Six years from the date of manufacture
- Five years from the date shipped to the WIPP site

6.2.2 MSA Model W-65

A) The approved service life is the lesser of:

- Fifteen years from the date of manufacture
- Ten years from the date shipped to the WIPP site

7.0 PROCEDURE

7.1 INSPECTION OF DRÄGER 810

7.1.1 Remove Dräger 810 from the protective pouch.

NOTE: The Dräger 810 has an in-service life extending forward in time from the date engraved on the label.

7.1.2 **IF** date on label indicates in-service life criteria of Step 6.2 has been exceeded, **THEN** discard the self-rescuer.

7.1.3 Verify the hermetic (vacuum) seal of the self-rescuer is intact by subjecting the lid and body to moderated twisting and pulling to establish a valid seal.

7.1.4 Perform the following:

A) Reject any self-rescuer for which the lid and body separate.

B) Place back into service those self-rescuers that pass the test.

NOTE: The Dräger 810 does NOT need the actual weight and factory weight recorded.

C) Record the following for self-rescuers that pass the test in Attachment 1, Self-Rescuer Quarterly Check:

- Time of inspection
- Self-rescuer model ID number
- Self-rescuer serial ID number
- In-service date

SIGNOFF REQUIRED

NOTE: Attachment 2, Self-Rescuer Color Codes, lists colors corresponding to a calendar quarter. Color coded tapes are used to verify the rescuer has been checked for that calendar quarter.

7.1.5 Attach to the self-rescuer, around the body, a color coded tape corresponding to the calendar quarter.

7.1.6 Return the self-rescuer for re-issue to the Underground Dispatcher's office.

7.2 INSPECTION OF MSA W-65 AND DRÄGER 910

7.2.1 Remove the self-rescuer from the protective pouch and remove all foreign particles.

NOTE: Both the MSA W-65 and the Dräger 910 have an in-service life extending forward in time from the date engraved on the label.

7.2.2 **IF** date on label indicates in-service life criteria of Step 6.2 has been exceeded, **THEN** discard the self-rescuer.

7.2.3 Weigh the self-rescuer on a calibrated scale.

7.2.4 Compare the weight of the self-rescuer with the factory weight stamped on the bottom of the self-rescuer.

7.2.5 Destroy, by separation, all self-rescuers weighing more than ten grams over the factory weight.

7.2.6 Examine the self-rescuer visually to assess its continued service using the following criteria:

- Banding seal is in place and unbroken
- Canister is NOT damaged around the sealing surface

7.2.7 Remove from service all damaged self-rescuers.

7.2.8 Record the following data for self-rescuers that pass the test in Attachment 1, Self-Rescuer Quarterly Check:

- Date
- Test Equipment ID Number
- Color Code
- Calibration Due Date
- Time of inspection
- Self-rescuer model ID number
- Self-rescuer serial ID number
- In-service date
- Actual weight
- Factory weight
- Pertinent remarks
- Names of Quarterly Check Performer and Reviewer/Validator

SIGNOFF REQUIRED

NOTE: Attachment 2, Self-Rescuer Color Codes, lists colors corresponding to a calendar quarter. Color coded tapes are used to verify the rescuer has been checked for that calendar quarter.

7.2.9 Attach to the self-rescuer, around the body, a color coded tape corresponding to the calendar quarter.

7.2.10 Return the self-rescuer for re-issue to the Underground Dispatcher's office.

8.0 REVIEW

NONE

9.0 RECORDS

9.1 The following is a Permanent Quality Record and Resource and Conservation Recovery Act (RCRA) Record:

- Attachment 1, Self-Rescuer Quarterly Check, Hoisting Operations

9.2 Validation of the Quality Record generated by this procedure is by signature of a Hoisting Operations Supervisor.

9.3 The record generated by this procedure is identified on, and maintained in accordance with Hoisting Operations Records Inventory and Disposition Schedule (RIDS).

9.4 The RCRA Record from this procedure is required to remain on-site for a minimum of three years.

ATTACHMENT 1 - SELF-RESCUER QUARTERLY CHECK

SELF-RESCUER QUARTERLY CHECK

Date:	Test Equipment ID No:
Color Code:	Calibration Due Date:

TIME	MODEL ID NO	SERIAL ID NO	IN-SERVICE DATE	ACTUAL WEIGHT	FACTORY WEIGHT

REMARKS:

PERFORMED BY

NAME (PRINTED)	INITIALS	SIGNATURE	DATE
			/ /
			/ /

REVIEWED AND VALIDATED BY:

NOTE: Completion of this step by a Hoisting Operations Supervisor constitutes validation of this record.

NAME (PRINTED)	INITIALS	SIGNATURE	DATE
			/ /

SELF-RESCUER COLOR CODES

Self-rescuers shall be inspected at intervals not to exceed three calendar months. To ensure the self-rescuers are properly maintained, each inspection period will be designated by a different color code to differentiate the requirement for inspection. Eight colors will be used over a two year period.

	COLOR	TIME PERIOD
01	VIOLET	1st Quarter, Even numbered calendar years
	BLUE	2nd Quarter, Even numbered calendar years
01	GRAY	3rd Quarter, Even numbered calendar years
	YELLOW	4th Quarter, Even numbered calendar years
	WHITE	1st Quarter, Odd numbered calendar years
	GREEN	2nd Quarter, Odd numbered calendar years
	RED	3rd Quarter, Odd numbered calendar years
	ORANGE	4th Quarter, Odd numbered calendar years

SURFACE RH TRU MIXED WASTE HANDLING AREA

Pre-operational Surface CH TRU Mixed Waste Handling Area Inspection

AREA/EQUIPMENT PRE-OPERATIONAL INSPECTIONS								
	DATE							
	TIME							
TRU Dock Storage Area	√/U*							
CH Container Storage Area	√/U*							
Shielded Room Storage Area	√/U*							
CH Derived Waste Area	√/U*							
Unloading Dock	√/U*							
Facility Pallets	√/U*							
PERFORMER INITIALS	xxxxxx							
WHE INITIALS	xxxxxx							

* √ = Satisfactory U = Unsatisfactory N/A = Not Inspected

Unloading Dock/Facility Pallet Checks:

- Structural fatigue, deformation, wear (obvious cracks, bends or breaks), rust
- Loose or deformed decking
- Missing hardware such as nuts and bolts

Container Area Checks:

- Epoxy floor coating in good condition - free of cracks and gaps
- No evidence of spills or leaks from waste containers
- Unobstructed access with 44 inch minimum aisle space around and between loaded facility pallets
- Containers in good condition/no visible deterioration
- Area free of debris and refuse
- Warning signs posted in area
- Telephone/Internal Communications - proper working order

PERFORMER NAME (PRINT) **INITIALS**

_____ _____

_____ _____

_____ _____

_____ _____

REMARKS:_____

VALIDATION:_____ / _____ / _____

WHE (Print Name) Signature Date

Off-Normal CH Container Storage Unit Pre-op/Weekly Inspection

OFF-NORMAL CONTAINER STORAGE UNIT PRE-OPERATIONAL/WEEKLY INSPECTION						
	DATE					
	TIME					
Pre-operational	√/U*					
Weekly	√/U*					
PERFORMER INITIALS	xxxxxxxx					
WHE INITIALS	xxxxxxxx					

* √ = Satisfactory U = Unsatisfactory N/A = Not Inspected

Pre-operational Checks:

- Epoxy floors in good condition NO cracks/gaps
- Storage area has been appropriately designated

Weekly Checks:

- No evidence of spills/leaks from waste container(s)
- Unobstructed access with a minimum 44 inches aisles space around loaded pallets
- Container(s) in good condition, no visible deterioration
- Waste containers elevated ≥6 inches above floor
- Area free of debris and refuse
- Warning signs posted in area

PERFORMER NAME (PRINT) **INITIALS**

_____ _____

_____ _____

_____ _____

_____ _____

REMARKS:_____

_____

VALIDATION:_____ / _____ / _____

WHE (Print Name) Signature Date

Trailer Parking Area and Container Storage Unit Weekly Inspection

TRAILER PARKING/CONTAINER STORAGE UNIT WEEKLY INSPECTIONS						
	DATE					
	TIME					
Trailer Parking Area	√/U*					
CH Container Storage Area	√/U*					
CH Derived Waste Area	√/U*					
Shielded Room Storage Area	√/U*					
PERFORMER INITIALS	xxxxxxx					
WHE INITIALS	xxxxxxx					

* √ = Satisfactory U = Unsatisfactory N/A = Not Inspected

Trailer Parking Area Checks:

- Warning signs posted in area
- Asphalt/concrete parking areas free from cracks/gaps that could create hazard to forklift operation
- Unobstructed access with minimum 4 foot aisle space around loaded TRUPACT(s)/Road Cask(s)
- TRUPACT-II(s) and Road Cask(s) in good condition/no visible deterioration
- No evidence of spills or leaks from TRUPACT-IIs or Road Casks
- Documented inventory representative of loaded TRUPACT-II/Road Cask in Parking Area

Container Area Checks:

- Epoxy floor coating in good condition - free of cracks and gaps
- No evidence of spills or leaks from waste containers
- Unobstructed access with 44 inch minimum aisle space around and between loaded facility pallets
- Containers in good condition/no visible deterioration
- Area free of debris and refuse
- Warning signs posted in area
- Telephone/Internal Communications - proper working order

PERFORMER NAME (PRINT) **INITIALS**

_____ _____

_____ _____

REMARKS:_____

VALIDATION:_____ / _____ / _____

WHE (Print Name) Signature Date

Pre-operational Surface RH TRU Mixed Waste Handling Area Inspection

AREA/EQUIPMENT PRE-OPERATIONAL INSPECTIONS								
	DATE							
	TIME							
RH Bay	√/U*							
Unloading Room	√/U*							
Facility Cask Loading Room	√/U*							
PERFORMER INITIALS	xxxxxxx							
WHE INITIALS	xxxxxxx							

* √ = Satisfactory U = Unsatisfactory N/A = Not Inspected

Area Checks:

- Epoxy floor coating in good condition - free of cracks and gaps
- Area free of debris and refuse
- Warning signs posted in area
- Telephone/Internal Communications - proper working order

PERFORMER NAME (PRINT) **INITIALS**

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

REMARKS:_____

VALIDATION:_____ / _____ / _____

WHE (Print Name) Signature Date

TRU MIXED WASTE DECONTAMINATION EQUIPMENT

TRU MIXED WASTE DECONTAMINATION EQUIPMENT

TRU MIXED WASTE DECONTAMINATION EQUIPMENT ANNUAL INSPECTION							
		DATE					
85 gallon drums	14						
SWBs	4						
RH Canister Overpack	1						
HEPA Filtered Vacuum	2						
Aquaset or Cement	100 lbs						
Polyvinyl Alcohol	1 - 5 gallon bucket						
Non Hazardous Decontaminating Agent	4 - 1 gallon bottles						

s = Satisfactory U = Unsatisfactory

- **Equipment Inventory Check**

PERFORMER NAME (PRINT) **INITIALS**

_____ _____

_____ _____

_____ _____

_____ _____

REMARKS:_____

VALIDATION:_____

WHE (PRINT NAME) SIGNATURE DATE

UNDERGROUND OPENINGS
ROOF BOLTS AND TRAVELWAYS

RECORD OF REVISION

Rev.	Reason for Revision
1	Combines WP 04-AU1006 and WP 04-AU1007 (WP 04-AU1006 will be cancelled upon approval of this procedure)

PERIODIC REVIEW PERFORMED: 6-13-95

TECHNICAL REVIEW ORGANIZATIONS	
ENGINEERING	QUALITY ASSURANCE
FACILITY OPERATIONS	ENVIRONMENT, SAFETY & HEALTH
MINING OPERATIONS	

	Print Name	Signature	Date
WRITER	Anthony P. Fernandez		02/24/93
OPSRC APPROVAL	Jeffrey J Cotton		022493
DEPT APPROVAL	H. Bibby		2-24-93

CONTROLLED COPY

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CONTROLLED COPY

1.0 PURPOSE AND SCOPE

1.1 This procedure provides the instructions to perform a ground control inspection of the ground conditions and roof bolts in the underground at the Waste Isolation Pilot Plant (WIPP).

01 1.2 General instructions are provided in Section 7.1 for removal of loose ground by hand scaling.

01 1.3 Mine Operations personnel will perform and document underground openings inspections described in Sections 7.2, 7.3 and 7.4.

03 1.4 Inspection performance will be documented on the underground openings inspection checklist. (Attach #1)

2.0 REFERENCES

2.1 BASELINE DOCUMENTS

01
- DOE/WIPP 91-005, Resource Conservation and Recovery Act, Part B permit application
- WP 12-1, Safety Manual
- 02 WP ~~13-6~~ 15-PR, Quality Assurance Records Management Policy
- 30 CFR Part 57, Federal Metal and Nonmetal Mine Safety and Health Regulations
- New Mexico Mine Safety Code for all Mines

2.2 REFERENCED DOCUMENTS

NONE

3.0 DEFINITIONS

- LOGBOOK - A numbered, bound, ledger retained by required shift personnel to record pertinent shift information and the operational history of the associated system/equipment
- BARRIER - A material object or set of objects place to impede unauthorized entry
- SCALING - Removal of insecure material from a back rib either by hand or by mechanical methods
- TRAVELWAY - A passage, walk, or route regularly use and designated for persons to go from one place to another, including shafts and stations

4.0 EQUIPMENT LIST

- Scaling bar or other appropriate sounding device (e.g., hammer, drillsteel, or roof bolt of appropriate length)

5.0 PRECAUTIONS AND LIMITATIONS

- Inspections should begin at a safe and sound starting point
- In areas where roof bolts have been covered with expanded metal or other supplemental support, a visual inspection **SHALL** be conducted using an elevated platform or other means suitable for performing a thorough inspection
- Loose roof bolts WILL NOT ring when sounded. Bad back or rib will have a drummy, hollow, or un-solid sound when sounded
- Ground conditions that create a hazard to persons **SHALL** be taken down **OR** supported before other work or travel is permitted in the affected area. Until corrective work is completed, the area **SHALL** be posted with a warning against entry, and when left unattended, **SHALL** have a barrier installed to impede unauthorized entry

6.0 INITIAL CONDITIONS

NONE

7.0 PROCEDURE

7.1 GENERAL EMPLOYEE GROUND CONTROL INSPECTION

7.1.1 Prior to performing work, visually inspect roof bolts, back, and rib in work area for the following:

- Roof, back, and rib bolts damaged/missing
- Roof bolts for loose or deformed plates
- Back and rib for cracks, fractures, and separations

7.1.2 Sound suspicious roof bolts, back, and rib in the work area to determine the following:

- Loose roof bolts
- Bad back or rib

7.1.3 Sound a random number of roof bolts, and random areas of the rib and back to determine the following:

- Loose roof bolts
- Bad back or bad rib

WARNING

When performing scaling operations, always maintain a safe avenue for retreat. Also maintain a position such that an unexpected event WILL NOT place you in a position where scaling bar or material being scaled could fall on you.

7.1.4 Using a scaling bar long enough to allow operator to work under good ground, remove bad ground.

7.1.5 **IF** loose, broken, or missing roof bolts are found,
THEN perform the following:

A) Notify immediate supervisor of deficiencies.

B) Notify Underground Facility Supervisor of deficiencies.

C) Proceed as directed by immediate supervisor.

7.1.6 **IF** bad ground CANNOT be removed manually,
THEN ensure the following are performed:

A) Post area to warn others of deficiencies.

B) **IF** area is to be left unattended,
THEN have barriers posted.

C) Notify supervisor of deficiencies.

D) Proceed as directed by supervisor.

7.2 UNDERGROUND TRAVELWAY WEEKLY INSPECTIONS

7.2.1 Visually inspect travelway roof bolts, back, and rib for the following:

- Roof bolts for loose or deformed plates
- Back and rib for cracks, fractures, and separations

7.2.2 Sound suspicious roof bolts, back, and rib to determine the following:

- Loose roof bolts
- Bad back or rib

7.2.3 Sound a random number of roof bolts, and random areas of the rib and back to determine the following:

- Loose roof bolts
- Bad back or bad rib

WARNING

When performing scaling operations, always maintain a safe avenue for retreat. Also maintain a position such that an unexpected event WILL NOT place you in a position where scaling bar or material being scaled could fall on you.

7.2.4 Using a scaling bar that is long enough to allow operator to work under good ground, remove bad ground.

7.2.5 **IF** loose, broken, or missing roof bolts are found,
THEN perform the following:

A) Physically mark <u>each</u> <u>loose</u> roof bolt.

B) Post area to warn others of deficiencies.

C) **IF** area is to be left unattended, **THEN** have barriers posted.

D) Notify supervisor of deficiencies.

E) Proceed as directed by supervisor.

03 F) Document action taken ~~in logbook.~~ on inspection checklist

7.2.6 **IF** bad ground CANNOT be removed manually, **THEN** ensure the following are performed:

A) Post area to warn others of deficiencies.

B) **IF** area is to be left unattended, **THEN** have barriers posted.

C) Notify supervisor of deficiencies.

D) Proceed as directed by supervisor.

03 E) Document action taken ~~in logbook.~~ on inspection checklist

7.3 LOOSE BOLT MONTHLY INSPECTIONS

7.3.1 Visually inspect assigned area for loose or deformed roof bolt plates, and broken or missing roof bolts.

NOTE: Loose bolts WILL NOT ring when sounded.

7.3.2 Sound roof bolts found to have loose or deformed plates for loose or broken roof bolts.

7.3.3 **IF** loose, broken, or missing roof bolts are found,
THEN perform the following:

A) Physically mark <u>each</u> <u>loose</u> roof bolt.

B) Post area to warn others of deficiencies.

C) **IF** area is to be left unattended,
THEN have barriers posted.

D) Notify supervisor of ANY deficiencies.

E) Proceed as directed by supervisor.

01 03 F) Document action ~~in logbook.~~ on inspection checklist.

7.4 UNDERGROUND FACILITY ANNUAL INSPECTIONS

7.4.1 Physically inspect travelway roof bolts, back, and rib for the following:

- Roof bolts for loose or deformed plates
- Back and rib for cracks, fractures, and separations

7.4.2 Sound suspicious roof bolts, back, and rib to determine the following:

- Loose roof bolts
- Bad back or rib

7.4.3 Sound a random number of roof bolts, and random areas of the rib and back to determine the following:

- Loose roof bolts
- Bad back or bad rib

WARNING

When performing scaling operations, always maintain a safe avenue for retreat. Also maintain a position such that an unexpected event WILL NOT place you in a position where scaling bar or material being scaled could fall on you.

7.4.4 Using a scaling bar that is long enough to allow operator to work under good ground, remove bad ground.

7.4.5 **IF** loose, broken, or missing roof bolts are found,
THEN perform the following:

A) Physically mark <u>each</u> <u>loose</u> roof bolt.

B) Post area to warn others of deficiencies.

C) **IF** area is to be left unattended, **THEN** have barriers posted.

D) Notify supervisor of deficiencies.

E) Proceed as directed by supervisor.

F) Document action taken in logbook.

8.0 REVIEW

NONE

9.0 RECORDS

01 9.1 The following is a Permanent Quality/Resource Conservation and Recovery Act record:

03
- Mine Operations Shift Logbook
- Underground Openings Inspection Checklist

01 9.2 The record from this procedure is identified on and maintained in accordance with Mine Operations Records Inventory and Disposition Schedule.

01 9.3 Validation of the Quality Record generated in accordance with this procedure is by signature.

03

UNDERGROUND OPENINGS INSPECTION SHEETS

DATE:_____ TIME:_____

WEEKLY:_____ MONTHLY:_____ ANNUAL:_____

DRIFT	INITIALS	COMMENTS & OBSERVATIONS	ACTION TAKEN & DATE
W-30 FROM S-90 TO S-2180			
W-170 FROM S-90 TO S-2180			
E-140 FROM S-1950 TO , S-2180			
E-300 FROM S-1950 TO S-2180			
S-700, S-1000, AND S-1300 SHOP AREA			
S-1600, S-1950 AND S-2180			
CORE STORAGE LIBRARY			
ADDITIONAL INFORMATION			

INSPECTOR (PRINT NAME):_____

SIGNATURE: _____

03

UNDERGROUND OPENINGS INSPECTION SHEETS

DATE:_____ TIME:_____

WEEKLY:_____ MONTHLY:_____ ANNUAL:_____

DRIFT	INITIALS	COMMENTS & OBSERVATIONS	ACTION TAKEN & DATE
E-140 FROM N-150 TO S-1950			
E-300 FROM S-90 TO S-1950			
S-90, S-400, S-700 S-1000, S-1300 AND S-550 ALCOVES			
S-1600 AND S-1950			
ROOM 1 PANEL 1			
ROOM 2 PANEL 1			
ROOM 3 PANEL 1			
ROOM 4 PANEL 1			
ROOM 5 PANEL 1			
ROOM 6 PANEL 1			
ROOM 7 PANEL 1			
ADDITIONAL INFORMATION			

INSPECTOR (PRINT NAME):_____

SIGNATURE: _____

03

UNDERGROUND OPENINGS INSPECTION SHEETS

DATE:_____ TIME:_____

WEEKLY:_____ MONTHLY:_____ ANNUAL:_____

DRIFT	INITIALS	COMMENTS & OBSERVATIONS	ACTION TAKEN & DATE
N-1100 ROOM 4 TO ROOM D			
N-1400 ROOM 4 TO ROOM D			
ROOM D			
ALCOVES L-1, L-2, L-3, L-4, AND ROOM 4			
N-1400 ALCOVES EAST OF 0-EAST			
N-1100 ALCOVES WEST OF 0-EAST			
EAST-140 BETWEEN N-1100 AND N-1400			
0-EAST BETWEEN N-1100 AND N-1400			
G-ACCESS DRIFT			
ADDITIONAL INFORMATION			

INSPECTOR (PRINT NAME):_____

SIGNATURE: _____

03

UNDERGROUND OPENINGS INSPECTION SHEETS

DATE:_____ TIME:_____

WEEKLY:_____ MONTHLY:_____ ANNUAL:_____

DRIFT	INITIALS	COMMENTS & OBSERVATIONS	ACTION TAKEN & DATE
0-EAST FROM S-90 TO N-1100			
EAST 140 FROM S-90 TO N-1100			
S-90 TO ROOM Q ALCOVES			
N-940, N-780, N-620, N-460 ALCOVES			
N-300, N-215 AND N-135 A.I.S AREA			
W-620 AND N-150			
WEST-170 BETWEEN S-90 AND N-150			
N-250 AND EAST 300 MAINTENANCE SHOP			
ADDITIONAL INFORMATION			

INSPECTOR (PRINT NAME):_____

SIGNATURE: _____

UNDERGROUND GEOMECHANICAL INSTRUMENTATION SYSTEM

TAPE EXTENSOMETER
CHECK CALIBRATION SHEET

CALIBRATION RUN BY _____ DATE _____
CALIBRATION CHKD. BY _____ DATE _____

TAPE EXTENSOMETER MANUFACTURER _____

TAPE EXTENSOMETER S/N _____ WIPP CALIBRATION LAB ID. No.

CALIBRATION FIXTURE S/N _____ WIPP CALIBRATION LAB ID. No.

CALIBRATION FIXTURE TEMPERATURE (°F) _____

TRIAL NUMBER	READINGS						SUM
	TAPE		DIAL (INCHES)				
	FEET	INCHES	INCHES	0.1	0.01	0.001	
1							
2							
3							
4							
5							
6							
7							
8							
						AVERAGE	
						AVERAGE FROM PREVIOUS CALIBRATION	
						CHANGE FROM PREVIOUS CALIBRATION	

ACCEPT ☐ REJECT ☐

COMMENTS AND CONCLUSIONS _____

● LAST REPAIR

● THIS CALIBRATION

CHANGE SINCE LAST REPAIR

GIS INITIAL DATA SHEET

GISID _____

FIELDTAG _____

DATE ___/___/___ DATE ___:___

INITIAL READING _____

FOR CVPT's: CHORD ___-___

FOR EXTN's: ANCHOR _____ DEPTH _____

LOCATION _____

SKETCH OF INSTALLATION

INSTRUMENT TYPE _____

READING DEVICE _____

SERIAL NUMBER _____

CALIBRATION DUE DATE _____

READING: ☐ MANUAL ☐ REMOTE

COMMENTS _____

VIEW LOOKING _____

DATA REDUCTION BY _____ DATE ___/___/___

CHECKED BY _____ DATE ___/___/___

UNDERGROUND TRU MIXED WASTE DISPOSAL AREA

TITLE: UNDERGROUND TRU MIXED WASTE DISPOSAL AREA INSPECTIONS

ATTACHMENT 1 - U/G TRU Mixed Waste Disposal Areas Preoperational Inspection

Sat Unsat (✓) Inspection Date _____

[] [] U/G Work Area Ground Control Inspection satisfactory in accordance with WP 04-AU1007, Underground Work Area Ground Control Inspections.

[] [] Room ventilation greater than 25,000 scfm.

[] [] Workplace is free of conditions that may adversely affect the safety or health of any employee.

[] [] Unobstructed access to exposed face of emplaced waste containers/canister for emergency equipment.

[] [] Area free of debris.

[] [] No evidence of spills or leaks from containers/canisters.

[] [] Mine Pager Phones Operational at HP Con Ex.

[] [] U/G Phone System Operational.

[] [] Warning Signs Posted in Area.

Record the following in the Equipment/Area Logbook:

- Check satisfactory or unsatisfactory
- Identified deficiencies which were NOT corrected
- Outstanding/newly generated Action Requests

Enter time and date, then sign the logbook to document last performance of inspection.

UNINTERRUPTIBLE POWER SUPPLY (UPS)

FACILITY OPERATIONS ROUND SHEET

RCRA

DATE_____

Location:				DAY	SUN	MON		TUES		WED		THURS		FRI		SAT		SUN	
				SHIFT	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
451,MECH EQUIPMENT RM 104 & RM 116				REVIEWER															
				FOT	C/O														
ITEM	MIN	NORM	MAX																
45-K-401 AIR DRYER																			
45-K-401 OUTLET PRESS (PSI)	95		135																
K-401 AQUADEX INDICATOR		BLUE [B]																	
K-401 AUTO BLOWDOWNS/TEST		SAT [B]																	
K-401 DRYING MODE		AMLOC [B]																	
45P-SWG04/1 SUPPORT BUILDING SUBSTATION																			
NO ABNORMAL CONDITIONS [A]		SAT [B]																	
TR-15/1 XFMR HIGH TEMP (`C)	RESET	MONDAY	170`																
45P-UPS03/1 SUPPORT BUILDING UPS																			
NORMAL AND ALT SOURCE AVAIL.		SAT [B] [C]																	
NORMAL SOURCE SUPPLYING LOADS		SAT [B] [C]																	
NO TRIP INDICATORS ENERGIZED		SAT [B] [C]																	
NO BLOWN FUSE INDICATORS		SAT [B] [C]																	
NO FAN FAIL INDICATORS		SAT [B] [C]																	
TIME OF INSPECTION																			

NOTES: [A] - THE PRESENCE OF LEAKS, UNUSUAL ODORS, OR NOISES CONSTITUTES AN ABNORMAL CONDITION.

[B] - IF NORMAL CONDITIONS EXIST, ENTER A CHECK MARK; OTHERWISE NOTE EXISTING CONDITION.

[C] - WHEN A NOTED CONDITION IS CORRECTED, ENTER THE DATE AND NATURE OF REPAIRS; OR OTHER REMEDIAL ACTION TAKEN THAT CORRECTED THE CONDITION.

COMMENTS: (STATE AR NUMBER SUBMITTED TO CORRECT ABNORMAL CONDITION IF/WHEN KNOWN)

FOM REVIEW:

VEHICLE SIREN

See Ambulance, Fire Truck, and Rescue Truck
for Weekly Inspection Form

VENTILATION EXHAUST

DATE: 10/23/95 ***** C H A M P S *****
TIME: 11:27 A.M. Work Order Step/Text Master

****

Work Order : 9508150 Type : P PLANNED
Status : 60 READY FOR SCHED

Description: 41B700A 41F30703 QTG IT FLOW (RCRA)

Priority : 6 SCORE - 60 ON RISK CHART
Class : 4M6

Project :
Account : P152501-01
Department : FACOP

Assigned To :
Contact :
Requested : PROCTOL
Requested Date: 10/23/95
Requested Time: 0920
Reference Id : IC041055

Task Id : IC041055

RCRA

Equipment : 41F30703
Name : FLOW CONTROL
Design Class:
System : VU01
Parent : 41-B-700A

Building : 413
Floor : 1
Room : 102

Work Description

BW

CAU	EFF	INT
RPM	CAF	

********** Work Order Line Item **********

Step : 001 Seq : 000 Status : 60 READY FOR SCHEDULING
Need Date : 11/06/95 Crew: Z4 Shift : D Trade: ITECH
Schedule Date:
Department : FACOP Notebook:

Short Description: 41F700A 41F30703 QTG IT FLOW

Long Description
41F700A 41F30703 QTG IT FLOW

Tagout/Lockout Y (N) No.	
Release/Date 110695	Work Group Supv Release/Date 110695
Work Performed: per instr.	
Man Hours: 6	Craft Signature: G. Bennetts
WORK COMP/DATE OPS 110795	RETEST COMP/DATE N/A
OPS CANCELLATION/DATE	WORK COMP/DATE WGS 11/07/95

IC041098

Revision 1

U/G Exhaust Mass Flow Measurement System Loops 41F030703; 41F030702 (VU01)

Maintenance Procedure

EFFECTIVE DATE: 11/8/95

SIGNATURE	PRINTED NAME	DATE
R.B. Geisler	R.B. Geisler	11-8-95

APPROVED FOR USE

REVIEW ORGANIZATIONS

Maintenance Operations	Engineering	Facility Operations
ES&H	Maintenance Engineering	Q&RA
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A
N/A	N/A	N/A

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REVISION HISTORY

REVISION	REASON FOR REVISION
1	Incorporate "lessons learned" from test performance: • Combine quarterly calibration check and annual calibration procedures (supersedes IC041055). • Increase "as found" and "as left" traverse series to 6 passes for higher precision. • Perform "as found" traverse series across full dynamic range to collect complete set of baseline data prior to cleaning probes. • Clean probes prior to full dynamic calibration. • Perform full dynamic calibration if quarterly check fails (optimization). • Increase traverse series for full dynamic calibration to 14 passes according to the requirements of "Underground Ventilation Exhaust Flow Measurement System Accuracy and Reliability Report" (HA:93:0554), Gary A. Clark et al., 8/13/93, p. 4. • Change calibration range to 212 to 260 KSCFM for full dynamic calibration over nominal operating range, according to the requirements of HA:93:0554, p. 4. • Eliminate statistical analysis of reference traverse data sets. (This procedure originally calculated the random measurement error of the traverse series, rejecting any data sets with an estimated error of >7% of reading. Actual testing has yielded data sets with errors significantly less than 7%, indicating that the random error is satisfactorily reduced by performance of repetitive traverses.) • Provide detailed instructions for programming/operation of Kurz Model 155 ADAM Mass Flow Computer/Transmitter. • Perform pre-test Pitot tube cleaning and inspection. • Delete instructions for inoperable portions of control loop. (Instructions for testing automatic control functions will be incorporated when equipment is reactivated.) • Prevent the use of two separate manometers to minimize systematic error.
0	New procedure developed in response to ORR pre-start finding VOC PROG - A.52.07.

INTRODUCTION

This procedure performs a calibration verification test and alignment of the U/G Exhaust mass flow measurement system.

This procedure satisfies the quarterly calibration check and annual full dynamic calibration for the U/G Exhaust mass flow measurement system required by the Conditional No Migration Determination (NMD) for DOE/WIPP.

This procedure applies to the following equipment:

41F030703 - U/G Exhaust Fan 41-B-700A Mass Flow

- Mass Flow Computer/Transmitter 413-FIT-307-003
- CMS Computer Point CH5729 "700A FAN FAILED SENSOR"
- CMS Computer Point AH5712 "413 U/G EXH FAN 700A FLOW"

41F030702 - U/G Exhaust Fan 41-B-700B Mass Flow

- Mass Flow Computer/Transmitter 413-FIT-307-002
- CMS Computer Point CH5730 "700B FAN FAILED SENSOR"
- CMS Computer Point AH5705 "413 U/G EXH FAN 700B FLOW"

REFERENCES

BASELINE DOCUMENTS

Procedures

- WP 04-AD3011, Equipment Tagout/Lockout
- WP 10-AD3005, Control and Use of Maintenance Locks
- WP 10-WC3004, Preventive Maintenance Administration
- WP 10-WC3007, Calibration Sticker Control
- WP 12-1, WIPP Safety Manual
- WP 12-110, Confined Space Entry Program
- WP 12-HP3600, Radiological Work Permit

- WP 13-003, Control of Nonconforming Items

Manufacturer's Operation and Maintenance Manuals

- Kurz Series 155 Mass Flow Computer/Transmitter User Guide

Code of Federal Regulations

- 40 CFR 60, Appendix A, Methods 1 and 2

COMPLIANCE DOCUMENTS

- Underground Ventilation Exhaust Flow Measurement System Accuracy and Reliability Report, 8/13/93 (HA:93:0554)

EQUIPMENT LIST

MEASURING AND TEST EQUIPMENT

- Electronic manometer - Shortridge Airdata Multimeter Model ADM-870 or ADM-8420 with temperature probe with Dwyer Series 160 48" standard Pitot tube

SPECIAL EQUIPMENT

- Airdata TEW-19 temperature extension wand
- Airdata TRC-16 temperature probe extension cord
- Extension ladder
- Solution of water and mild detergent (Joy®, Ivory®, or similar) (required if sensor cleaning is performed)

PRECAUTIONS AND LIMITATIONS

An RWP may be required to perform this procedure (after waste receipt).

Calibration shall be performed using a single micromanometer to minimize systematic error.

Troubleshooting or other activities outside of the scope of this procedure MAY require initiation of an AR according to WP 10-WC3002, as determined by Work Group Supervisor or Zone Team Leader and cognizant Maintenance Engineer.

If contingencies arise outside of the scope of this procedure, or if any acceptance criteria cannot be met, workers shall notify the I&C Supervisor.

Completed Sign-off Sheet and Data Sheet(s) are permanent QA records and shall be controlled and maintained according to WP 10-WC3004.

Nonconformances shall be handled according to WP 13-003.

PREREQUISITE ACTIONS

NOTE

Performance of the annual calibration satisfies the requirement for the quarterly calibration check.

[] 1. Record the following information (from check sheet) on Attachment 1:

- Work order number
- Loop number
- Reason for test

SIGN-OFF

[] 2. Obtain equipment specified by equipment list.

[] 3. Record M&TE data on Table 1, Attachment 1 and verify that all M&TE is within current calibration cycle.

SIGN-OFF

[] 4. Record RWP number on Attachment 1 and review radiological protection requirements (N/A if RWP not required).

SIGN-OFF

[] 5. Notify CMR Operator that procedure is to be performed.

SIGN-OFF

[] 6. Notify VOC Monitoring Group that procedure is to be performed.

SIGN-OFF

[] 7. Obtain minimum of eighteen (18) copies of Attachment 2 and three (3) copies of Attachment 4.

[] 8. Perform Pitot tube cleaning and inspect tube for:

- Visible damage
- Tip deformation
- Clogging or obstruction of ports

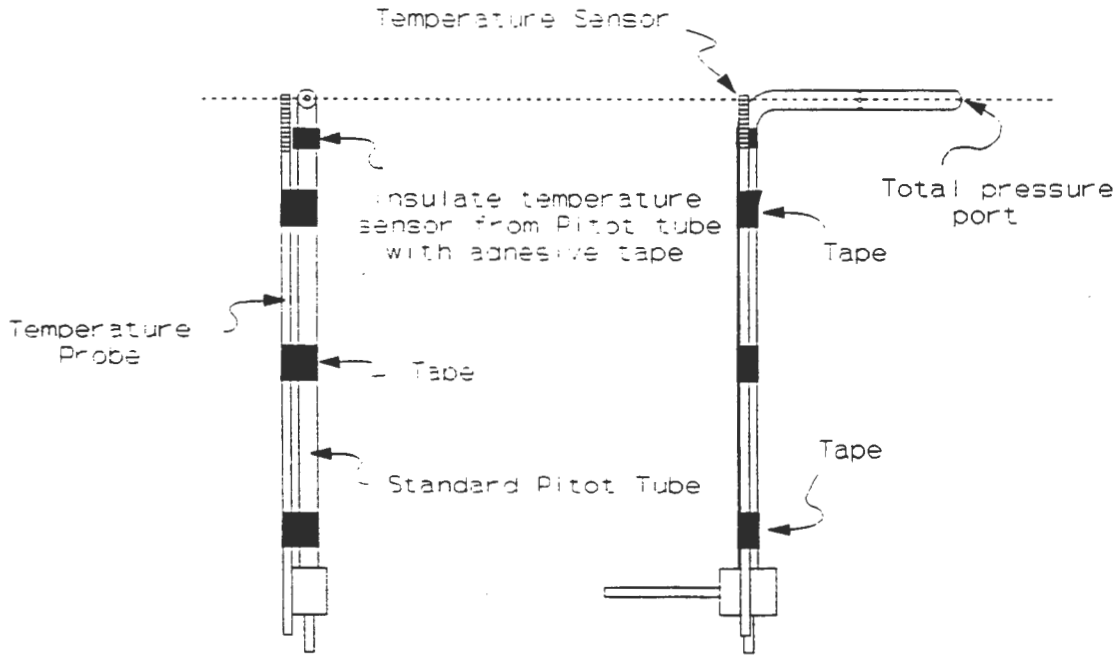
SIGN-OFF

[] 9. Assemble Pitot tube and temperature probe as shown in Figure 1 and connect assembly to micromanometer.

NOTE

Temperature probe and Pitot tube are assembled such that the temperature sensor and total pressure sensing port intersect the same plane. Temperature probe must be insulated from Pitot tube to ensure correct temperature measurement.

Figure 1. Pitot Tube/Temperature Probe Assembly



[] 10. Mark insertion depths (from Data Block 1) on Pitot tube.

PERFORMANCE

1. CHANNEL KICKOUT ALARM FUNCTIONAL TEST

NOTE

Mass Flow Computer/Transmitter (ADAM) 413-FIT-307-003 (413-FIT-307-002) is located in Control Panel 413-CP-308-01A(B) in the Exhaust Filter Building (BLDG 413).

[] 1.1 Press "D" on front panel keypad of ADAM unit until display reads "AVG'D CHS ABCDEFGHIJKLMNOP" and press "H" to hold display.

NOTE

A missing character or "?" in the display identifies an inoperable sensor.

[] 1.2 Verify a minimum of eight (8) flow sensors are operable.

SIGN-OFF

[] 1.3 Verify CMS Computer Point CH5729(CH5730) 700A(B) FAILED SENSOR is reset.

SIGN-OFF

[] 1.4 Unplug any operable sensor at ADAM unit motherboard.

[] 1.5 Verify CMS Computer Point CH5729(CH5730) alarms.

SIGN-OFF

[] 1.6 Verify ADAM unit display reads "CHANNEL X TOO HIGH (or LOW) REMOVED FROM AVG" and correctly identifies the failed sensor channel.

SIGN-OFF

[] 1.7 Reconnect sensor at ADAM unit motherboard.

[] 1.8 Verify CMS Computer Point CH5729(CH5730) resets.

SIGN-OFF

2. AS FOUND PITOT TRAVERSE SERIES

NOTE

Section 2 performs six (6) Pitot traverses each at flow rates of 212 KSCFM, 236 KSCFM, and 260 KSCFM. Specified flowrates are nominal values, and may vary ±10% without affecting test results.

[] 2.1 Facility Operator, establish the required flowrate at the associated U/G exhaust fan.

[] 2.2 Allow flow to stabilize before performing traverse.

[] 2.3 Reset ADAM unit totalizers as follows:

[] 2.3.1 Press "C" several times to return to EXECUTIVE mode.

[] 2.3.2 Press "P" (display reads "ENTER ACCESS CODE:").

[] 2.3.3 Key in "123456" and press "E" (display reads "PRESS ENTER TO RESET TOTALIZERS").

[] 2.3.4 Press "E" (display reads "ARE YOU SURE?").

[] 2.3.5 Press "YES" to reset totalizers.

[] 2.3.6 Press "C" several times to return to EXECUTIVE mode.

[] 2.3.7 Press "D" until display reads:

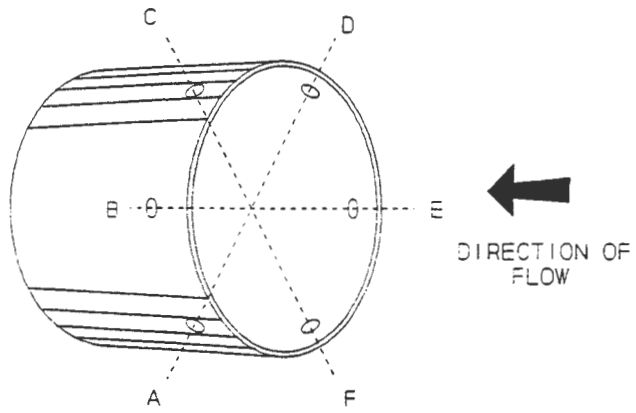
TOTAL = XXX.X MSCF
ET = XX.X MIN

[] 2.3.8 Press "H" to hold display.

NOTE

Pitot traverse measures mass flow directly by using Airdata Multimeter in the "STANDARD DENSITY" mode.

Figure 2. Orientation of U/G Exhaust Fan Traverse Penetrations



[] 2.4 Perform six (6) traverses at selected flow rate according to Data Block 1A, observing penetration orientation shown in Figure 2.

[] 2.5 Record ADAM unit total flow ($KURZ_{TOTAL}$) and elapsed time readings on Data Block 3.

[] 2.6 Calculate average velocity (V_{AVG}) for each of the 6 traverses and record on Data Block 2.

[] 2.7 Calculate CMS average flow (CMS_{AVG}) for each of the 6 traverses and record on Data Block 4.

[] 2.8 Calculate reference method flow (Q_{RM}) as shown on Data Block 2.

[] 2.9 Calculate Kurz average flow ($KURZ_{AVG}$) as shown on Data Block 3.

[] 2.10 Calculate relative percent difference (RPD) between $KURZ_{AVG}$ and Q_{RM} as shown on Data Block 3.

[] 2.11 Calculate CMS average flow (CMS_{AVG}) as shown on Data Block 4.

[] 2.12 Calculate RPD between CMS_{AVG} and Q_{RM} as shown on Data Block 4.

[] 2.13 Repeat Steps 2.1 through 2.13 as required to complete 6 traverses each at 236,000 and 260,000 SCFM.

[] 2.14 **IF** any as found values are not acceptable,
THEN notify the following of the out-of-tolerance condition:

- FSM
- WGS
- VOC Monitoring Group

[] 2.15 **IF** this procedure is being performed to satisfy the annual calibration,
THEN GO TO Section 3, PROBE CLEANING.

[] 2.16 **IF** all as found values are acceptable,
THEN GO TO Section 6, RESTORATION.

3. PROBE CLEANING

WARNING

Interior of duct work at U/G exhaust fans may be contaminated (after waste receipt). Workers shall conduct all activities inside duct according to the RWP requirements (if applicable).

Duct work at U/G exhaust fans is a **NON-PERMIT CONFINED SPACE**. Entry shall be performed according to the requirements of WP 12-110.

Workers shall notify Industrial Safety and Facility Operations shall lock out the associated U/G exhaust fan prior to entering duct.

[] 3.1 Notify Industrial Safety that entry is to be performed at U/G exhaust fan duct work.

SIGN-OFF

[] 3.2 Facility Operator, tagout/lockout the associated U/G exhaust fan.

NOTE

Tagout/lockout information is provided as a minimum recommendation only. The Authorizing Supervisor shall verify and authorize the tagout configuration according to the requirements of WP 04-AD3011.

Table 1. Minimum Tagout/Lockout Recommendations

Equipment No.	Description	Feed From	Location
41-B-700A	Exhaust Fan	41P-DP03/29	EFB (BLDG 413)
41-B-700B	Exhaust Fan	41P-DP03/29	EFB (BLDG 413)

[] 3.3 Verify tagout is in place.

SIGN-OFF

[] 3.4 Place maintenance lock(s) on multiple locking device(s).

SIGN-OFF

NOTE

Steps 3.5 and 3.6 may be performed concurrently with Facility Operations verification of tagout.

[] 3.5 Facility Operator, attempt to start the associated U/G exhaust fan.

[] 3.6 Maintenance Technician, verify that the associated U/G exhaust fan will not start.

SIGN-OFF

[] 3.7 All personnel entering confined space signify acceptance of tagout/lockout on Attachment 1.

SIGN-OFF

[] 3.8 De-energize ADAM unit and unplug AC line cord.

SIGN-OFF

[] 3.9 Attach "MAINTENANCE IN PROGRESS" tag to AC line cord.

[] 3.10 Clean sensors as required with solution of water and mild detergent (Joy®, Ivory®, or similar).

[] 3.11 Verify all personnel have exited confined space and all equipment has been removed.

SIGN-OFF

[] 3.12 Secure duct entry hatch.

SIGN-OFF

[] 3.13 Remove maintenance locks and request clearance for U/G exhaust fan tagout.

[] 3.14 Reconnect AC line cord and energize ADAM unit.

[] 3.15 Verify CMS Computer Point CH5729(CH5730) is reset.

SIGN-OFF

4. FULL DYNAMIC CALIBRATION

[] 4.1 Obtain a minimum of eighteen (18) copies of Attachment 2, forty-two (42) copies of Attachment 3, three (3) copies of Attachment 4, and three (3) copies of Attachment 5.

NOTE

Section 4 performs fourteen (14) Pitot traverses each at flow rates of 212 KSCFM, 236 KSCFM, and 260 KSCFM. Specified flowrates are nominal values, and may vary ±10% without affecting test results.

[] 4.2 Facility Operator, establish the required flow at the associated U/G exhaust fan.

[] 4.3 Allow flow to stabilize before performing traverse.

[] 4.4 Perform fourteen (14) traverses at selected flow rate according to Data Block 1B, recording the sensor velocities after each traverse.

[] 4.5 Calculate average velocity (V_{AVG}) for each traverse and record on Data Block 5.

[] 4.6 Calculate data set reference method velocity (V_{RM}) as shown on Data Block 5.

[] 4.7 Record sensor velocities for Traverse 1 through 14 on Data Block 6.

[] 4.8 Calculate data set velocity (V_{DS}) for each operable sensor A through P as shown on Data Block 6.

[] 4.9 Repeat Steps 4.2 through 4.9 as required to complete data sets at 236,000 and 260,000 SCFM.

[] 4.10 Record reference method velocity (V_{RM}) and sensor data set velocities (V_{DS}) for each reference data set on Data Block 7.

[] 4.11 Re-program ADAM unit with the new values as follows:

[] 4.11.1 Press "C" several times to return to EXECUTIVE mode.

[] 4.11.2 Press "P" (display reads "ENTER ACCESS CODE:").

[] 4.11.3 Key in "123456" and press "E".

[] 4.11.4 Press "P" until display reads "PRESS ENTER TO SET METER DATA".

[] 4.11.5 Press "E" (display reads "PRESS ENTER TO SET METER 1).

[] 4.11.6 Press "E" (display reads "ENTER METER ID").

[] 4.11.7 Press "E" as required to step through menu and verify following settings:

- METER ID = 700A(B) DUCT 1

  (NEXT ^v)

- METER TYPE = INSERTION FLOW

  (NEXT ^v)

- FLOW = SCFM

- INCLUDE CH ABCDEFGHIJKLMNOP ("YES" FOR EACH CHANNEL)

- FLOW AREA = 78.54 SQ FT

- CF TYPE = CCF

- BCF = 1

- NUMBER OF RM DATA SETS = 3

[] 4.11.8 When display reads "ENTER RM DATA SET 1", press "E" to enter REFERENCE METHOD VELOCITY for DATA SET 1 (display reads "ENTER V_{RM}1".

[] 4.11.9 Key in value for the REFERENCE METHOD VELOCITY (V_{RM}) for DATA SET 1 and press "E" (display reads "ENTER V_{DS}1 CH A").

[] 4.11.10 Key in value for the DATA SET VELOCITY (V_{DS}) for SENSOR A from DATA SET 1 and press "E" (display reads "ENTER V_{DS}1 CH B"). Repeat for channels B through P.

[] 4.11.11 When last sensor DATA SET VELOCITY is successfully entered, display reads "C.F. #1 = X.XXX AT XXX.XX SFPM".

[] 4.11.12 Repeat procedure for DATA SETS 2 and 3.

[] 4.11.13 When last DATA SET VELOCITY is successfully entered, press "C" several times to exit PROGRAM mode.

[] 4.12 Verify ADAM unit re-programming completed.

SIGN-OFF

5. AS LEFT PITOT TRAVERSE SERIES

NOTE

Section 5 performs six (6) Pitot traverses each at flow rates of 212 KSCFM, 236 KSCFM, and 260 KSCFM. Specified flowrates are nominal values, and may vary ±10% without affecting test results.

[] 5.1 Facility Operator, establish the required flowrate at the associated U/G exhaust fan.

[] 5.2 Allow flow to stabilize before performing traverse.

[] 5.3 Reset ADAM unit totalizers as follows:

[] 5.3.1 Press "C" several times to return to EXECUTIVE mode.

[] 5.3.2 Press "P" (display reads "ENTER ACCESS CODE:").

[] 5.3.3 Key in "123456" and press "E" (display reads "PRESS ENTER TO RESET TOTALIZERS").

[] 5.3.4 Press "E" (display reads "ARE YOU SURE?").

[] 5.3.5 Press "YES" to reset totalizers.

[] 5.3.6 Press "C" several times to return to EXECUTIVE mode.

[] 5.3.7 Press "D" until display reads:

TOTAL = XXX.X MSCF
ET = XX.X MIN

[] 5.3.8 Press "H" to hold display.

[] 5.4 Perform six (6) traverses at selected flow rate according to Data Block 1A.

[] 5.5 Record Kurz total flow ($KURZ_{TOTAL}$) and elapsed time readings on Data Block 3.

[] 5.6 Calculate average velocity (V_{AVG}) for each of the 6 traverses and record on Data Block 2.

[] 5.7 Calculate CMS average flow (CMS_{AVG}) for each of the 6 traverses and record on Data Block 4.

[] 5.8 Calculate reference method flow (Q_{RM}) as shown on Data Block 2.

[] 5.9 Calculate Kurz average flow ($KURZ_{AVG}$) as shown on Data Block 3.

[] 5.10 Calculate relative percent difference (RPD) between $KURZ_{AVG}$ and Q_{RM} as shown on Data Block 3.

[] 5.11 Calculate CMS average flow (CMS_{AVG}) as shown on Data Block 4.

[] 5.12 Calculate RPD between CMS_{AVG} and Q_{RM} as shown on Data Block 4.

[] 5.13 Repeat Steps 5.1 through 5.13 to complete 6 traverses each at 236,000 and 260,000 SCFM.

[] 5.14 **IF** all as left values are not acceptable,
THEN notify the following of the out-of-tolerance condition:

- FSM
- WGS
- VOC Monitoring Group

6. RESTORATION

[] 6.1 Replace all plugs in traverse penetrations.

SIGN-OFF

[] 6.2 Apply calibration sticker per WP 10-WC3007.

[] 6.3 Notify CMR Operator that procedure is completed.

SIGN-OFF

[] 6.4 Notify VOC Monitoring Group that procedure is completed.

SIGN-OFF

7. RETEST

None

Attachment 1 - Sign-off Sheet

PREREQUISITE ACTIONS

Step No.	Action	Initials
1	Work Order No.:_____ Loop No.:_____ Reason for Test: ☐ Quarterly Calibration Check ☐ Annual Calibration ☐ Other (specify):_____	
3	M&TE verified	
4	Reviewed RWP (N/A if RWP not required) RWP No.:_____	
5	CMR Operator notified	
6	VOC Monitoring Group notified	
8	Pitot tube cleaning and inspection completed	

Table 1. M&TE Data

Description	ID Number	Cal Due Date
Airdata Multimeter		

PERFORMANCE

Step No.	Action	Initials
1.2	Verified minimum of eight (8) flow sensors operable	
1.3	CMS Computer Point CH5729(CH5730) is reset	
1.5	CMS Computer Point CH5729(CH5730) alarms	
1.6	Failed sensor channel identified by ADAM unit	
1.8	CMS Computer Point CH5729(CH5730) is reset	
3.1	Industrial Safety notified (N/A if probe cleaning not required)	

Attachment 1 - Sign-off Sheet

PERFORMANCE

Step No.	Action	Initials
3.3	Tagout verified (N/A if probe cleaning not required) U/G Exhaust Fan: ☐ 700A ☐ 700B	
3.4	Maintenance locks in place (N/A if probe cleaning not required)	
3.6	Verified associated U/G exhaust fan will not start (N/A if probe cleaning not required) U/G Exhaust Fan: ☐ 700A ☐ 700B	
3.7	Tagout/lockout accepted (N/A if probe cleaning not required)	
3.8	ADAM unit de-energized; AC line cord unplugged (N/A if probe cleaning not required)	
3.11	All personnel have exited confined space and all equipment has been removed (N/A if probe cleaning not required)	
3.12	Duct entry hatch secured (N/A if probe cleaning not required)	
3.15	CMS Computer Point CH5729(CH5730) is reset (N/A probe cleaning not required)	
4.12	ADAM unit programming completed (N/A if programming not required)	
6.1	All plugs replaced in traverse penetrations	
6.3	CMR Operator notified	
6.4	VOC Monitoring Group notified	

Printed Name	Signature	Date	Initials

Attachment 2 - As Found/As Left Traverse Data Sheet

Traverse No. _____ ☐ As Found ☐ As Left Nominal Flow Rate _____ KSCFM

Data Block 1A. Traverse Data

Depth inches	A SFM	B SFM	C SFM	D SFM	E SFM	F SFM
2.50						
8.00						
14.00						
21.25						
30.00						
42.75						
CMS Flow						

Date/Time	Performed By	V_{AVG} $\frac{\Sigma VELOCITIES}{36}$	CMS_{AVG} $\frac{\Sigma FLOWS}{6}$

Attachment 3 - Full Dynamic Calibration Traverse Data Sheet

Traverse No. _____ Data Set _____ Nominal Flow Rate _____ KSCFM

Data Block 1B. Traverse Data

Depth inches	A SFM	B SFM	C SFM	D SFM	E SFM	F SFM
2.50						
8.00						
14.00						
21.25						
30.00						
42.75						

Date/Time	Performed By	V_{AVG} $\frac{\Sigma VELOCITIES}{36}$

Sensor Velocities			
Sensor A	Sensor B	Sensor C	Sensor D
Sensor E	Sensor F	Sensor G	Sensor H
Sensor I	Sensor J	Sensor K	Sensor L
Sensor M	Sensor N	Sensor O	Sensor P

Attachment 4 - Acceptance Criteria Calculation Sheet

☐ As Found ☐ As Left Nominal Flow Rate _____ KSCFM

Data Block 2. Reference Method Flow

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}

$Q_{RM} = (\sum TRAVERSE\ AVERAGES \div 6) \times 78.5398\ ft^2$	Ref Method Flow (Q_{RM}) SCFM

Data Block 3. Kurz Flow

$KURZ_{TOTAL}$ SCF	Elapsed Time MINUTES

$KURZ_{AVG} = \frac{KURZ_{TOTAL}}{ELAPSED\ TIME}$	$KURZ_{AVG}$ SCFM
$RPD = \frac{KURZ_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%

Data Block 4. CMS Flow

Traverse 1 CMS_{AVG}	Traverse 2 CMS_{AVG}	Traverse 3 CMS_{AVG}	Traverse 4 CMS_{AVG}	Traverse 5 CMS_{AVG}	Traverse 6 CMS_{AVG}

$CMS_{AVG} = \frac{\sum CMS\ TRAVERSE\ AVERAGES}{6}$	CMS_{AVG} SCFM
$RPD = \frac{CMS_{AVG} - Q_{RM}}{Q_{RM}} \times 100$	Relative Percent Difference ACCEPTANCE CRITERIA ±5%

Attachment 5 - Data Set Calculation Sheet Data Set _____ Nominal Flow Rate _____ KSCFM

Data Block 5. Reference Method Velocity (V_{RM})

Traverse 1 V_{AVG}	Traverse 2 V_{AVG}	Traverse 3 V_{AVG}	Traverse 4 V_{AVG}	Traverse 5 V_{AVG}	Traverse 6 V_{AVG}	Traverse 7 V_{AVG}	Traverse 8 V_{AVG}	Traverse 9 V_{AVG}	Traverse 10 V_{AVG}	Traverse 1 V_{AVG}	Traverse 12 V_{AVG}	Traverse 13 V_{AVG}	Traverse 14 V_{AVG}
V_{RM} = TOTAL OF ALL AVERAGES ÷ 14								Ref Method Velocity (V_{RM})					

Data Block 6. Data Set Velocities (V_{DS})

Traverse No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
TOTAL																

Data Set Velocities (V_{DS})																
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
$\frac{\Sigma \text{SENSOR VELOCITIES}}{14}$																

Attachment 6 - ADAM Unit Programming Data

Data Block 7. Programming Data

Data Set	Reference Method Velocity V_{RM}	Data Set Velocities (V_{DS})															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																	
2																	
3																	

WASTE HANDLING CRANES

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ATTACHMENT 1

5 TON BRIDGE CRANE PREOPERATIONAL CHECKS

1.0 Review the Equipment Logbook for the following:

[] • Outstanding Deficiencies

[] • Outstanding PWRs

2.0 Prior to energizing the Crane, perform the following:

2.1 Inspect the following items for obvious wear and damage:

[] • Sheaves

[] • Wire Rope

[] • Hook

[] • Power/Control Cables

[] 2.2 Verify the wire ropes are wound properly on the Drum.

[] 2.3 Verify Bridge Path clear of any obstructions.

[] 2.4 Verify Trolley Path clear of any obstructions.

[] 2.5 Verify NO leakage of oil/grease from Crane mechanisms.

[] 2.6 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 2.7 Verify Load Cell is within calibration period.

3.0 Energize the applicable Crane as follows:

3.1 **IF** testing 5 Ton Crane 41-T-151A, perform the following:

[] 3.1.1 Verify 41P-T-151A 5 TON CRANE EAST LOWBAY W.H.B. breaker on 41P-MCC04/5 is in the ON position.

[] 3.1.2 Place 480V DISC. SW. 41P-SW04/36 in the ON position.

5 TON BRIDGE CRANE PREOPERATIONAL CHECKS (Continued)

3.2 <u>IF</u> testing 5 Ton Crane 41-T-151B, perform the following:

[] 3.2.1 Verify 41P-T-151B 5 TON CRANE WEST LOWBAY W.H.B. breaker on 41P-MCC04/5 is in the ON position.

[] 3.2.2 Place 480V DISC. SW. 41P-SW04/37 in the ON position.

[] 3.3 Verify the MAN/AUTO Key is in the MAN position.

[] 3.4 Verify the SET/RUN Key is in the RUN position.

[] 3.5 Momentarily press the CONTROL POWER ON Red Light/Switch,
AND verify CONTROL POWER ON Red Light illuminates.

NOTE: Steps 4.0, 5.0, and 6.0 may be performed in any order.

4.0 To test Hoist Controls, perform the following:

[] 4.1 Place the POSITION switch in the "X" position.

4.2 Pressing the HOIST UP Pushbutton, verify the following:

[] 4.2.1 Hoist Position Indicator resets to zero at the reset point.

[] 4.2.2 Position Readout counts correctly.

[] 4.2.3 Up Overtravel Stop actuates and alarm sounds.

4.3 Pressing the HOIST DOWN Pushbutton, verify the following:

[] 4.3.1 Position Readout counts correctly.

[] 4.3.2 Down Overtravel Stop actuates and alarm sounds.

5 TON BRIDGE CRANE PREOPERATIONAL CHECKS (Continued)

5.0 To test Bridge Controls, perform the following:

[] 5.1 Place the POSITION Switch in the "Y" position.

[] 5.2 Pressing the BRIDGE NORTH or BRIDGE SOUTH Pushbuttons, traverse the Bridge to the center to actuate the Bridge Position Update Switch.

5.3 Pressing the BRIDGE NORTH Pushbutton, verify the following:

[] 5.3.1 Position Readout counts correctly.

[] 5.3.2 Bridge Overtravel North Stop actuates and alarm sounds.

5.4 Pressing the BRIDGE SOUTH Pushbutton, verify the following:

[] 5.4.1 Position Readout counts correctly.

[] 5.4.2 Bridge Overtravel South Stop actuates and alarm sounds.

6.0 To test the Trolley Controls, perform the following:

[] 6.1 Place the POSITION switch in "Z" position.

[] 6.2 Pressing the TROLLEY EAST and TROLLEY WEST Pushbuttons, traverse the Trolley to the center to actuate the Trolley Position Update Switch.

6.3 Pressing the TROLLEY EAST Pushbutton, verify the following:

[] 6.3.1 Position Readout counts correctly.

[] 6.3.2 Trolley Overtravel East Stop actuates and alarm sounds.

6.4 Pressing the TROLLEY WEST Pushbutton, verify the following:

[] 6.4.1 Position Readout counts correctly.

[] 6.4.2 Trolley Overtravel West Stop actuates and alarm sounds.

5 TON BRIDGE CRANE PREOPERATIONAL CHECKS (Continued)

7.0 Check the crane load cell indication as follows:

[] 7.1 With an empty hook, using the TARA knob, zero the load cell indication.

[] 7.2 Using the short legs, connect an ACGLF to the crane hook.

[] 7.3 Position the crane at one of the TRUPACT dock locations.

[] 7.4 Raise or lower the crane until the Position Readout X reads between 2300 and 800.

[] 7.5 Verify the load cell indication is 2500 lbs ± 250 lbs.

PCN 00-01

[] 8.0 Initiate PWRs to address any deficiencies that **CANNOT** be corrected by Waste Operations.

[] 9.0 Notify the WHS of any deficiencies discovered during the preoperational checks and their status (such as deficiencies corrected and/or PWR generated).

10.0 Record the following information in the Equipment Logbook:

[] 10.1 Checks satisfactory or unsatisfactory.

[] 10.2 Any discovered deficiencies **NOT** corrected.

[] 10.3 Any outstanding/newly generated PWRs.

[] 11.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

ATTACHMENT 1

15 Ton Hot Cell Crane Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Perform the following prior to energizing the Crane:

[] 2.1 Inspect the following for wear and damage:

[] • Sheaves

[] • Wire Rope

[] • Hook

[] • Power/Control Cables

[] 2.2 Verify wire ropes are wound properly on Drum.

[] 2.3 Verify Bridge path is clear of obstructions.

[] 2.4 Verify Trolley path is clear of obstructions.

[] 2.5 Verify no leakage is evident from Crane mechanisms.

[] 2.6 Verify rotating block and grapple power cable is wound on the take-up reel.

[] 2.7 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 3.0 Verify BRIDGE L.S. keylock is in NORMAL.

[] 4.0 Verify HOIST L.S. keylock is in NORMAL.

15 Ton Hot Cell Crane Preoperational Checks (Continued)

[] 5.0 Energize the Crane as follows:

[] 5.1 Place Disconnect Switch on Power Distribution section of 41-P-001 in ON.

[] 5.2 Turn on Power Breaker (right side of Digital Readout Power Supply inside Display Control section of 41-P-001).

[] 5.3 Momentarily depress START.

[] 5.4 Verify red POWER ON light comes on.

[] 5.5 Set Grapple Speed Controller as follows:

[] 5.5.1 Verify DRIVE switch is in RUN.

[] 5.5.2 Adjust FREQ ADJ knob to the desired speed (clockwise is faster).

[] 6.0 Perform the following to test Crane controls:

[] 6.1 Verify the Hoist/Grapple is NOT connected to a load.

[] 6.2 Move the Hoist using the HOIST control lever to where the Hoist Position Update Switch actuates (full up, position 00.0).

[] 6.3 Verify HOIST POSITION updates.

[] 6.4 Lower the Hoist using the HOIST control lever.

[] 6.5 Verify HOIST POSITION counts while moving.

[] 6.6 Raise the Hoist using the HOIST control lever.

[] 6.7 Verify HOIST POSITION counts while moving.

[] 6.8 Verify Hoist Up Limit Switch actuates and stops Hoist.

15 Ton Hot Cell Crane Preoperational Checks (Continued)

CAUTION

This caution applies to Step 6.9. The 15 Ton Hoist must be full up to clear the Power Manipulator Bridge during the remainder of this test. There must be 4.5 feet between centerlines of the Crane Trolley and the Manipulator Carriage when passing.

[] 6.9 Move the Trolley using Trolley control lever to where the Trolley Position Update Switch actuates (position 00.0, over Cask Unloading Room Access Plug).

[] 6.10 Verify TROLLEY POSITION updates.

[] 6.11 Move the Trolley South using the TROLLEY control lever.

[] 6.12 Verify TROLLEY POSITION counts while moving.

[] 6.13 Verify Trolley South Travel Limit Switch actuates and stops Trolley.

[] 6.14 Move the Trolley North using the TROLLEY control lever.

[] 6.15 Verify TROLLEY POSITION counts while moving.

[] 6.16 Verify Trolley North Travel Limit Switch actuates and stops Trolley.

CAUTION

This caution applies to Step 6.17. There must be 4.5 feet between centerlines of the Crane Trolley and Manipulator Carriage when passing.

[] 6.17 Position the Trolley so it will NOT hit the Power Manipulator Carriage while testing the Bridge.

[] 6.18 Move the Bridge using the BRIDGE control lever to where Bridge Position Update Switch actuates (position 00.0, over Cask Unloading Room Access Plug).

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15 Ton Hot Cell Crane Preoperational Checks (Continued)

[] 6.19 Verify BRIDGE POSITION updates.

[] 6.20 Move the Bridge East using the BRIDGE control lever.

[] 6.21 Verify Bridge East Travel Limit Switch actuates and stops Bridge.

[] 6.22 Verify BRIDGE POSITION counts while moving.

[] 6.23 Move the Bridge West using the BRIDGE control lever.

[] 6.24 Verify Bridge West Travel Limit Switch actuates and stops the Bridge.

[] 6.25 Verify BRIDGE POSITION counts while moving.

CAUTION

This caution applies to Step 6.26. The Grapple Power Cable can be damaged while rotating the Grapple. Rotating counter-clockwise is more likely to cause damage due to cable length.

[] 6.26 Test Grapple Block rotation as follows:

[] 6.26.1 Rotate the Grapple clockwise by holding BLOCK ROTATE in CW.

[] 6.26.2 Rotate the Grapple counter-clockwise (as far as power cable will allow) by holding BLOCK ROTATE in CCW.

[] 6.27 Test Grapple as follows:

[] 6.27.1 Place GRAPPLE switch in CLOSE.

[] 6.27.2 Verify GRAPPLE FULLY CLOSED lights.

[] 6.27.3 Place GRAPPLE switch in OPEN.

[] 6.27.4 Verify GRAPPLE FULLY OPEN lights.

15 Ton Hot Cell Crane Preoperational Checks (Continued)

[] 7.0 Initiate PWRs to address any deficiencies which cannot be corrected by Waste Operations.

[] 8.0 Notify the WHS of deficiencies discovered during checks, and the status (corrected, PWR generated, etc.).

[] 9.0 Record the following in the Equipment Logbook:

[] • Check satisfactory or unsatisfactory.

[] • Identified deficiencies which were NOT corrected.

[] • Outstanding/newly generated Plant Work Requests.

[] 10.0 Enter time and date, then sign Equipment Logbook to document last performance of Preoperational Checks.

ATTACHMENT 1

50/25 Ton RH Crane 41-T-001 Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Perform the following prior to energizing the Crane:

[] 2.1 Inspect the following for wear and damage:

[] • Sheaves

[] • Wire Rope

[] • Hook

[] • Power/Control Cables

[] 2.2 Verify wire ropes wound properly on the Drum.

[] 2.3 Verify bridge path is clear of obstructions.

[] 2.4 Verify trolley path is clear of obstructions.

[] 2.5 Verify no leakage is evident from Crane mechanisms.

[] 2.6 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 3.0 Energize Crane as follows:

[] 3.1 Place Disconnect Switch 41P-SW04/2, 41 TM001 OVERHEAD TRAV CRANE in ON.

[] 3.2 Verify the "0" button in out position.

[] 3.3 Momentarily depress the Start (1) pushbutton.

[] 3.4 Verify the MAIN CONT light comes on.

[] 4.0 Perform the following to test Crane controls:

[] 4.1 Verify the Main Hoist is not connected to a load.

[] 4.2 Verify the Aux Hoist is not connected to a load.

50/25 Ton RH Crane 41-T-001 Preoperational Checks (Continued)

NOTE: Steps 4.3 through 4.10 may be performed in any order.

[] 4.3 Lower the Main Hoist using the MAIN HOIST control.

[] • Verify the Main Hoist Hoist Down Limit Switch actuates and the Hoist stops.

[] 4.4 Raise the Main Hoist using the MAIN HOIST control.

[] • Verify the Main Hoist Up Limit Switch actuates and the Hoist stops.

[] 4.5 Lower the Aux Hoist using the AUX HOIST control.

[] • Verify the Aux Hoist Hoist Down Limit Switch actuates and the Hoist stops.

[] 4.6 Raise the Aux Hoist using the AUX HOIST control.

[] • Verify the Aux Hoist Hoist Up Limit Switch actuates and the Hoist stops.

[] 4.7 Move the Trolley North using the TROLLEY control.

[] • Verify the Trolley North Travel Limit Switch actuates and the Trolley stops.

[] 4.8 Move the Trolley South using the TROLLEY control.

[] • Verify the Trolley South Travel Limit Switch actuates and the Trolley stops.

[] 4.9 Move the Bridge East using the BRIDGE control.

[] • Verify the Bridge East Travel Limit Switch actuates and the Bridge stops.

50/25 Ton RH Crane 41-T-001 Preoperational Checks (Continued)

[] 4.10 Move the Bridge West using the BRIDGE control.

[] • Verify the Bridge West Travel Limit Switch actuates and the Bridge stops.

[] 5.0 Check for burned out RH Bay overhead and bridge mounted lights.

[] 6.0 Initiate PWRs to address any deficiencies which cannot be corrected by Waste Operations.

[] 7.0 Notify the WHS of deficiencies discovered during checks and the status (corrected, PWR generated, etc.).

[] 8.0 Record the following in the Equipment Logbook:

[] • Preop Check satisfactory or unsatisfactory

[] • Identified deficiencies which were not corrected

[] • Outstanding/newly generated PWRs

[] 9.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

ATTACHMENT 1 - Bridge Mounted Power Manipulator Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

2.0 Verify the Hot Cell 15-Ton Crane, 41-T-104, is as follows to allow performing Power Manipulator checks:

[] 2.1 Hot Cell Crane Hoist/Grapple is disconnected from any load.

[] 2.2 Hot Cell Crane Hoist/Grapple is in the fully raised position.

[] 2.3 Hot Cell Crane Trolley is positioned so as NOT to interfere with the Manipulator Carriage.

3.0 Perform the following before energizing the Manipulator:

[] 3.1 Inspect the Manipulator for wear and damage.

[] 3.2 Verify wire ropes are wound properly on Drum.

[] 3.3 Verify Bridge path is clear of obstructions.

[] 3.4 Verify Carriage path is clear of obstructions.

[] 3.5 Verify no oil leakage from the Manipulator mechanisms.

[] 3.6 Verify the Load Test Due Date, located on the Brass Tag, has **NOT** passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

4.0 Energize the Power Manipulator as follows:

[] 4.1 Verify the 41-T101 41P002 BRIDGE POWER MANIPULATOR breaker is closed on 41P-MCC04/2.

[] 4.2 Turn the MANIPULATOR DISCONNECT to ON at 41-P-002.

[] 4.3 Momentarily depress the green MAIN POWER ON pushbutton on the control panel and verify the MAIN POWER ON pushbutton lights.

CAUTION

This caution applies to Step 5.0. All limit switches are to be approached slowly. The Manipulator arm should be in the vertical position while performing checks of Bridge and Carriage.

5.0 Test the Power Manipulator controls as follows:

[] 5.1 Hold the HOIST control in LOWER.

[] 5.2 Verify Hoist Position Readout tracks correctly.

[] 5.3 Hold the HOIST control in RAISE.

[] 5.4 Verify Hoist Position Readout tracks correctly.

[] 5.5 Verify Hoist Upper Limit stops the Hoist.

[] 5.6 Hold the CARRIAGE control in NORTH.

[] 5.7 Verify North Travel Limit Switch stops the Carriage.

[] 5.8 Verify Carriage Position Readout tracks correctly.

[] 5.9 Hold the CARRIAGE control in SOUTH.

[] 5.10 Verify South Travel Limit Switch stops the Carriage.

[] 5.11 Verify Carriage Position Readout tracks correctly.

NOTE: This note applies to Step 5.12. The centers of the Carriage and Trolley **SHALL** be at least 4.5 feet apart.

[] 5.12 Position the Power Manipulator Carriage, using the CARRIAGE control, so that the Carriage and Hot Cell Crane Trolley will NOT hit while testing Bridge controls.

[] 5.13 Hold the BRIDGE control in EAST.

[] 5.14 Verify East Travel Limit Switch stops the Bridge.

ATTACHMENT 1 - Bridge Mounted Power Manipulator Preoperational Checks

[]	5.15	Verify Bridge Position Readout tracks correctly.
[]	5.16	Hold the BRIDGE control in WEST.
[]	5.17	Verify West Travel Limit Switch stops the Bridge.
[]	5.18	Verify Bridge Position Readout tracks correctly.
[]	5.19	Hold the SHOULDER ROTATE control in CW.
[]	5.20	Verify shoulder rotation in the clockwise direction.
[]	5.21	Hold the SHOULDER ROTATE control in CCW.
[]	5.22	Verify shoulder rotation in the counter-clockwise direction.
[]	5.23	Hold the SHOULDER PIVOT control towards the yellow line.
[]	5.24	Verify the shoulder pivots in the yellow direction.
[]	5.25	Hold the SHOULDER PIVOT control towards the blue line.
[]	5.26	Verify the shoulder pivots in the blue direction.
[]	5.27	Hold the ELBOW PIVOT control towards the yellow line.
[]	5.28	Verify the elbow pivots in the yellow direction.
[]	5.29	Hold the ELBOW PIVOT control towards the blue line.
[]	5.30	Verify the elbow pivots in the blue direction.
[]	5.31	Hold the WRIST PIVOT control towards the yellow line.
[]	5.32	Verify the wrist pivots in the yellow direction.

ATTACHMENT 1 - Bridge Mounted Power Manipulator Preoperational Checks

[] 5.33 Hold the WRIST PIVOT control towards the blue line.

[] 5.34 Verify the wrist pivots in the blue direction.

[] 5.35 Hold the WRIST ROTATE control in CW.

[] 5.36 Verify wrist rotation in the clockwise direction.

[] 5.37 Hold the WRIST ROTATE control in CCW.

[] 5.38 Verify wrist rotation in the counter-clockwise direction.

[] 5.39 Hold the WRIST EXTEND control in EXTEND.

[] 5.40 Verify the wrist mechanism extends.

[] 5.41 Hold the WRIST EXTEND control in RETRACT.

[] 5.42 Verify the wrist mechanism retracts.

[] 5.43 Hold the GRIP control in CLOSE.

[] 5.44 Verify the gripper mechanism closes.

[] 5.45 Hold the GRIP control in OPEN.

[] 5.46 Verify the gripper mechanism opens.

6.0 **IF** it is desired to de-energize the Power Manipulator, perform the following:

[] 6.1 Momentarily press the MAIN POWER OFF pushbutton on the control panel.

[] 6.2 Verify the MAIN POWER ON light goes off.

[] 6.3 Turn the MANIPULATOR DISCONNECT to OFF-RESET on 41-P-002.

[] 7.0 Initiate PWRs to address any deficiencies which CANNOT be corrected by Waste Operations.

[] 8.0 Notify the WHS of deficiencies discovered during checks, and the status (corrected, Work Request generated, etc.).

ATTACHMENT 1 - Bridge Mounted Power Manipulator Preoperational Checks

9.0 Record the following in the Equipment Logbook:

[] 9.1 Check satisfactory or unsatisfactory.

[] 9.2 Identified deficiencies which were NOT corrected.

[] 9.3 Outstanding/newly generated Work Requests.

[] 10.0 Enter the time and date, then print name and sign the Equipment Logbook to document the last performance of the Preoperational Checks.

[] 11.0 Discard the completed checklist.

ATTACHMENT 1

CH Overpacking Crane Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Inspect the following for wear and damage:

[] • Sheaves

[] • Wire Rope

[] • Hook

[] • Power/Control Cables

[] • Pneumatic Cylinder Cables

[] 3.0 Verify the following prior to energizing the Crane:

[] • Wire ropes are wound properly on the Drum

[] • Power Cable properly wound on take-up reel

[] • Gantry and Trolley path clear of obstructions

[] • No leakage evident from Crane mechanisms

[] 4.0 Verify the Load Test Due Date, located on the Brass Tag, has NOT passed.
<u>IF</u> the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 5.0 Energize the Crane as follows:

5.1 Verify the 41P-SW04/22 DISC FOR 41-HM-032 breaker is in ON on 41P-DP04-4, TRUPACT Maintenance Facility.

5.2 Close 41P-SW04/22, O/P ENCLOSURE Crane.

CH Overpacking Crane Preoperational Checks (Continued)

[] 6.0 Perform the following to test Crane controls:

[] • Lower the Hoist using HOIST DOWN

[] • Raise the Hoist using HOIST UP. Verify the Hoist Up Limit Switch operates and the Hoist stops

[] • Move the Trolley East using TROLLEY RIGHT

[] • Move the Trolley West using TROLLEY LEFT

[] • Move the Gantry North using the Gantry Control

[] • Move the Gantry South using the Gantry Control

[] 7.0 Initiate PWRs to address any deficiencies that CANNOT be corrected by Waste Handling Operations.

[] 8.0 Notify the WHS of any deficiencies discovered during the preoperational checks and their status (corrected, PWR generated, etc.).

[] 9.0 Record the following in the Equipment Logbook:

[] 9.1 Preoperational Check satisfactory or unsatisfactory.

[] 9.2 Any identified deficiencies that were NOT corrected.

[] 9.3 Outstanding/newly generated Plant Work Requests.

[] 10.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

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WASTE SHAFT HOIST

WASTE HOIST OPERATOR'S LOG

DATE _____

NIGHT SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.

I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____

I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____

The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

WASTE HOIST INSPECTION		TIME	COMMENTARY
1. Disk Brake Paths Clean	☐		
2. Hoist Bearings -Lube Level	☐		
3. Brake Reservoirs-Oil Level	☐		
4. Hydraulic Pipes-Leaks	☐		
5. Brake Drain Lines	☐		
6. Brake Drain Collector	☐		
7. Motor Shaft Ground Brushes	☐		
8. Lilly Controller	☐		
9. Brake Maint. Valves-Locked	☐		

Comments: _____

Hoistman _____ Time _____

W/S COLLAR INSPECTION			
1. Mine Phone-Functional	☐		
2. Bells-Functional	☐		
3. Hst Rope Cappels-Cage & Cntrwght	☐		
4. Fixed Guides-Cage	☐		
5. Fixed Guides-Cntrwght	☐		
6. Rope Shoes-Cage (8 Ea.)	☐		
7. Trolley Phone-Functional	☐		
8. Track Limits (2 Ea.)	☐		

Comments: _____

Toplander _____ Time _____

W/S STATION INSPECTION			
1. Ground Control	☐		
2. Control Panel-Lights	☐		
3. Mine Phone Functional	☐		
4. Bells-Functional	☐		
5. Rope Shoes Cntrwght	☐		
6. Tail Rope Cappels-Cage & Cntrwght	☐		
7. Chairs Proper Function	☐		
8. Chairs Physical Conditions	☐		
9. Fixed Guides Cage & Cntrwght	☐		

Comments: _____

Bottomlander _____ Time _____

DAY SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.

I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____

I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____

The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

WASTE HOIST INSPECTION		TIME	COMMENTARY
1. Disk Brake Paths Clean	☐		
2. Hoist Bearings -Lube Level	☐		
3. Brake Reservoirs-Oil Level	☐		
4. Hydraulic Pipes-Leaks	☐		
5. Brake Drain Lines	☐		
6. Brake Drain Collector	☐		
7. Motor Shaft Ground Brushes	☐		
8. Lilly Controller	☐		
9. Brake Maint. Valves-Locked	☐		

Comments: _____

Hoistman _____ Time _____

W/S COLLAR INSPECTION			
1. Mine Phone-Functional	☐		
2. Bells-Functional	☐		
3. Hst Rope Cappels-Cage & Cntrwght	☐		
4. Fixed Guides-Cage	☐		
5. Fixed Guides-Cntrwght	☐		
6. Rope Shoes-Cage (8 Ea.)	☐		
7. Trolley Phone-Functional	☐		
8. Track Limits (2 Ea.)	☐		

Comments: _____

Toplander _____ Time _____

W/S STATION INSPECTION			
1. Ground Control	☐		
2. Control Panel-Lights	☐		
3. Mine Phone Functional	☐		
4. Bells-Functional	☐		
5. Rope Shoes Cntrwght	☐		
6. Tail Rope Cappels-Cage & Cntrwght	☐		
7. Chairs Proper Function	☐		
8. Chairs Physical Conditions	☐		
9. Fixed Guides Cage & Cntrwght	☐		

Comments: _____

Bottomlander _____ Time _____

MID SHIFT

I have read and noted all entries made by the previous shift hoistman and all special instructions.

I tested the hoist brakes at _____(time) and report as follows: _____

I tested the overwinds and underwinds at _____(time), and report as follows: _____

I made the following trial trips, and report as follows (give time): _____

The working condition of the hoist; including the brakes, clutches, and their interlocks; and depth indicators; and all other safety devices and fittings; was as follows: _____

The working condition of the signaling equipment was as follows: _____

Hoistman _____ Supervisor _____

WASTE HOIST INSPECTION		TIME	COMMENTARY
1. Disk Brake Paths Clean	☐		
2. Hoist Bearings -Lube Level	☐		
3. Brake Reservoirs-Oil Level	☐		
4. Hydraulic Pipes-Leaks	☐		
5. Brake Drain Lines	☐		
6. Brake Drain Collector	☐		
7. Motor Shaft Ground Brushes	☐		
8. Lilly Controller	☐		
9. Brake Maint. Valves-Locked	☐		

Comments: _____

Hoistman _____ Time _____

W/S COLLAR INSPECTION			
1. Mine Phone-Functional	☐		
2. Bells-Functional	☐		
3. Hst Rope Cappels-Cage & Cntrwght	☐		
4. Fixed Guides-Cage	☐		
5. Fixed Guides-Cntrwght	☐		
6. Rope Shoes-Cage (8 Ea.)	☐		
7. Trolley Phone-Functional	☐		
8. Track Limits (2 Ea.)	☐		

Comments: _____

Toplander _____ Time _____

W/S STATION INSPECTION			
1. Ground Control	☐		
2. Control Panel-Lights	☐		
3. Mine Phone Functional	☐		
4. Bells-Functional	☐		
5. Rope Shoes Cntrwght	☐		
6. Tail Rope Cappels-Cage & Cntrwght	☐		
7. Chairs Proper Function	☐		
8. Chairs Physical Conditions	☐		
9. Fixed Guides Cage & Cntrwght	☐		

Comments: _____

Bottomlander _____ Time _____

SPECIAL INSTRUCTIONS

Requires Time, Date & Authorized Signature

_____

SHAFT INSPECTION RECORD

Date _____ PIC (Maint) _____

Weekly Inspection #38-CHS-001

ITEM EXAMINED	OK	SEE COMMENTS
GUIDES & ATTACHMENTS		
COLLAR & SUMP STEEL		
SHAFT LINER		
SALT BUILD-UP		
WATER RINGS & DRAINS		
WALL ROCK & BROW		
CONVEYANCE CLEARANCE		
CABLES, PIPES & SUPPORTS		
LADDERS & LANDINGS (SUMP)		
SUMP WATER		

SIGN OR INITIAL THESE COLUMNS

COMMENTS

SIGNATURE SHAFTS SUPERVISOR (OPS) _____

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HOISTING MACHINERY RECORD

Date _____ PIC (Maint) _____

INSTRUCTIONS

CIRCLE THE PM# PERFORMED & THE INTERVAL.

W=Weekly M=Monthly BM=Bi-Monthly

Q=Quarterly SA=Semi-Annually A=Annually

PM#	DESCRIPTION	INTERVAL					
38-GM-001	BRAKE AUX AIR COMP.	-	M	-	Q	-	-
38-GM-002 & 3	HOIST BEARING OIL PUMP A & B	-	M	-	-	SA	-
38-H-001	SH HOIST DRUM ASSY	W	M	-	-	-	-
38-H-002	SH HOIST HEADSHEAVE	W	-	-	-	-	-
38-H-003	SH HOIST ROPE ASSY	W	-	-	-	SA	-
38-H-008	LILLY CONTROLLER	W	-	-	-	-	-
38-K-001	BRAKE AIR DRIVER/FILTER S/A	-	M	-	-	-	-

COMMENTS

SIGNATURE HOIST SUPERVISOR (OPS) _____

ELECTRICAL HOISTING EQUIPMENT RECORD

Date _____ PIC (Maint) _____

INSTRUCTIONS

CIRCLE THE PM# PERFORMED & THE INTERVAL.

W=Weekly M=Monthly BM=Bi-Monthly

Q=Quarterly SA=Semi-Annually A=Annually

PM#	DESCRIPTION	INTERVAL					
38-PM-OC03/1	PROCESS CONTROL PANEL	-	-	-	-	-	A
38-HM-001	SH HOIST DRIVE MOTOR	-	-	-	Q	SA	-
38-HMG-001A	DC GENERATOR	-	-	-	Q	SA	-
38-HMG-001B	SYNCHRONOUS MOTOR	-	-	-	Q	SA	-
38-P-BC-04/1	DECELRTN CNTRL (DYNAPAR)	-	-	-	-	-	A
38-P-FE-03/1	MG FIELD EXCITER	-	-	-	-	SA	-
38-P-MCC-04/1	MOTOR CONTROL CENTER	-	-	-	-	-	BIA*
38-P-PC-04AB	SILCOMATIC PLUS	-	M	-	Q	-	-
38-P-SMC-05/1	LIMITAMP CNTRLR	-	-	-	Q	-	A
38-P-SW-04/1	PRINGLE SWITCH	-	-	-	Q	-	A
38-P-IR-04/1	INTERPHASE REACTOR	-	-	-	Q	-	A
38-P-SWG-051CB6	VACUUM CIRCUIT BREAKER	-	-	-	-	-	A

COMMENTS

SIGNATURE HOIST SUPERVISOR (OPS) _____

* Bi-Annually

FACILITY OPERATIONS ROUND SHEET

RCRA

DATE_____

Location:	DAY	SUN	MON		TUES		WED		THURS		FRI		SAT		SUN	
	SHIFT	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
456, PUMPHOUSE BUILDING	REVIEWER															
	FOT	C/O														

ITEM	MIN	NORM	MAX														
DOMESTIC WATER STORAGE TANKS																	
01A S. DW STG TNK LVL LI-01	80%																
01A VISUAL INSPECTION [A]		SAT [B] [C]															
01B N. DW STG TNK LVL LI-02	80%																
01B VISUAL INSPECTION [A]		SAT [B] [C]															
TIME OF INSPECTION																	

NOTES: [A] - IF NORMAL CONDITONS EXIST, AND THE INSPECTION IS SATISFACTORY, ENTER A CHECK MARK; OTHERWISE NOTE EXISTING CONDITION.

[B] - INSPECT FOR LEAKS, VISIBLE CORROSION, INSULATION INTACT, ETC.

[C] - WHEN A NOTED CONDITION IS CORRECTED, ENTER THE DATE AND NATURE OF REPAIRS; OR OTHER REMEDIAL ACTION TAKEN THAT CORRECTED THE CONDITION.

COMMENTS: (STATE AR NUMBER SUBMITTED TO CORRECT ABNORMAL CONDITION IF/WHEN KNOWN)

FOM REVIEW:

OPERATORS INITIALING THIS LOGSHEET, SHALL COMPLETE THE FOLLOWING:

NAME (PRINT)	INITIALS	NAME (PRINT)	INITIALS	NAME (PRINT)	INITIALS

BRUDI

ATTACHMENT 1

Brudi Push/Pull Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and/or PWRs.

[] 2.0 Verify the Load Test Due Date, located on the Brass Tag, has NOT passed.
IF the Load Test Due Date is within 30 days of the current date, record the Load Test Due and the Due Date in the Equipment Logbook.

[] 3.0 Verify mechanical connections have NO evidence of wear or deterioration.

[] 4.0 Verify hydraulic system has no apparent wear/leakage from hoses, connections, valves, or cylinders.

[] 5.0 Verify the Platen is free from nicks or rough spots

[] 6.0 Clean surfaces with a broom to reduce friction.

[] 7.0 Cycle each control to verify proper movement.

[] 8.0 Initiate PWRs to address any deficiencies that CANNOT be corrected by Waste Operations.

[] 9.0 Notify the WHS of any deficiencies discovered during the preoperational checks and their status (such as deficiencies corrected and/or PWRs generated).

10.0 Record the following in the Equipment Logbook:

[] 10.1 Checks satisfactory or unsatisfactory.

[] 10.2 Identified deficiencies NOT corrected.

[] 10.3 Outstanding/newly generated PWRs.

[] 11.0 Enter the time and date, then sign the Equipment Logbook to document the performance of the Preoperational Checks.

CONTROLLED COPY

TRAILER JOCKEY

ATTACHMENT 1

Trailer Jockey Preoperational Checks

[] 1.0 Review the Equipment Logbook for outstanding deficiencies and PWRs.

[] 2.0 Record Hour Meter reading in the Equipment Logbook.

3.0 Raise the cab and check the following:

[] • Engine Oil Level: Normal range

[] • Power Steering Fluid Level: Cold range

[] • Radiator Coolant: Visible in upper tank

[] • Belts: Not loose, worn or cracked

[] • Transmission Oil Level (cold): Above high mark

[] 4.0 Lower and lock the cab.

5.0 Check the following:

[] • Fifth Wheel: Clean and greased

[] • General Condition: No damage, loose parts, oil leaks, grease, oil or trash

[] • Seat Belts: In good condition

[] • Tires: In good condition, inflated to proper pressure, NOT excessively worn or cracked, all wheel lugs tight

[] • Hydraulic Oil Tank Level: Normal range in sightglass

[] • Battery: Free from acid spills, no loose or missing caps or cables

[] • Fuel: Sufficient for intended operation

[] • Pedals and levers: Not loose or sticking

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CONTROLLED COPY

Trailer Jockey Preoperational Checks (Continued)

[] 6.0 Start the engine and check the following:

[] • Engine Oil Press: Normal

[] • Water Temp: Normal

[] • Transmission Oil Press: Normal

[] • Transmission Oil Temp: Normal

[] • Voltage: 13-14 volts

[] • Air Press: 90-120 psig

[] • Horn: Sounds

[] • Driving lights: Illuminate

[] 7.0 Test the following PTO Functions:

[] 7.1 Fifth Wheel Engage

[] 7.2 Fifth Wheel Raise

[] 7.3 Fifth Wheel Lower

[] 7.4 Fifth Wheel Disengage

CAUTION

This caution applies to Step 7.5. DO NOT release the parking brake or attempt to move the machine with air press < 60 psig.

[] 7.5 With the parking brake applied, verify the truck does NOT move after shifting into gear.

7.6 Move the truck in forward and reverse and test the following:

[] 7.6.1 Steering operates smoothly and does NOT pull.

[] 7.6.2 Service Brakes are in good condition and do NOT drag.

[] 7.6.3 Backup Alarm sounds.

CONTROLLED COPY

Trailer Jockey Preoperational Checks (Continued)

[] 8.0 Initiate PWRs to address any deficiencies which cannot be corrected by Waste Operations.

[] 9.0 Notify the WHS of deficiencies discovered during checks, and the status (corrected, PWR generated, etc.).

[] 10.0 Record the following in the Equipment Logbook:

[] 10.1 Check satisfactory or unsatisfactory.

[] 10.2 Addition of oil, water or other fluids and amount added.

[] 10.3 Identified deficiencies which were NOT corrected.

[] 10.4 Outstanding/newly generated PWRs.

[] 11.0 Enter the time and date, then sign the Equipment Logbook to document the last performance of the Preoperational Checks.

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RH-TRU WASTE HANDLING

CANISTER SHUTTLE

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QUARTERLY PREVENTIVE MAINTENANCE INSTRUCTIONS

41-HH-019
CANISTER SHUTTLE CAR
M06C (QUARTERLY)

1. VERIFY EQUIPMENT IS TAGGED OUT.

2. INSPECT V-BELTS, REPLACE AS NECESSARY.

3. INSPECT SHEAVES FOR ALIGNMENT AND ALIGN AS REQUIRED.

4. INSPECT ALL MECHANICAL FASTENERS. RETORQUE AS REQUIRED PER TORQUE TABLES.

5. CHECK GEAR BOX LUBRICANT LEVEL. ADD TEXACO MEROPA 150 AS REQUIRED TO BRING LEVEL WI FILL PLUG.

6. REPALCE DRIVE BELT COVER.

RECOVERY
1. REPLACE BELT COVER

2. REMOVE TAGOUT

RETEST

NO RETEST REQUIRED

TAGOUT

BREAKER	POSITION	TAG	LOCK	LOCATION
41-HM-019	OPEN	DANGER	YES	41P-MCC04/1

41-11-019
CANNISTER SHUTTLE CAR
DATA SHEET
M06C (QUARTERLY)

1. EQUIPMENT LOCKED AND TAGGED OUT OF SERVICE

_____
OPERATIONS/DATE/TIME

VERIFIED _____
MAINT. TECH./DATE/TIME

2.	V-BELT INSPECTION	OK	REPLACED
3.	SHEAVE ALIGNMENT	OK	ALIGNMENT
4.	MECHANICAL FASTENER CHECK	OK	RETORQUED*

*IDENTIFY LOOSE CONNECTIONS

TORQUE WRENCH S/N_____

CAL DUE DATE _____

5.	GEAR BOX LUBRICANT LEVEL	OK	ADDED _____OZ.
6.	DRIVE BELT COVER REINSTALLED	YES	NO

WORK COMPLETE _____
MAINT. TECH./DATE/TIME

_____
MAINT. SUPERVISOR/DATE

ANNUAL PREVENTIVE MAINTENANCE INSTRUCTIONS

41-11-019
CANISTER SHUTTLE CAR
M08C (ANNUAL)

PREREQUISITES

1. ACCESS TO THE CANISTER TRANSFER ROOM IS POSSIBLE.

2. AN RWP IF REQUIRED IS IN PLACE.

3. HAVE OPERATIONS POSITION SHUTTLE CAR TO THE FAR EAST END OF THE CELL.

PROCEDURE

4. VERIFY EQUIPMENT TAGOUT.

5. PERFORM STEPS 2 THRU 6 OF THE QUARTERLY PMI.

6. LUBRICATE THE EX-CELL DRIVE PILLOW BLOCK BEARING USING TEXACO MULTIFAK EP-2 GREASE.

7. IN-CELL, LUBRICATE THE TWO SHUTTLE CAR DRIVE PILLOW BLOCK BEARINGS USING NRRG GREASE ONLY. DO NOT SUBSITUTE LUBRICANT.

8. LUBRICATE THE SHUTTLE CAR WHEELS USING NRRG GREASE ONLY. NO NOT SUBSITUTE LUBRICANT

9. INSPECT THE DRIVE CHAIN, SHUTTLE CAR CONNECTIONS FOR DRIVE CHAIN, AND DRIVE CHAIN TF FOR WEAR OR OTHER PHYSICAL DAMAGE (BOTH SIDES, TOP AND BOTTOM).

10. INSPECT THE DRIVE CHAIN IDLER SPROCKETS FOR WEAR.

11. VISUALLY INSPECT THE SHUTTLE CAR FOR WELD CRACKING. NOTIFY THE RESPONSIBLE ENGINEEF FROM WASTE HANDLING ENGINEERING FOR RESOLUTION AND PROBLEM DOCUMENTATION.

12. VISUALLY INSPECT THE SHUTTLE CAR SUPPORT ASSEMBLY FOR LOOSE MECHANICAL (BOLTED) CONNECTIONS. NOTIFY THE RESPONSIBLE ENGINEER FROM WASTE HANDLING ENGINEERING IF DISCREPANCIES ARE NOTED, FOR RESOLUTION AND PROBLEM DOCUMENTATION.

13. REMOVE ALL PMI ASSICIATED EQUIPMENT AND MATERIALS FROM THE SHUTTLE CAR ROOM AND STO OR DISPOSE OF THEM PROPERLY.

RECOVERY

1. REMOVE TOOLS, EQUIPMENT, AND PM MATERIALS FORM THE CELL.

2. REPLACE SHIELDS REMOVED FOR INSPECTION.

3. REMOVE TAGOUT

RETEST

NO RETEST REQUIRED

TAGOUT

BREAKER	POSITION	TAG	LOCK	LOCATION
41-HM-019	OPEN	DANGER	YES	41P-MCC04/1

41-H-019
CANISTER SHUTTLE CAR

DATA SHEET
MOSC (ANNUAL)

PREREQUISITES:

1. ACCESS TO CANISTER TRANSFER ROOM COORDINATED VIA PLAN OF THE WEEK.

_____
MAINTENANCE SCHEDULER / DATE

2. RADIATION WORK PERMIT (RWP) (IS/IS NOT) REQUIRED.

_____
HEALTH PHYSICS / DATE

IF REQUIRED: RWP NUMBER _____

COPY ATTACHED YES NO

3. SHUTTLE CAR POSITIONED TO THE EAST END OF CELL AND EQUIPMENT LOCKED AND TAGGED OUT SERVICE.

_____
OPERATIONS / DATE / TIME

PROCEDURE

4. TAGOUT VERIFIED

_____
MAINTENANCE TECHNICIAN / DATE/TIME

5. V-BELT INSPECTION OK REPLACED

6. SHEAVE ALIGNMENT OK ALIGNED

7. MECHANICAL FASTENER CHECK OK RETORQUED*

*IDENTIFY LOOSE CONNECTIONS

TORQUE WRENCH S/N _____

CAL DUE DATE _____

8. GEAR BOX LUBRICANT LEVEL OK ADDED _____OZ.

9. DRIVE BELT COVER REINSTALLED YES NO

10. EXCELL PILLOW BLOCK LUBRICATED YES NO

NOTE: STEPS 11 - 17 (PROCEDURE STEPS 7-13) ARE IN THE CANISTER TRANSFER CELL.

11. SHUTTLE CAR DRIVE PILLOW BLOCKS (2 EA) LUBED

YES NO

12. SHUTTLE CAR WHEELS (4 EA) LUBED YES NO

13. INSPECT DRIVE CHAIN AND TRACK MARKING WORN OR REPAIR REQUIRED MANDATES NOTIFICATIO ENGINEERING.

NORTH SIDE: DRIVE CHAIN OK WORN REPAIR REQUIRED

DRIVE CHAIN TRACK

TOP OK WORN REPAIR REQUIRED

BOTTOM OK WORN REPAIR REQUIRED

DRIVE CHAIN CONNECTION TO CAR OK REPAIR REQUIRED

SOUTH SIDE: DRIVE CHAIN OK WORN REPAIR REQUIRED

DRIVE CHAIN TRACK

TOP OK WORN REPAIR REQUIRED

BOTTOM OK WORN REPAIR REQUIRED

DRIVE CONNECTION TO CAR OK REPAIR REQUIRED

ENGINEER NOTIFIED _____

DATE _____

TIME _____

ENGINEERING RESOLUTION:

14. DRIVE CHAIN: SPROCKET INSPECTION:

NORTH-WEST DRIVE	OK	WORN	REPAIR REQUIRED
SOUTH-WEST DRIVE	OK	WORN	REPAIR REQUIRED
NORTH-WEST IDLER	OK	WORN	REPAIR REQUIRED
SOUTH-WEST IDLER	OK	WORN	REPAIR REQUIRED
NORTH TENSIONER	OK	WORN	REPAIR REQUIRED
SOUTH TENSIONER	OK	WORN	REPAIR REQUIRED
NORTH-EAST IDLER	OK	WORN	REPAIR REQUIRED
SOUTH-EAST IDLER	OK	WORN	REPAIR REQUIRED

15. SHUTTLE CAR INSPECTION OK DESCREPANCY NOTED*

*SPECIFY

ENGINEER NOTIFIED _____

DATE _____

TIME _____

ENGINEERING RESOLUTION:

16. SHUTTLE CAR SUPPORT ASSEMBLY INSPECTION OK DISCREPANCY NOTED

ENGINEER NOTIFIED: _____

DATE _____

TIME _____

ENGINEERING RESOLUTION:

17. ALL FMI ASSOCIATED MATERIAL STORED PROPERLY OR REMOVED FROM CELL

YES NO

WORK COMPLETE

_____
MAINT. TECH. DATE/TIME

_____
MAINT. SUPERVISOR / DATE

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FACILITY CASK

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41-Z-003
FACILITY CASK
E07C (SEMI-ANNUAL)

PREREQUISITES:

1. VERIFY EQUIPMENT IS DISCONNECTED FROM ALL POWER SOURCES AND INSTALL A "MAINTENANCE IN PROGRESS" TAG ON P-10 & P-11 RECEPTACLES.

2. LUBRICATE EACH MOTOR BEARING WITH ONE FULL STROKE OF A MANUAL GREASE GUN. (TWC MOTORS EACH WITH TWO ZERK FITTINGS). USE TEXACO PREMIUM RB GREASE OR EQUAL.

3. INSPECT ALL FLEXIBLE CONDUIT TO INSURE IT IS SECURE ON EACH END AND IS NOT DAMAGED

4. INSPECT THE COOLING FAN ON EACH MOTOR FOR CLEANLINESS AND SECURITY TO THE MOTOR SHAFT. CLEAN AND TIGHTEN AS NECESSARY.

5. INSPECT MAGNETIC MOTOR BRAKES AS FOLLOWS:

   - CLEAN OUT DUST AND/OR DIRT USING COMPRESSED AIR OR A SOFT BRUSH AND VACUU
   - CHECK OPERATION OF MANUAL RELEASE
   - CHECK BRAKE DISCS FOR CONDITION

6. OPEN AND INSPECT EACH JUNCTION BOX ASSOCIATED WITH EACH MOTOR. INSPECT FOR SIGNS OF HEATING, LOOSE CONNECTIONS, CHAFED WIRES, ETC. CLEAN AS NECESSARY.

7. RECLOSE THE DISTRIBUTION BOX COVER.

8. INSPECT RECEPTICALS P-10 & P-11 FOR LOOSE AND/OR DAMAGED PINS. PREPARE A WORK REQUEST TO REPAIR DAMAGE FOUND.

9. HAVE OPERATIONS PERSONNEL CONFIGURE THE CASK SUCH THAT THE MOTORS MAY BE RUN OPENING AND CLOSING EACH GATE TWICE. VERIFY PROPER OPERATION OF THE LIMIT SWITCHES, LISTEN FOR UNSUAL MOTOR NOISE AND EXCESSIVE (VERY HOT TO THE TOUCH) MOTOR TEMPERATURES.

10. REMOVE MAINTENANCE IN PROGRESS TAGS.

RECOVERY:

1. CLOSE DISTRIBUTION BOX COVERS
2. REMOVE MAINTENANCE IN PROGRESS TAGS

RETEST:

CASK CONTROLS RESPOND TO OPERATOR CONTROL INPUT AS EXPECTED.

TAGOUT:

MAINTENANCE IN PROGRESS TAGS ON RECEPTACLES P-10 AND P-11

41-Z-003
FACILITY CASK
DATA SHEET
E07C (SEMI-ANNUAL)

PREREQUISITE:

HEALTH PHYSICS PERSONNEL MUST DETERMINE THE NEED FOR A RADIATION WORK PERMIT.

RWP (IS/IS NOT) REQUIRED: _____
HEALTH PHYSICS / DATE

RWP NO: _____ IF REQUIRED.

1. VERIFY EQUIPMENT IS DISCONNECTED AND INSTALL "MAINTENANCE IN PROGRESS" TAG O AND P-11 ELECTRICAL RECEPTACLE.

_____
MAINTENANCE TECH. / DATE / TIME

2. LUBRICATE MOTORS WITH TEXACO PREMIUM RB OR EQUAL.

ROTATION LIFTING END	YES	NO
NON-LIFTING END	YES	NO

3. CONDUIT INSPECTION OK LOOSE DAMAGED*

*SPECIFY DAMAGE

4. MOTOR COOLING FANS

ROTATION LIFTING END	CLEAN	CLEANED	TIGHT	TIGHTED
NON-LIFTING END	CLEAN	CLEANED	TIGHT	TIGHTED

5. MAGNETIC MOTOR BRAKE INSPECTION

UNIT CLEANED	CLEAN	CLEANED
MANUAL RELEASE CHECK	OK	MALFUNCTION
BRAKE DISC CONDITION	OK	NEED REPLACEMENT*

*PREPARE WORK REQUEST: WR#_____

6. JUNCTION BOX INSPECTION

ROTATION LIFTING END	CLEAN	CLEANED	LOOSE	CONNECTOR	HEATING	OTHER
NON LIFTING END	CLEAN	CLEANED	LOOSE	CONNECTOR	HEATING	OTHER
CENTER DISTRIBUTION BAR	CLEAN	CLEANED	LOOSE	CONNECTOR	HEATING	OTHER*

7. INSPECT P-10 AND P-11 FOR:

	P-10		P-11	
LOOSE PIN	OK	PIN(S) LOOSE	OK	PIN(S) LOOSE
DAMAGED PINS	OK	DAMAGED PIN(S)	OK	DAMAGED PIN

*IDENTIFY POSITION AND DISPOSITION TAKEN.

8. CASK GATES OPENED AND CLOSED BY OPERATIONS TWICE. YES NO

MOTOR NOISES	NORMAL	EXCESSIVE*
MOTOR TEMPERATURE	NORMAL	EXCESSIVE*
LIMIT SWITCHES	OK	MALFUNCTION

*NOTIFY WASTE HANDLING ENGINEERING COG ENGINEER FOR FURTHER EVALUATION AND DIRECTION. WORK REQUEST WILL BE PREPARED IF RESOLUTION REQUIRES FURTHER WORK.

W/R #_____

9. MAINTENANCE IN PROGRESS TAGS REMOVED YES NO

WORK COMPLETE

_____
MAINTENANCE TECH. / DATE / TIME

_____
MAINTENANCE SUPERVISOR / DATE

RETEST (SATISFACTORY / UNSATISFACTORY*)

_____
OPERATIONS / DATE

*SPECIFY REASON

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FACILITY CASK TRANSFER CAR

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1. VERIFY EQUIPMENT IS LOCKED AND TAGGED OUT.

2. VERIFY TIGHTNESS OF ALL EXTERNAL BOLTS AND SCREWS.

3. REMOVE TOP FILLER PLUG ON GEAR REDUCER AND CHECK OIL LEVEL. FILL TO LEVEL OF CHECK PLUG WITH GST 100 TURBINE OIL AS REQUIRED.

4. REPLACE PLUGS ON GEAR REDUCER AND VERIFY THAT THERE IS NO OIL LEAKAGE.

5. LUBRICATE GEAR REDUCER SHAFT SEALS (ONE INPUT, TWO OUTPUT) WITH ARC OPALINE #5 THROUGH THE LUBRICATION FITTING AT THE TOP OF THE BEARING RETAINERS. OLD GREASE WILL BE EXPELLED THROUGH THE PRESSURE RELIEF FITTING AT THE BOTTOM OF THE RETAINER AND FOREIGN MATERIAL WILL BE EXPELLED FROM THE SHAFT CLEARANCE.

6. CLEAN GEARCASE ASSEMBLY OF EXCESS AND EXPELLED LUBRICANTS.

7. LUBRICATE PILLOW BLOCK BEARINGS (4 EACH) WITH MULTIFAK EP #2 GREASE UNTIL GREASE APPEARS AT THE BEARING SEAL.

8. LUBRICATE WHEEL ASSEMBLIES (4 EACH) THROUGH THE ZERT LOCATED AT THE END OF EACH WHEEL SHAFT WITH MULTIFAK #2 GREASE UNTIL GREASE APPEARS AROUND WHEEL.

9. REMOVE THE COVERS FROM EACH OF THE FOUR SHAFT COUPLINGS. VERIFY THE TIGHTNESS OF SHAFT SET SCREWS AND COUPLING HALF MOUNTING BLOTS. (FE. TORQUE TABLE).

10. REMOVE THE 1/4" ALLEN HEAD SCREW FROM ACH COUPLING AND REPLACE WITH A GREASE ZERT. LUBRICATE WITH MULTIFAK EP #2 UNTIL GREASE IS EXPELLED FROM COUPLING HALVES.

11. REMOVE ZERTS, REPLACE ALLEN SCREWS AND WIPE UP EXCESS LUBRICANT.

12. REPLACE COUPLING COVERS.

13. CLEAN OPEN GEARS OF FOREIGN MATERIAL AND INSPECT FOR WEAR.

14. COAT OPEN GEARS EVENLY WITH CRATER 5X FLUID OR EQUIVALENT.

_____ / _____
MAINT. SUPERVISOR DATE

ACKNOWLEDGE - TAG REMOVED

_____ / _____ / _____
OPERATIONS TIME DATE

1. EQUIPMENT LOCKED AND TAGGED OUT:

_____ / _____
OPERATIONS DATE

_____ / _____
MAINT. TECH. DATE

2. TIGHTNESS OF EXTERNAL BOLTS AND SCREWS OK. TIGHTENED

3. OIL LEVEL ON GEAR REDUCER OK. QUANTITY ADDED_____

4. PLUGS REPLACED: NO LEAKS YES NO

5. LUBRICATE GEAR REDUCER SHAFT SEALS YES NO

6. CLEAN EXCESS LUBRICANTS FROM GEAR REDUCER. YES NO

7. LUBRICATE PILLOW BLOCK BEARINGS (4 EACH) YES NO

8. LUBRICATE WHEEL ASSEMBLIES YES NO

9. COUPLINGS SET (4 EACH) SCREWS AND MOUNTING BLOTS TIGHT. YES NO

10. LUBRICATE COUPLINGS (4 EACH). YES NO.

11. CLEAN COUPLINGS, REPLACE ALLEN SCREWS YES NO

12. REPLACE COUPLING COVERS YES NO

13. CLEAN OPEN GEARS: INSPECT FOR WEAR

CLEANING YES NO

INDICATION OF WEAR YES NO

14. LUBRICATE OPEN GEARS YES NO

WORK COMPLETE _____ / _____ / _____
MAINT.TECH. TIME DATE

FACILITY CASK TRANSFER CAR
MO7C (SEMI-ANNUAL)

1. VERIFY EQUIPMENT IS LOCKED AND TAGGED OUT.

2. VERIFY TIGHTNESS OF ALL EXTERNAL BOLTS AND SCREWS.

3. REMOVE GEAR REDUCER INSPECTION PLATE AND INSPECT GEARS OR EXCESSIVE OR UNEVEN WEAR: REPLACE INSPECTION PLATE.

4. CHANGE OIL IN THE GEAR REDUCER. CAPACITY IS APPROXIMATELY 2.5 GALLONS. USE GST 100 TURBINE OIL.

5. VERITY THAT THERE IS NO OIL LEAKAGE FROM GEAR REDUCER.

6. LUBRICATE GEAR REDUCER SINGLE INPUT AND DOUBLE OUTPUT SEALS WITH ARC-OPALINE #5 THROUGH THE LUBRICATION FITTING AND CONTAMINANTS FROM THE SHAFT CLEARANCE. VERIFY THAT NO METAL PARTICLES ARE PRESENT IN EXPELLED LUBRICANT.

7. CLEAN GEAR REDUCER OF EXCESS LUBRICANTS

8. LUBRICATE PILAR BLOCK BEARINGS (4 EACH) WITH MULTIFAK EP2 GREASE UNTIL GREASE APPEARS AT THE BEARING SEAL.

9. LUBRICATE WHEEL ASSEMBLIES (4 EACH) THROUGH THE ZERT LOCATED AT THE END OF EACH AXLE SHAFT. USE MULTIFAK EP-2 GREASE UNTIL EXCESS GREASE APPEARS AROUND WHEEL.

10. REMOVE COVERS FROM COUPLINGS. CHECK ALIGNMENT (T.005 IN.) ADJUST IF NECESSARY.

11. LUBRICATE COUPLINGS WITH MULTIFAK EP 2: REPLACE COVERS.

12. CLEAN OPEN GEARING OF ANY FOREIGN MATERIAL: CHECK FOR EVIDENCE OF BINDING OR LINEVEN WEAR.

13. LUBRICATE OPEN GEARING WITH CRATER 5X FLUID OR EQUIVALENT.

14. REMOVE LOCKS AND TAGS - (OPERATIONS)

WHILE OPERATIONS PERSONNEL OPERATE THE EQUIPMENT:

15. CHECK FOR EXCESSIVE TEMPERATURE IN BEARINGS AND GEAR REDUCER.

16. CHECK FOR UNUSUAL NOISE, SLACK OR VIBRATION IN GEAR REDUCER, BEARINGS, SHAFTS AND COUPLINGS.

17. CLEAN MAINTENANCE GENERATED DEBRIS FROM AREA.

FACILITY CASK TRANSFER CAR
MO7C (SEMI-ANNUAL)
DATA SHEET

1. EQUIPMENT LOCKED AND TAGGED OUT

_____ / _____
OPERATIONS DATE

_____ / _____
MAINT. TECH. DATE

2.	EXTERNAL BOLTS AND SCREWS TIGHT	YES	NO
3.	INSPECT GEAR REDUCER INTERNAL GEARING	OK	WORN
4.	CHANGE OIL IN GEAR REDUCER	YES	NO
5.	CHECK OIL LEAKAGE FROM GEAR REDUCER	YES	NO
6.	LUBRICATION OF GEAR REDUCER SEALS (3 EACH).	YES	NO
7.	CLEAN GEAR REDUCER	YES	NO
8.	LUBRICATE PILLOW BLOCK BEARINGS (4 EACH).	YES	NO
9.	LUBRICATE WHEEL ASSEMBLIES. (4 EACH)	YES	NO
10.	CHECK & ADJUST COUPLING ALIGNMENT (4 EACH)	YES	NO
11.	LUBRICATE COUPLINGS (4 EACH)	YES	NO
12.	A. CLEAR OPEN GEARING	YES	NO
	B. CHECK FOR WEAR ON GEARING	OK	WORN
13.	LUBRICATE GEARING	YES	NO
14.	REMOVE LOCKS AND TAGS	(OPERATIONS)	
15.	CHECK FOR EXCESSIVE TEMPERATURE:		
	BEARINGS	OK	HOT
	GEAR REDUCER	OK	HOT

16. CHECK UNUSUAL NOISE, SLACK OR VIBRATION

GEAR REDUCER:	OK	NOISY
BEARINGS:	OK	NOISY
SHAFTS & COUPLINGS	OK	ADJUSTED

17. CLEAN UP AREA YES NO

18. WORK COMPLETE

_____ / ____ / _____
MAINT. TECH. DATE TIME

_____ / ____ / _____
MAINT. SUPER. DATE TIME

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FACILITY CASK TURNTABLE

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1. VERIFY AIR SUPPLY IS VALVED OFF.

2. DISCONNECT THE 3/4" ROTARY JOINT AIR HEADER CONNECTION ASSEMBLY ON THE CENTER PIPE RISER.

3. INSTALL FOUR 7/8" SWIVEL PAD LIFTING EYES IN THE TURNTABLE SURFACE AND ATTACH A FOUR PART SLING COMPRISED OF TWO 12' LONG 12,600 LB. BRIDELS ATACHED TO A 1 1/2" SHACKLE (25,500 LB. RATING).

4. SET UP THE 28 TON CAPACITY P&H CRANE IN A POSITION AS CLOSE TO THE TURNTABLE AS POSSIBLE USING 3/4 INCH OR THICKER PLYWOOD TO PAD THE OUTRIGGERS THUS PREVENTING FLOOR DAMAGE.

5. ATTACH TO THE FOUR PART SLING AND VERY CAREFULLY LIFT THE TURNTABLE OUT OF THE PIT. EXTEND THE CRANE BOOM TO A POINT OPPOSITE THE CRANE SUCH THAT THE TURNTABLE CAN BE SET DOWN ON CRIBBING LEAVING THE PIT OPEN. DO NOT SET THE TURNTABLE DOWN ON BARE FLOOR. POSITION CRIBBING IN SUCH A LOCATION UNDER THE TURNTABLE TO PREVENT PHYSICAL DAMAGE TO THE TURNTABLE.

6. REMOVE ALL ACCESS COVERS. NOTE THE POSITION FROM WHICH THEY WERE REMOVED FROM TO FACILITATE LATER REINSTALLATION.

7. REMOVE THE 5/16" BOLT SECURING THE BEARING TRAYS TO THE TURNTABLE.

8. SLIDE THE TRAYS OUT NOTING WHICH BEARING TRAY CAME FROM WHICH POSITION AND CARRY THEM TO A WORK SPACE WHERE THEY CAN BE CLEANED. (NO PIPING OR HOSES REQUIRE DISCONNECTING).

9. CLEAN ANY BUILDUP OF DIRT AND GREASE FROM THE BEARING USING SOAP OR DETERGENT AND WATER. DRY THE BEARING THOROUGHLY.

10. INSPECT THE FOUR BEARINGS AND SEALS FOR DAMAGE. IF DAMAGED, REPLACE THE BEARING AND SEAL PER STEPS 11 THROUGH 13. IF NO DAMAGE IS EVIDENT, PROCEED TO STEP 14.

11. REMOVE CLIPS HOLDING THE BEARING TO THE TRAY.

12. REPLACE THE BEARING AND SEAL.

13. REATTACH THE BEARING TO TRAY KEEPING THE SEAL CENTERED IN THE 3" DIAMETER HOLE IN THE TRAY.

14. SLIDE THE TRAYS INTO THE GROOVE FROM WHERE THE TRAY WAS ORIGINALLY REMOVED.

15. REINSTALL AND TIGHTEN THE RETAINING BOLT.

16. CLEAN THE TURNTABLE PIT USING CLEAN RAGS AND A VACUUM CLEANER TO REMOVE ALL DUST AND/OR DIRT FROM THE PIT. PAY PARTICULAR ATTENTION TO THE BEARING PATHWAY WHEN CLEANING THE PIT.

17. CLEAN AND LUBRICATE THE 4" PIPE SLEEVE IN THE CENTER OF THE PIT INSURING THAT THE UPPER PORTION IS COVERED WITH A LIGHT COATING OF MACHINE OIL.

18. USING THE P&H 28 TON CRANE AND RIGGING, LIFT THE TURNTABLE AND SET THE HOLE IN THE CENTER OF THE TURNTABLE OVER THE 4" PIPE SLEEVE IN THE PATHWAY KEEPING THE TABLE HORIZONTAL. GENTLY LOWER THE TURNTABLE IN PLACE.

19. REMOVE THE RIGGING AND LIFTING EYES.

20. REATTACH THE ROTARY JOINT ASSEMBLY IN THE 3/4" COUPLING THAT IS ON THE CENTER RISER PIPE.

21. REPLACE ALL COVERS ON THE TOP OF THE TURNTABLE.

RECOVERY

RECOVERY IS PER STEPS 18 THROUGH 21 OF THE WORK INSTRUCTION SET.

RETEST

OPERATION TO OPERATE THE TURNTABLE PER ESTABLISHED OPERATION PROCEDURES TO VERIFY THE TURNTABLE OPERATES AS EXPECTED. THE TABLE SHOULD RISE APPROXIMATELY 1/2" TO 5/8" WITHOUT EXCESSIVE NOISE AND SHOULD BE EASILY ROTATED BY HAND.

TAGOUT

VALVE	POSITION	LOCK	TAG	LOCATION
41-T-017	CLOSED	YES	DANGER	EAST WALL OF THE CASK LOADING ROOM OR FLOOR PIT JUST EAST & ADJACENT TO THE TURNTABLE.

1. AIR VERIFIED OFF. VERIFIED _____
INITIAL

2.	ROTARY JOINT DISCONNECTED.	YES	NO
3-5.	RIGGING PERFORMED & TURNTABLE REMOVED AND SET DOWN ON CRIBBING.	YES	
6.	ACCESS COVERS REMOVED	YES	
7.& 8.	BEARING TRAYS REMOVED AND IDENTIFIED AS TO LOCATION REMOVED FROM.	YES	
9.	BEARINGS CLEANED AND DRIED.	YES	NO
10.	BEARINGS INSPECTED.		
	NO. 1	OK	REPLACED
	NO. 2	OK	REPLACED
	NO. 3	OK	REPLACED
	NO. 4	OK	REPLACED

11,12&13 CLIPS REMOVED AND COMPONENTS REPLACED.
(BEARINGS AND/OR SEALS) (MARK N/A ON UNITS NOT REPLACED)

	CLIPS REMOVED		BEARING & SEAL REPLACED		BEARING REACTIVATED	
NO. 1	_____ INITIAL	N/A	_____ INITIAL	N/A	_____ INITIAL	N/A
NO. 2	_____ INITIAL	N/A	_____ INITIAL	N/A	_____ INITIAL	N/A
NO. 3	_____ INITIAL	N/A	_____ INITIAL	N/A	_____ INITIAL	N/A
NO. 4	_____ INITIAL	N/A	_____ INITIAL	N/A	_____ INITIAL	N/A

14.	TRAYS REPLACED IN LOCATIONS FROM WHICH THEY WERE REMOVED.	YES	NO

15.	BOLTS TIGHTENED.	YES	NO
16.	PIT CLEANED.	YES	NO
17.	CENTER POST CLEANED AND LUBRICATED.	YES	NO
18.	TURNTABLE REPLACED.	YES	NO
19.	RIGGING REMOVED.	YES	NO
20.	COVERS REPLACED.	YES	NO

WORK COMPLETE

_____
TECHNICIAN / DATE

_____
SUPERVISOR

RETEST
SATISFACTORY/UNSATISFACTORY*
*EXPLAIN

_____
WASTE HANDLING OPERATIONS /DATE

FACILITY GRAPPLE

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Waste Isolation Pilot Plant Westinghouse - Operations Dept. *MECHANICAL PM INSTRUCTIONS REPORT* 02/17/89	EQPT. NO.: 41-T-022 A,B&D DESCRIPTION: FACILITY GRAPPLE

PREVENTIVE MAINTENANCE INSTRUCTIONS VERSION: REV. 0

** EQUIPMENT DATA **

CUSTODIAN: MGR, WST HNDLG OPS.

LOCATION: 1.CASK UNLOADING RM,2.HOT CELL

MAKE: WESTMONT

MODEL: 8950-28

SERIAL NO.:

HORSE POWER: 0.25

CYC./SEC.:

DRAWINGS:

MANUALS: WESTMONT OMM 41-T-022

OP. PARAMETERS:

WORKMANSHIP STANDARDS: REMOVE PMI GENERATED DEBRIS, CLEAN ANY SPILLED OR DROPPED GEAR LUBRICANT. AN RWP IF REQUIRED, WILL BE PREPARED BY HP PROVIDING RADIATION RELATED INSTRUCTION.

SAFETY REQUIREMENTS: EQUIPMENT MUST BE IN AN ACCESSABLE LOCATION, DECONTAMINATED OR DECLARED FREE OF CONTAMINANTS BY HEALTH PHYSICS PERSONNEL. AN RWP IF REQUIRED, WILL BE PREPARED BY HP PROVIDING RADIATION RELATED INSTRUCTION.

TOOLS/EQUIP. REQUIREMENTS: STANDARD MECHANIC TOOL SET.

MATERIAL REQUIREMENTS: TEXACO CRATER 2X FLUID (OR EQUAL)

MISCELLANEOUS INFORMATION

LOCATION: 41-T-022A HOT CELL
41-T-022B FACILITY CASK LOADING STATION
41-T-022D SPARE

SEMI-ANNUAL PREVENTIVE MAINTENANCE INSTRUCTIONS

41-T-022A,B
FACILITY GRAPPLE
NOTE: 41-T-022D IS A SPARE - NO PM REQUIRED UNTIL PUT INTO SERVICE.
M07C (SEMI-ANNUAL)

PROCEDURE:
1. VERIFY GRAPPLE IS ACCESSABLE FOR MAINTENANCE (MAINT. SCHEDULER ACTION).
2. VERIFY AN RWP IS IN EFFECT IF REQUIRED. (HEALTH PHYSICS ACTION).
3. HAVE A QUALIFIED OPERATIOR CYCLE THE GRAPPLE FROM THE CLOSED POSITION TO THE EXTENDE POSITION SEVRERAL TIMES. LISTEN FOR NOISE WHICH MAY INDICATE BINDING OR ALIGNMENT PROBLE IDENTIFY THE SOURCE OF UNUSUAL NOISES. IDENTIFY PROBLEMS ON DATA SHEET.
4. HAVE OPERATIONS DE-ENERGIZE THE EQUIPMENT AND TAG IT OUT OF SERVICE.
5. PERFORM ALIGNMENT OR ADJUSTMENTS REQUIRED AS A RESULT OF THE STEP 3 INSPECTION.

RECOVERY
1. COMPLETE ALIGNMENT(S) AS REQUIRED.
2. REMOVE TAGOUT.

RETEST
SMOOTH OPERATION OF THE GRAPPLE WITH NO BINDING OR EXCESSIVE TORQUE REQUIREMENTS REQUIRED EXTEND AND RETRACT GRAPPLE FINGERS.

TAGOUT

EQUIPMENT NO.	BREAKER	POSITION	LOCK	TAG	LOCATION
41-T-104 & 41-T-022A	41-T-104	OPEN	YES	DANGER	41-P-MCC04/2
41-H-022	SW04-6	OPEN	YES	DANGER	41P-MCC04/1
41-T-022B	TM022B	OPEN	YES	DANGER	CASK LOADING ROOM PANEL LP-04
41-T-022D	NO TAGOUT REQUIRED. SPARE EQUIPMENT ITEM.				

41-T-122 A, B & D
FACILITY GRAPPLE
DATA SHEET
M C

1. GRAPPLE ACCESSIBLE FOR MAINTENANCE

_____
MAINTENANCE SCHEDULER / DATE

2. RWP (IS - IS NOT) REQUIRED _____
HEALTH PHYSICS / DATE

IF REQUIRED. RWP NUMBER_____

NOTE: RWP MUST BE POSTED AT THE WORK LOCATION.

PM WORK BEGUN AT _____
TIME OF DAY

3. UNUSUAL NOISE OR BINDING EVIDENT YES* NO

*DESCRIBE PROBLEM

4. GRAPPLE TAGGED OUT _____
OPERATIONS / DATE / TIME

VERIFIED _____
MAINTENANCE TECHNICIAN / DATE / TIME

5. ALIGNMENT REQUIRED PERFORMED YES NO NOT APPLICABLE

WORK COMPLETE _____
MAINTENANCE TECHNICIAN / DATE / TIME

_____
MAINTENANCE SUPERVISOR / DATE / TIME

RETEST: SATISFACTORY/UNSATISFACTORY

_____
OPERATIONS / DATE

15-TON BRIDGE CRANE

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WASTE ISOLATION PILOT PLANT
WESTINGHOUSE OPERATIONS DEPT.
41-T-104, REV. 2
LUBRICATION LEVEL CHECK
MO7C (SEMI-ANNUAL)

1. CELL ACCESS MUST BE AVAILABLE FOR THIS WORK (SUPERVISOR VERIFIED).

2. HEALTH PHYSICS PERSONNEL MUST CERTIFY THE CELL FOR INHABITATION AND PROVIDE AN APPLICABLE RADIATION WORK PERMIT IF REQUIRED. COPY OF THE RWP MUST BE POSTED AT WORK LOCATION.

3. VERIFY TAG-OUT OF EQUIPMENT (CRANE IN MAINTENANCE AREA).

4. INSPECT GEAR BOXES FOR LUBRICATION LEVELS AND OR LEAKS AS FOLLOWS: (TOP OFF WITH CONOCO GEAR OIL 150 AS REQUIRED).

   1. HOIST GEAR CASE (CENTER OF SITE GLASS)
   2. TROLLEY DRIVE GEAR CASE (CENTER OF SITE GLASS)
   3. BRIDGE DRIVE GEAR CASE (CENTER OF SITE GLASS)
   4. TROLLEY GEAR REDUCTION UNIT (FULL)
   5. BRIDGE GEAR RESOLUTION UNIT (FULL)

5. REMOVE PM GENERATED RESIDUE.

6. NOTIFY OPERATIONS OF WORK COMPLETION

RECOVERY
NONE REQUIRED

RETEST
NONE REQUIRED

TAGOUT

BREAKER	POSITION	LOCK	LOCATION
41-T-104	OPEN	YES	41-P-MCC04/2

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE OPERATIONS DEPT.
41-T-104, REV. 2
DATA SHEET
MO7C (SEMI-ANNUAL)

_____
DATE / SHIFT

1. CELL AVAILABILITY ESTABLISHED (FROM POW).

_____
MAINT. SUPERVISOR / DATE

2. CELL CLEARED FOR PM WORK.

_____
MAINT. SUPERVISOR / DATE

3. TAG-OUT VERIFIED/CRANE IN MAINTENANCE AREA.

_____
OPERATIONS / DATE / TIME

4. LUBRICATION LEVEL:

1.	HOIST GEAR BOX	OK	ADDED_____
	LEAKS EVIDENT	YES	NO
2.	TROLLEY DRIVE	OK	ADDED_____
	LEAKS EVIDENT	YES	NO
3.	BRIDGE DRIVE	OK	ADDED_____
	LEAKS EVIDENT	YES	NO
4.	TROLLEY GEAR REDUCER	OK	ADDED_____
	LEAKS EVIDENT	YES	NO
5.	BRIDGE GEAR REDUCER	OK	ADDED_____
	LEAKS EVIDENT	YES	NO

WORK COMPLETE

_____
MAINT. TECH. / DATE / TIME

_____
MAINT. SUPERVISOR /DATE/TIME

TAGOUT REMOVED

_____
OPERATIONS / DATE

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE OPERATIONS DEPT.
41-T-104, REV. 2
MO8C (ANNUAL)

TASK:
INSPECT THE HOT CELL BRIDGE CRANE HOISTING ROPES, TACKLE AND FUNCTIONAL OPERATING MECHANISMS.

REFERENCES:
1. 12-4, WIPP HOISTING AND RIGGING MANUAL
2. WP-04-001, EQUIPMENT TAG-OUT PROCEDURE
3. EDERER O&M MANUAL

PRECAUTIONS AND LIMITATIONS:
1. THE BRIDGE CRANE WILL BE OUT OF SERVICE FOR PERFORMANCE OF THIS PREVENTIVE MAINTENANCE INSPECTION.
2. OBSERVE THE APPLICABLE SAFETY PRECAUTIONS AND PROCEDURES OF 12-4, WIPP HOISTING AND RIGGING MANUAL.
3. TAGOUT AS REQUIRED PER WP-04-001.
4. THE CELL MUST BE SURVEYED AND RELEASED FOR ENTRY PRIOR TO BEGINNING THIS WORK.
5. ALL MATERIALS ENTERING THE HOT CELL MUST BE SURVEYED FOR RADIATION PRIOR TO LEAVING THE CELL. THIS INCLUDES TOOLS, MATERIALS, SUPPLIES AND DISPOSABLE ITEMS (E.G. RAGS, GREASE, LUBRICANTS, ETC.). EXIT REQUIREMENTS (JOB SPECIFIC) WILL BE ESTABLISHED BY HEALTH PHYSICS BASED UPON THEIR CELL SURVEY RESULTS.

EQUIPMENT, TOOLS AND MATERIALS:
1. CONOCO COGLUBE OR EQUAL
2. CONOCO GEAR OIL 150 OR EQUAL
3. CONOCO CONOLITH EP-2 OR EQUAL
4. FLASHLIGHT
5. CLEAN RAGS
6. SHEAVE GROOVE GAUGES, 2 EACH 9/16" DIAMETER
7. ZERK FITTINGS
8. PARALLEL JAW CALIPER (VERNIER)
9. GREASE GUN

PREREQUISITES:
1. HAVE OPERATIONS PERSONNEL LOWER THE HOIST HOOK TO THE OPERATING FLOOR.
2. HAVE OPERATIONS PERSONNEL CAUTION TAG THE CRANE IN ACCORDANCE WITH WP-04-001.

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE OPERATIONS DEPT.
41-T-104, REV. 2
MO8C (ANNUAL)

PROCEDURE:

NOTE

IF ANY CONDITION IS OBSERVED WHILE PERFORMING THIS WORK WHICH MAY AFFECT THE SAFETY OF THE OPERATOR OR OTHER PERSONNEL WORKING IN THE VICINITY OF THIS EQUIPMENT OR THAT MAY ADVERSELY AFFECT THE OPERATIONS OF THIS EQUIPMENT, NOTIFY THE RESPONSIBLE MANAGER IMMEDIATELY.

1. VERIFY THE FOLLOWING:
   A. CELL ENTRY REQUIREMENTS HAVE BEEN ESTABLISHED AND ARE INCLUDED AS ATTACHEMENT TO THIS PMI (MAINTENANCE SCHEDULER ACTION).
   B. IDENTIFIED EQUIPMENT, TOOLS, AND MATERIALS ARE AVAILABLE AND GATHERED PRIOR TO CELL ENTRY.

NOTE

THIS PMI CAN USE CONVENTIONAL LUBRICANTS UNTIL HOT CELL NUCLEAR OPERATIONS BEGIN. AT THAT TIME ALL LUBRICANTS BE PURGED AND CHEVRON NUCLEAR RADIATION RESISTANT LUBRICANTS INSTALLED. THE CROSS REFERENCE IS AS FOLLOWS:

CONOCO GEAR OIL 150	CHEVRON NRKO 360
CONOCO SRI OR TEXACO CRATER 2X	CHEVRON NRRG 235
EP-2 GREASE	CHEVRON NRRG 335

2. PERFORM A WALKDOWN OF THE CRANE: VISUALLY INSPECT ALL OPERATING MECHANISMS FOR WEAR, PROPER OPERATION AND ANY UNUSUAL NOISES. NOTE ANY ABNORMALITIES ON THE DATA SHEET.

3. INSPECT THE HOIST SHEAVE:
   A. RELIEVE THE TENSION OF THE WIRE ROPE.
   B. LIFT THE ROPE OUT OF THE SHEAVE AND CHECK THE ROPE FOR WEAR ON THE PORTION THAT NORMALLY RESTS IN THE GROOVE OF THE EQUALIZER SHEAVE.
   C. THE HOIST SHEAVE SHOULD BE INSPECTED FOR:
      1. GROOVE WEAR. GROOVE GAUGE SHOULD BE THE SAME DIAMETER AS THE WIRE ROPE.
      2. BROKEN OR CHIPPED FLANGES.
      3. OUT OF ROUND CONDITION.
      4. ALIGNMENT WITH ANY OTHER SHEAVES.
      5. FREEDOM OF MOVEMENT OF SHEAVE.

PROCEDURE CONT'D.

D. RESEAT WIRE ROPE IN THE SHEAVE. RAISE GRAPPLE TO THE UPPER LIMIT.

E. RECORD FINDINGS ON THE DATA SHEET.

4. WIRE ROPE INSPECTION

CAUTION

DO NOT LOOP RAGS AROUND HANDS WHEN CHECKING WIRE ROPE FOR BROKEN STRANDS.

A. HAVE THE OPERATOR RAISE THE HOIST HOOD TO THE UPPER LIMITS, VERIFY OPERATION OF UPPER LIMIT SWITCH (ULS).

B. VISUALLY INSPECT THE WIRE ROPE WHILE TURNING THE DRUM SLOWLY. WRAP TWO LONG RAGS HALFWAY AROUND THE WIRE ROPE TO DETECT SNAGS AND BROKEN WIRES AS HE ROPE PLAYS OFF THE DRUM.

C. INSPECT ROPE FOR CORROSION, RUSTING, HEAT DAMAGE, KINKING, CRUSHING, BIRDCAGING, TWISTING AND EXCESSIVE WEAR. CHECK ROPE FASTENERS TO DRUM FOR DISTORTION, CORROSION AND LOOSENESS. RECORD INSPECTION RESULTS ON THE DATA SHEET.

D. MEASURE THE HOIST ROPE AT TWO POINTS WITH A PAIR OF PARALLEL-JAWED CALIPERS TO ASSURE ROPE IS NOT FLATTENING (ALWAYS MEASURE AT THE LARGEST DIMENSION).

E. INSPECT THE HOISTING DRUM FOR WEAR CAUSED BY THE WIRE ROPE.

F. LUBRICATE THE WIRE ROPE WITH CONOCO SRI LUBRICANT OR EQUIVALENT AS NECESSARY.

5. HAVE OPERATIONS PERSONNEL MOVE THE CRANE TO THE CRANE MAINTENANCE AREA OF THE HOT CELL IF NOT THERE ALREADY AND LOCK THE EQUIPMENT OUT OF SERVICE PER WP-04-001. SIGN OFF DATA SHEET PRIOR TO PROCEEDING.

NOTE

STEPS 6, 7 & 8 CAN ONLY BE PERFORMED UNTIL NUCLEAR OPERATIONS BEGIN. AT THAT TIME THEY ARE NOT APPLICABLE.

6. SAMPLE THE HOIST GEAR CASE. SEND SAMPLE TO ANALYSIS LAB BEING USED BY WIPP FOR OIL ANALYSIS. TOP OFF THE GEAR CASE WITH CONOCO GEAR OIL 150 OR EQUAL.

PROCEDURE CONT'D.

7. SAMPLE THE TROLLEY DRIVE GEAR CASE. SEND SAMPLE TO ANALYSIS LAB BEING USED BY WIPP FOR OIL ANALYSIS. TOP OFF THE GEAR CASE WITH CONOCO GEAR OIL 150 OR EQUAL.

8. SAMPLE THE BRIDGE DRIVE GEAR CASE (CENTER OF BRIDGE EAST SIDE). SEND THE SAMPLE TO THE ANALYSIS LAB BEING USED BY WIPP FOR OIL ANALYSIS. TOP OFF THE GEAR CASE WITH CONOCO GEAR OIL 150 FILLING TO THE CENTER OF THE SITE GLASS ONLY.

9. DRAIN THE BRIDGE GEAR REDUCER GEAR CASE (APPROXIMATELY 1.4 QUARTS) AND THE TROLLEY GEAR REDUCER (APPROXIMATELY 1 PINT). REFILL EACH WITH CONOCO 150 GEAR OIL.

10. CHECK LUBRICANT LEVELS IN ALL OVERRIDER GEAR BOXES. TOP OFF AS NECESSARY.

11. LUBRICATE THE MACHINE BEARING AS FOLLOWS:
(USE CONOCO CONOLITH EP-2 GREASE)
WIPE OFF ANY EXCESS OR EXPELLED GREASE.

    A. BRIDGE RAIL WHEELS (2 PLACES EACH 4 WHEELS)
    B. TROLLEY RAIL WHEELS (2 PLACES EACH 4 WHEELS)
    C. HOIST DRUM PILLOW BLOCK AND DRUM (2 PLACES)
    D. BOTTOM BLOCK ASSEMBLY (2 PLACES)
    E. UPPER BLOCK AND EQUALIZER (3 PLACES)
    F. HOIST OVERRIDE PILLOW BLOCK (2 PLACES)
    G. TROLLEY OVERRIDE PILLOW BLOCK (2 PLACES)
    H. BRIDGE SQUARING SHAFT BEARING (2 PLACES)

12. LUBRICATE MACHINE COUPLINGS AS FOLLOWS:
REMOVE BOTH PLUGS, INSTALL A ZERK FITTING IN ONE AND USING A LOW PRESSURE GREASE GUN, ADD CONOCO CONOLITH EP-1 GREASE.
WIPE OFF EXCESS OR EXPELLED GREASE.

    A. HOIST OVERRIDE (3 EACH)
    B. TROLLEY OVERRIDE (3 EACH)
    C. HOIST MOTOR TO CLUTCH (1 EACH)
    D. BRIDGE DRIVE SQUARING SHAFT (3 EACH, 2 LARGE, 1 SMALL)
    E. TROLLEY DRIVE (4 EACH)

13. LUBRICATE ALL HOIST BRAKE BEARING PINS SPARINGLY (IF REQUIRED) WITH A LIGHT WEIGHT MACHINE OIL (CHEVRON NRRO 360). CAUTION: DO NOT GET OIL ON BRAKE DRUM.

14. INSPECT HOIST BRAKE FOR LOOSE OR EXCESSIVELY WORN PINS, MISSING RETAINERS OR EXCESSIVELY WORN BRAKE SHOE LINERS. MINIMUM LINER THICKNESS IS 0.25 INCHES. LUBRICATE BEARING PINS SPARINGLY (ONE DROP) USING A LIGHT WEIGHT MACHINE OIL (CHEVRON NRRO 360). MEASURE PARAMETER AS IDENTIFIED ON DATA SHEET OF HOIST BRIDGE AND TROLLEY BRAKES.

15. INSPECT HOIST GENERAL CONDITIONS AS FOLLOWS:
    1. LOOSE GEAR CASE MOUNTING BOLTS. TIGHTEN AS NECESSARY.
    2. COUPLINGS FOR LOOSE BOLTS, KEYS, OR FIT ON SHAFT. TIGHTEN AS NECESSARY.
    3. INSPECT GEAR CASE SEALS FOR LEAKS.
    4. INSPECT DRUM FOR CRACKS. VERIFY CABLE CLAMPS ARE TIGHT.
    5. INSPECT UPPER AND LOWER BLOCK SHEAVES FOR EXCESSIVE WEAR, CRACKS OR OTHER FAULTS. VERIFY SHEAVES TURN FREELY.
    6. VERIFY ALL BEARING MOUNTING BOLTS ARE TIGHT.
    7. INSPECT WHEELS FOR FLAT SPOTS OR FLANGE WEAR.
    8. CHECK GIRDER TO END TRUCK CONNECTION BOLTS FOR LOOSE OR MISSING NUTS. TIGHTEN OR REPLACE AS APPROPRIATE.

16. PERFORM (QA TO ACCOMPLISH) A MAG PARTICLE TEST OF HOOK (REF. WP 12-4, EXHIBIT IV, PAGE 2 OF 2). ATTACH COPY OF THE REPORT TO DATA SHEET.

17. VERIFY ALL SHIELDS AND/OR COVERS REMOVED FOR SERVICE DURING THIS PM PERFORMANCE ARE RE-INSTALLED.

18. CLEAR ALL RESIDUE MATERIALS FROM THE HOT CELL AS DIRECTED BY THE HEALTH PHYSICS PERSONNEL OR THE RADIATION WORK PERMIT.

RECOVERY

1. REFILL ANY GEAR CASE DEVOID OF OIL.
2. REINSTALL ANY PLUG REMOVED.
3. REINSTALL ANY COVER OR SHIELD REMOVED.
4. SPILLED GREASE OR GEAR LUBRICANT CLEANED UP.

RETEST

1. FULL MECHANICAL FUNCTION OF THE CRANE BRIDGE AND TROLLEY (EAST WEST BRIDGE MOVEMENT; NORTH SOUTH TROLLEY MOVEMENT).
2. VERTICAL MOVEMENT OF HOIST.

WASTE ISOLATION PILOT PLANT
WESTINGHOUSE OPERATIONS DEPT.
41-T-104, REV.2
MO8C (ANNUAL)

TAGOUT

BREAKER	POSITION	LOCK	TAG	LOCATION	PROCEDURE STEPS
N/A	CLOSED	NO	CAUTION	OPERATIONS CONSOLE	2-5
41-T-104	OPEN	YES	DANGER	41PMCC04/2	6-17

GRAPPLE HOIST, 6¼ TON

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1. TOGGLE BLOCK LOWERED TO FLOOR LEVEL.

_____
OPERATIONS / DATE / TIME

2. HOIST LOCKED AND TAGGED OUT OF SERVICE.

_____
OPERATIONS / DATE / TIME

3&4. BARRIER TAPE AND WARNING SIGNS IN PLACE AND TAGOUT VERIFIED.

_____
MAINT. TECH / DATE / TIME

5.	HOIST GEAR LUBRICANT CHECKED.	OK	ADDED_____
6.	WORM GEAR REDUCER LUBRICANT CHECKED.	OK	ADDED_____
7.	HOIST DRUM BEARINGS LUBRICATED.	YES	NO
8.	WINDING DRUM INSPECTION	OK	DAMAGED+*

+EXPLAIN DAMAGE
*WASTE HANDLING ENGINEER NOTIFIED

_____
NAME / DATE / TIME

ENGINEERING RECOMMENDED RESOLUTION:

WORK REQUEST NO._____

9.	WIRE ROPE INSPECTION *EXPLAIN	OK	DAMAGED*
	WIRE ROPE LUBRICATED	YES	NO
	DIAMETER (TWO PLACES AT LEAST 10 FT. SEPARATION) *EXPLAIN	_____IN.	_____IN.
10.	HOIST BRAKE OIL LEVEL	OK	ADDED_____
11.	HOIST STRUCTURAL INSPECTION	OK	DAMAGE*

*WASTE HANDLING ENGINEER NOTIFIED

_____
NAME / DATE / TIME

ENGINEER RECOMMENDED RESOLUTION: WORK REQUEST NO._____

12. HOIST MOUNTING BOLTS TORQUED TO TBD FT. LBS. YES NO
    TORQUE WRENCH S/N_____
    CAL DUE DATE_____

13. BARRIER AND SIGNS REMOVED. YES NO

WORK COMPLETE

_____
MAINT. TECH / DATE / TIME

_____
MAINT. SUPERVISOR / DATE / TIME

TAGOUT REMOVED

_____
OPERATIONS / DATE / TIME

1. HAVE OPS PERSONNEL LOWER THE TOGGLE BLOCK TO FLOOR LEVEL IN THE CANISTER TRANSFER ROOM.

2. HAVE OPERATIONS PERSONNEL LOCK AND TAG THE HOIST OUT OF SERVICE PER WP-4-001.

3. INSTALL A "WARNING TAPE" PERIMETER BARRIER AND OVERHEAD WORK IN PROGRESS SIGNS AT ENTRANCES TO THE CASK UNLOADING ROOM.

4. POSITION THE MANLIFT FOR ACCESS TO THE HOIST.

5. DRAIN THE LUBRICANT FROM THE HOIST GEAR CASE. REPLACE WITH TEXACO THUBAN SAE-90 (TBD QTS.) OR EQUAL.

6. DRAIN LUBRICANT FROM THE WORM GEAR REDUCER. REPLACE WITH TEXACO THUBAN SAE-90 (TBD QTS.) OR EQUAL.

7. LUBRICATE HOIST DRUM BEARINGS USING TEXACO MULTIFAK EP-2 GREASE (OR EQUAL).

8. DRAIN LUBRICANT FROM HOIST BRAKE CASE. REPLACE WITH TEXACO R&O 32 (TBD PTS.) OR EQUAL.

9. INSPECT WIRE ROPE FOR DAMAGE, BROKEN STRANDS, EXCESSIVE WEAR IN HIGH TRAVEL AREAS (AROUND CEILING MOUNTED SHEAVE) AND VERIFY PROPER FOLLOW INTO WINDING DRUM GROOVE. INSPECT WIRE ROPE FOR ADEQUATE LUBRICATION. RELUBRICATE AS NECESSARY USING TEXACO CRATER 2X FLUID.

10. INSPECT WINDING DRUM FOR CRACKS OR ANY OBVIOUS DAMAGE.

11. INSPECT HOIST STRUCTURAL MEMBERS FOR ANY SIGNS OF FAILURE SUCH AS LOOSE RIVTTS, LOOSE BOLTS, OR CRACKING WELDS.

12. RETORQUE HOIST MOUNTING BOLTS TO_____ FT. LBS AND APPLY TORQUE STRIPE.

13. REMOVE BARRIERS AND OVERHEAD WORK SIGNS.

RECOVERY

1. REFILL ALL LUBRICANT RESERVOIRS DRAINED WITH THE PROPER LUBRICANT.
2. REMOVE TAGOUT.

RETEST

NO RETEST REQUIRED

TAGOUT

BREAKER/SWITCH	POSITION	LOCK	TAG	LOCATION
SW04/6	OPEN	YES	DANGER	41P-MCC04/1

1. TOGGLE BLOCK LOWERED TO FLOOR LEVEL. _____
OPERATIONS / DATE / TIME

2. HOIST LOCKED AND TAGGED OUT OF SERVICE._____
OPERATIONS / DATE / TIME

3&4. BARRIER TAPE AND WARNING SIGNS IN PLACE AND TAGOUT VERIFIED.

_____
MAINT. TECH / DATE /TIME

5.	HOIST GEAR LUBRICANT CHANGED.	YES	NO
6.	WORM GEAR REDUCER LUBRICANT CHANGED.	YES	NO
7.	HOIST DRUM BEARINGS LUBRICATED.	YES	NO
8.	HOIST BRAKE LUBRICANT CHANGED.	YES	NO
9.	WIRE ROPE INSPECTION *EXPLAIN	OK	DAMAGED*
	WIRE ROPE LUBRICATED.	YES	NO
	DIAMETER (TWO PLACES AT LEAST 10 FT. SEPARATION)	_____IN.	_____IN.
10.	WINDING DRUM INSPECTION.	OK	DAMAGE+*
	+EXPLAIN DAMAGE		
	*WASTE HANDLING ENGINEER NOTIFIED	_____ NAME / DATE / TIME	
11.	HOIST STRUCTURAL INSPECTION.	OK	DAMAGED+*
	+EXPLAIN DAMAGE		
	*WASTE HANDLING ENGINEER NOTIFIED.	_____ NAME / DATE / TIME	
	ENGINEERING RECOMMENDATION RESOLUTION:	WORK REQUEST NO._____	
12.	HOIST MOUNTING BOLTS TORQUED. TBD FT. LBS. TORQUE WRENCH S/N _____ CAL DUE DATE_____	YES	NO

13. BARRIER AND SIGNS REMOVED. YES NO

WORK COMPLETE

_____
MAINT. TECH / DATE / TIME

_____
MAINT. SUPERVISOR / DATE / TIME

TAGOUT REMOVED

_____
OPERATIONS / DATE

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HOOK AND ROPE ON 140/25-TON BRIDGE CRANE

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8.0 INSTRUCTIONS

8.1 PREREQUISITE CONDITIONS

[] SO 8.1.1 **ALL** required materials and equipment available and staged **PRIOR** to start of work.

[] SO 8.1.2 **ALL** required Measuring and Test Equipment shall be within current calibration period.

[] SO 8.1.3 Operations **SHALL** be notified and work release obtained **PRIOR** to starting work.

[] SO 8.1.4 Record work order number on Data Sheet.

[] 8.1.5 Request a qualified operator to position hoist load blocks at floor level.

[] 8.1.6 Place "MAINTENANCE IN PROGRESS" tag on the pendant control box.

8.2 HOOK INSPECTION

M A
[] [] SO 8.2.1 Inspect Main and Aux. hooks visually for the following **AND** notify supervisor if nonconformance exists:

[] [] a. Wear

[] [] b. Visible Damage

[] [] c. Distortion

[] [] d. Safety latch in place **AND** operational

[] [] e. Twist from plane of the unbent hook.

[] [] f. Axial play of hook.

8.3 WIRE ROPE INSPECTION

M A
[] [] SO 8.3.1 Measure the diameter of wire rope, approximately 12 inches above Main and Aux. load block pulleys using a vernier caliper. Refer to FIGURE 1. Notify supervisor if nonconformance exists.

> **NOTE:**
>
> Replacement of the rope will be required **IF** any of the following conditions are found.

M A
[] [] SO 8.3.2 Inspect Main and Aux. wire rope for the following conditions **AND** notify supervisor if nonconformance exists.

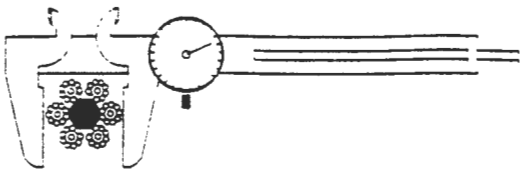
M A
[] [] a. Twelve randomly distributed broken wires in one rope lay.

M A
[] [] b. Four broken wires in one strand in one rope lay.

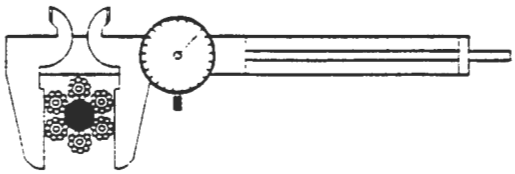
M A
[] [] c. Kinking, crushing, bird caging, or any other damage resulting in distortion of the wire rope structure.

M A
[] [] d. Evidence of heat damage.

M A
[] [] e. Rust or corrosion.



Right Way



Wrong Way

FIGURE 1

8.4 RESTORATION

[] 8.4.1 Ensure maintenance tools and equipment removed from crane.

[]SO 8.4.2 Remove "MAINTENANCE IN PROGRESS" Tag from pendant control box.

[]SO 8.4.3 Notify Operations PMP complete.

[]SO 8.4.4 Document any nonconforming item or conditions.

9.0 TASK VERIFICATION (RETEST)

None

10.0 ATTACHMENTS

10.1 TAGOUT/LOCKOUT RECOMMENDATIONS

10.2 DATA SHEETS

10.1 TAGOUT/LOCKOUT RECOMMENDATIONS
EQUIPMENT NUMBER 41-T-001
Page 1 of 1

DISCONNECT	POSITION	TAG	LOCK	LOCATION
41P-SW04/2	Off	Danger	Yes	East Wall of RH Bay, at Stairs.

Work Order No_____

10.2 DATA SHEETS
EQUIPMENT NUMBER 41-T-001
Page 1 of 4

TITLE: INSPECTION OF HOOK AND ROPE ON 140/25 TON BRIDGE CRANE

SECTION/STEP	DESCRIPTION	INITIAL

8.1 PREREQUISITE CONDITIONS

8.1.1 Materials and equipment available and staged. _____

8.1.2 Measuring and Test Equipment.

M&TE DESCRIPTION	ID NUMBER	CAL DUE DATE
Digital calipers		

8.1.3 Operations notified. _____

8.2 HOOK INSPECTION

8.2.1 Visually inspected Main and Aux. hooks for wear, damage distortion, safety latch cond., twist, and axial play.

A. Main SAT/UNSAT _____

B. Auxiliary SAT/UNSAT _____

10.2 Data Sheet
EQUIPMENT NUMBER 41-T-001
Page 2 of 4

8.3 WIRE ROPE INSPECTION

8.3.1 Diameter of Wire Rope

MAIN ROPE

NOTE

Main Hoist has a total of 16 turns. Measure four ropes west side working north to south. Measure four ropes east side working north to south.

WEST SIDE

	1.	2.	3.	4.
NEW	26 mm	26 mm	26 mm	26 mm
NOW	_____ mm	_____ mm	_____ mm	_____ mm
MIN	24.40 mm	24.40 mm	24.40 mm	24.40 mm

EAST SIDE

	5.	6.	7.	8.
NEW	26 mm	26 mm	26 mm	26 mm
NOW	_____ mm	_____ mm	_____ mm	_____ mm
MIN	24.40 mm	24.40 mm	24.40 mm	24.40 mm

AUXILIARY ROPE

NOTE

Rope measurements will be taken at northwest rope and northeast rope.

	1.	2.
NEW	18 mm	18 mm
NOW	_____ mm	_____ mm
MIN	16.80 mm	16.80 mm

10.2 Data Sheet
EQUIPMENT NUMBER 41-T-001
Page 3 of 4

8.3 WIRE ROPE INSPECTION (CONTINUED)

8.3.2 Inspected wire rope for:

a. Twelve randomly distributed broken wires in one rope lay.

b. Four broken wires in one strand in one rope lay.

c. Kinking, crushing, bird caging, or any other damage resulting in distortion of the wire rope structure.

d. Evidence of heat damage.

e. Rust or corrosion.

A.	**MAIN**	SAT/UNSAT	_____
B.	**AUXILIARY**	SAT/UNSAT	_____

8.4 RESTORATION

8.4.2 Removed "MAINTENANCE IN PROGRESS" Tag. _____

8.4.4 Notified Operations PMP Complete. _____

8.4.5 Documented any nonconforming items or conditions. _____

Yes_____ None_____

NCR # _____

NCR # _____

NCR # _____

10.2 DATA SHEET
EQUIPMENT NUMBER 41-T-001
PAGE 4 OF 4

Comments: _____

_____

_____

_____

_____

_____

_____

PERFORMED BY: PRINT NAME INITIALS SIGNATURE DATE

_____ / _____ / _____ / _____

_____ / _____ / _____ / _____
CRANE INSP.

REVIEWED BY: _____ / _____
SUPERVISOR SIGNATURE DATE

MANIPULATOR

Waste Isolation Pilot Plant Westinghouse - Operations Dept. *MECHANICAL PM INSTRUCTIONS REPORT* 02/17/89	EQPT. NO.: 41-T-100 ABC&D DESCRIPTION: MASTER/SLAVE MANIPULATOR

PREVENTIVE MAINTENANCE INSTRUCTIONS VERSION: REV. 0

** EQUIPMENT DATA **

CUSTODIAN: MGR, WSTE HNDLG OPS.

LOCATION: HOT CELL

MAKE: CENTRAL RESEARCH LABORATORIES

MODEL: E-HEAVY DUTY MASTER/SLAVE MAN.

SERIAL NO.: 6226, 6227, 6228 & 6229

HORSE POWER: N/A

CYC./SEC.:

DRAWINGS: N/A

MANUALS: N/A

OP. PARAMETERS: WORK ASSOCIATED WITH THIS EQUIPMENT SHOULD BE COORDINATED WITH HOT CELL OPERATIONS INVOLVING THIS PIECE OF EQUIPMENT.

WORKMANSHIP STANDARDS: WIPE ALL DEBRIS FROM CABLES, PULLEYS, AND EXPOSED SURFACES. ADJU ST ROLLERS ON MASTER BOOM TUBE SO THAT ROLLERS ARE JUST IN CONTAC T WITH BOOM TUBE. DISPOSE OF PMI GENERATED DEBRIS AS REQUIRED FO R THIS TYPE DEBRIS GENERATED.

SAFETY REQUIREMENTS: MANIPULATORS MUST BE UNPLUGGED WITH A MAINTENANCE IN PROGRESS TAG A TTACHED.

TOOLS/EQUIP. REQUIREMENTS: RAGS, VARIOUS SIZED ALLEN WRENCHES, LADDER, AND A STANDARD SC REWDRIVER.

MATERIAL REQUIREMENTS: CRC ELECTRICAL PARTS CLEANER.

QUARTERLY PREVENTIVE MAINTENANCE INSTRUCTIONS

41-T-103 A,B,C & D
MASTER SLAVE MANIPULATORS
M06C (QUARTERLY)

1. VERIFY MANIPULATOR IS UNPLUGGED AND MAINTENANCE IN PROGRESS TAG HUNG.

2. INSPECT AND CLEAN AZIMUTH CABLES, AND PULLEYS.

3. INSPECT AND CLEAN ELEVATIVE-TWIST (WRIST MOTION) TAPES AND PULLEYS.

4. INSPECT AND CLEAN Z MOTION TAPES AND PULLEYS.

5. INSPECT AND CLEAN TONG MOTION TAPES AND PULLEYS.

6. ADJUST THE 4 COLLERS ON MASTER BOOM TUBE AS REQUIRED.

7. INSPECT AND CLEAN REMAINING MANIPULATOR PARTS. (BOOM TUBE, TRUNK TUBE, ETC.)

RECOVERY:

1. PLUG MANIPULATOR BACK INTO OUTLET.

RETEST:

VERIFY ELECTRICAL AND MECHANICAL X Y AND Z MOTIONS FUNCTION PROPERLY.

TAGOUT

NO TAGOUT REQUIRED. MAINTENANCE IN PROGRESS TAG TO BE USED (PLUG IS WITHIN REACH FROM WHE
WORK IS BEING PERFORMED).

41-T-100 A,B,C & D
MASTER SLAVE MANIPULATOR
DATA SHEET
M06C (QUARTERLY)

1. VERIFY UNIT UNDER SERVICE IS UNPLUGGED WITH A MAINTENANCE IN PROGRESS TAG HUNG.

_____
TECHNICIAN / DATE / TIME

2.	AZIMUTH CABLE AND PULLEY INSPECTION	OK	CLEANED	ADJUSTED
3.	WRIST MOTION TAPES & PULLEY INSPECTION	OK	CLEANED	ADJUSTED
4.	Z-MOTION TAPES AND PULLEY INSPECTION	OK	CLEANED	ADJUSTED
5.	TONG MOTION TAPE & PULLEY INSPECTION	OK	CLEANED	ADJUSTED
6.	MASTER BOOM TUBE ROLLER INSPECTION	OK	CLEANED	ADJUSTED
7.	BALANCE OF MANIPULATOR INSPECTION	OK	CLEANED	

WORK COMPLETE

_____
TECHNICIAN / DATE / TIME

_____
SUPERVISOR / DATE

RETEST: SATISFACTORY / UNSATISFACTORY

_____
WASTE HANDLING OPS. / DATE

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RH EMPLACEMENT MACHINE

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IGNMENT FIXTURE.: MONTHLY PREVENTIVE MAINTENANCE INSTRUCTIONS.

TOOLS REQUIREMENTS:

1. STANDARD MECHANICS TOOLS.
2. GREASE GUN.
3. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE. OR EQUIVALENT.
2. MOBIL DTE EXTRA HEAVY OIL, OR EQUIVALENT.

---

1. CLEAN ALL DUST, DIRT AND DEBRIS FROM SCREW JACKS, GEAR REDUCERS, MITER GEAR BOXES AND SHAFTS WITH CLEAN DRY RAGS.
2. CHECK MOUNTING BOLTS AND NUTS ON GEAR REDUCERS, GEAR BOXES, SCREW JACKS, SWIVEL FEET AND MOTOR FOR WEAR, DAMAGE AND TIGHTNESS. REPLACE OR TIGHTEN AS CONDITION WARRANTS.
3. CHECK ALL DRIVE SHAFTS AND COUPLINGS FOR WEAR, ALIGNMENT AND TIGHTNESS.
4. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EVIDENCE OF LEAKS AROUND DRIVE SHAFTS, PLUGS AND ACCESS PLATES. REPLACE SEALS AND/OR PACKINGS AND TIGHTEN PLUGS OR SCREWS AS THE PROBLEM WARRANTS.
5. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EXCESSIVE GEAR BACKLASH.
6. CHECK SCREW JACK WORM GEAR FOR EXCESSIVE END PLAY. END PLAY CAN BE ADJUSTED BY REMOVING THE BEARING CAP AND REMOVING OR ADDING SHIMS. REPLACE THE BEARING CAP AND TIGHTEN THE SCREWS.
7. CLEAN THE NEOPRENE COATED NYLON BOOTS AND INSPECT THEM FOR CUTS, CRACKS AND TEARS. IF THE BOOTS ARE FOUND TO BE DAMAGED, THEY SHOULD BE REMOVED. THE SCREW JACK SHOULD BE CLEANED TO REMOVE ANY BUILD UP OF SALT DUST AND LUBRICATED LIGHTLY WITH TEXACO MULTIFAK EP-1 GREASE OR EQUIVALENT. AND NEW BOOTS INSTALLED.
8. CHECK LIFTING SCREWS FOR SIDE PLAY AND END PLAY. IF PLAY IN EITHER DIRECTION APPEARS TO BE EXCESSIVE, THE JACK SHOULD BE REMOVED, DISASSEMBLED AND INSPECTED FOR WORN OR DAMAGED PARTS.
9. LUBRICATE THE SCREW JACKS THROUGH THE GREASE FITTINGS WITH ONE QUARTER OUNCE OF TEXACO MULTIFAK EP-1 GREASE OR EQUIVALENT. ABOUT 8 PUMPS ON A HAND OPERATED GREASE GUN.
10. CHECK THE OIL IN THE GEAR REDUCERS FOR CONTAMINATION AND AT THE PROPER OPERATING LEVEL. IF CONTAMINATED THE GEAR REDUCER SHOULD BE DRAINED. FLUSHED AND REFILLED WITH MOBIL DTE EXTRA HEAVY OIL, OR ITS EQUIVALENT.

LEVELING PLATFORM.: MONTHLY PREVENTIVE MAINTENANCE INSTRUCTIONS.

TOOL REQUIREMENTS:

1. STANDARD MECHANICS TOOLS.
2. GREASE GUN.
3. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE OR EQUIVALENT.
2. MOBIL DTE EXTRA HEAVY OIL, OR EQUIVALENT.
3. RUST INHIBITING LIGHT WEIGHT OIL.

---

1. CLEAN ALL DUST, DIRT AND DEBRIS FROM SHAFT RAILS AND CABLE TRACKS, WITH CLEAN DRY RAGS.
2. LUBRICATE THE CABLE TRACKS BETWEEN THE LINKS, LIGHTLY, WITH A RUST INHIBITING LIGHT WEIGHT OIL.
3. CLEAN DUST, DIRT AND DEBRIS FROM FLANGED BEARINGS ON THE DRIVE SYSTEM SCREW JACK, WITH CLEAN DRY RAGS. LUBRICATE BEARING THROUGH FITTING PROVIDED WITH TEXACO MULTIFAK EP-1 GREASE OR EQUIVALENT.
4. CLEAN ALL DUST, DIRT AND DEBRIS FORM SCREW JACKS, GEAR REDUCERS, MITER GEAR BOXES AND AND SHAFTS WITH CLEAN DRY RAGS.
5. CHECK MOUNTING BOLTS AND NUTS ON GEAR REDUCERS, GEAR BOXES, SCREW JACKS, SWIVEL FOOT AND MOTOR FOR WEAR, DAMAGE AND TIGHTNESS. REPLACE OR TIGHTEN AS CONDITION WARRANTS.
6. CHECK ALL DRIVE SHAFTS AND COUPLINGS FOR WEAR, DAMAGE, ALIGNMENT AND TIGHTNESS.
7. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EVIDENCE OF LEAKS AROUND DRIVE SHAFTS, PLUGS AND ACCESS PLATES. REPLACE SEALS AND/OR PACKINGS AND TIGHTEN PLUGS OR SCREWS AS THE PROBLEM WARRANTS.
8. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EXCESSIVE GEAR BACKLASH.
9. CHECK SCREW JACK WORM GEAR FOR EXCESSIVE END PLAY. END PLAY CAN BE ADJUSTED BY REMOVING THE BEARING CAP AND REMOVING OR ADDING SHIMS, REPLACE THE BEARING CAP AND TIGHTEN THE SCREWS.
10. CLEAN THE NEOPRENE COATED NYLON BOOTS AND INSPECT THEM FOR CUTS, CRACKS AND TEARS. IF THE BOOTS ARE FOUND TO BE DAMAGED, THEY SHOULD BE REMOVED. THE SCREW JACK SHOULD BE CLEANED TO REMOVE ANY BUILDUP OF SALT DUST AND LUBRICATED LIGHTLY WITH TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT, AND NEW BOOTS INSTALLED.
11. CHECK THE BOOT SUPPORT WIRE FOR PROPER SUPPORT OF THE BOOT.
12. CHECK LIFTING SCREWS AND DRIVE SYSTEM SCREWS FOR SIDE PLAY AND END PLAY. IF PLAY IN EITHER DIRECTION APPEARS TO BE EXCESSIVE. THE JACK SHOULD BE REMOVED, DISASSEMBLED AND INSPECTED FOR WORN OR DAMAGED PARTS.
13. LUBRICATE THE SCREW JACKS THROUGH THE GREASE FITTINGS WITH ONE QUARTER OUNCE OF TEXACO MULTIFAK EP-1 GREASE OR EQUIVALENT, ABOUT 8 PUMPS ON A HAND OPERATED GREASE GUN.
14. CHECK THE OIL IN THE GEAR REDUCERS FOR CONTAMINATION AND AT THE PROPER OPERATING LEVEL IF CONTAMINATED THE GEAR REDUCER SHOULD BE DRAINED, FLUSHED WITH SAFETY SOLVENT AND REFILLED WITH MOBIL DTE EXTRA HEAVY OIL OR ITS EQUIVALENT.

STAGING PLATFORM.: MONTHLY PREVENTIVE MAINTENANCE INSTRUCTIONS.

TOOL REQUIREMENTS:

1. STANDARD MECHANICS TOOLS.
2. GREASE GUN.
3. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE, OR EQUIVALENT.
2. MOBIL DTE EXTRA HEAVY OIL, OR EQUIVALENT.
3. RUST INHIBITING, LIGHT WEIGHT OIL.

---

1. CLEAN ALL DUST, DIRT AND DEBRIS FROM SHAFT RAILS AND CABLE TRACKS, WITH CLEAN DRY RAGS
2. LUBRICATE THE CABLE TRACKS BETWEEN LINKS, LIGHTLY, WITH A RUST INHIBITING LIGHT WEIGHT OIL.
3. CLEAN DUST, DIRT AND DEBRIS FROM FLANGED BEARINGS ON THE DRIVE SYSTEM SCREW JACK, WITH CLEAN DRY RAGS. LUBRICATE BEARING THROUGH FITTING PROVIDED WITH TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT.
4. CLEAN ALL DUST, DIRT AND DEBRIS FORM SCREW JACK, GEAR REDUCER, MITER GEAR BOX AND SHAFTS WITH CLEAN DRY RAGS.
5. CHECK MOUNTING BOLTS AND NUTS ON GEAR REDUCER, GEAR BOX, SCREW JACK, AND MOTOR FOR WEAR, DAMAGE AND TIGHTNESS. REPLACE OR TIGHTEN AS CONDITION WARRANTS.
6. CHECK ALL DRIVE SHAFTS AND COUPLINGS FOR WEAR, DAMAGE, ALIGNMENT AND TIGHTNESS.
7. CHECK GEAR REDUCER AND MITER GEAR BOX FOR EVIDENCE OF LEAKS AROUND DRIVE SHAFTS, PLUGS AND ACCESS PLATES. REPLACE SEALS AND/OR PACKINGS AND TIGHTEN PLUGS OR SCREWS AS THE PROBLEM WARRANTS.
8. CHECK GEAR REDUCER AND MITER GEAR BOX FOR EXCESSIVE GEAR BACKLASH.
9. CHECK SCREW JACK WORM GEAR FOR EXCESSIVE END PLAY. END PLAY CAN BE ADJUSTED BY REMOVING THE BEARING CAP AND REMOVING OR ADDING SHIMS. REPLACE THE BEARING CAP AND TIGHTEN THE SCREWS.
10. CLEAN THE NEOPRENE COATED NYLON BOOT AND INSPECT FOR CUTS, CRACKS AND TEARS. IF THE BOOT IS FOUND TO BE DAMAGED IT SHOULD BE REMOVED. THE SCREW JACK SHOULD BE CLEANED TO REMOVE ANY BUILDUP OF SALT DUST AND LUBRICATED LIGHTLY WITH TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT AND A NEW BOOT INSTALLED.
11. CHECK THE BOOT SUPPORT WIRE FOR PROPER SUPPORT OF THE BOOT.
12. CHECK DRIVE SYSTEM SCREW FOR SIDE PLAY AND END PLAY. IF PLAY IN EITHER DIRECTION APPEARS TO BE EXCESSIVE, THE JACK SHOULD BE REMOVED, DISASSEMBLED AND INSPECTED FOR WORN OR DAMAGED PARTS.
13. LUBRICATE THE SCREW JACK THROUGH THE GREASE FITTING WITH ONE QUARTER OUNCE OF TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT, ABOUT 8 PUMPS ON A HAND OPERATED GREASE GUN.
14. CHECK THE OIL IN THE GEAR REDUCER FOR CONTAMINATION AND THE PROPER OPERATING LEVEL. IF CONTAMINATED THE GEAR REDUCER SHOULD BE DRAINED, FLUSHED AND REFILLED WITH MOBIL DTE EXTRA HEAVY OIL OR ITS EQUIVALENT.
15. CLEAN THE ROUNDWAY BEARINGS AND LUBRICATE THE EXPOSED AREAS OF THE BEARING RACE AND CHAIN WITH TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT.
16. CLEAN ALL DUST, DIRT AND DEBRIS FROM THE AIR SYSTEM PRESSURE REGULATOR, SOLENOID VALVES, AIR LINES AND TRANSDUCER.
17. CHECK ALL MOUNTING BOLTS AND NUTS ON COMPONENTS OF THE AIR SYSTEM FOR WEAR, DAMAGE AND TIGHTNESS.
18. CHECK ALL AIR LINES FOR WEAR, CHAFFING AND DAMAGE. CHECK FITTINGS AND COUPLINGS FOR CLEANLINESS AND TIGHTNESS

TRANSFER CARRIAGE ASSEMBLY.: MONTHLY PREVENTIVE MAITNENANCE INSTRUCTIONS.

TOOL REQUIREMENTS:

1. STANDARD MECHANICS TOOLS.
2. GREASE GUN.
3. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE, OR EQUIVELENT.
2. MOBIL DTE 24 HYDRAULIC FLUID.
3. LIGHT WEIGHT MACHINE OIL.
4. HYDRAULIC FILTER ELEMENT P/N P2E574.

---

1. HAVE THE OPERATOR ACTIVATE THE TRANSFER MACHANISM AND EXTEND THE HYDRAULIC CYLINDER ITS FULL LENGTH. OBSERVE THE HYDRAULIC SYSTEM FILTER CONTAMINATION INDICATORS. IF T INDICATE THAT THE FILTERS ARE MARGINAL OR DIRTY, REPLACE THE ELEMENTS. RELIEVE ALL PRESSURE FROM THE HYDRAULIC SYSTEM AND LOCK-OUT THE TRANSFER MECHANISM PRIOR TO CHANGING FILTERS.
2. HAVE THE OPERATOR LOCK OUT THE TRANSFER MECHANISM WITH THE CYLINDER IN THE EXTENDED POSITION. INSPECT THE CYLINDER FOR EVIDENCE OF LEAKS. CHECK HYDRAULIC LINES FOR DAMAGE, CHAFFING AND THE FITTINGS FOR TIGHTNESS OR EVIDENCE OF LEAKS.
3. CLEAN ALL DUST, DIRT AND DEBRIS FROM ALL COMPONENTS OF THE HYDRAULIC SYSTEM.
4. CHECK ALL HYDRAULIC LINES FOR WEAR, DAMAGE AND CHAFFING.
5. CHECK HYDRAULIC LINE FITTINGS, PUMP, VALVES AND CYLINDER FOR EVIDENCE OF LEAKS, MOUNTING BOLTS FOR TIGHTNESS AND CLAMPS FOR WEAR AND TIGHTNESS.
6. CHECK MOTOR TO PUMP SHAFT FOR PROPER ALIGNMENT, AND COUPLING FOR ALIGNMENT, WEAR AND/OR DAMAGE.
7. CHECK HYDRAULIC FLUID FOR EVIDENCE OF CONTAMINATION, AND PROPER LEVEL IN THE RESERVOIR. IF FLUID IS NEEDED IT SHOULD BE PUMPED THROUG A 25 MICRON FILTER INTO THE RESERVOIR.
8. CHECK THE BREATHER CAP ON THE HYDRAULIC RESERVOIR FOR CLEANLINESS. IF THE FILTER I THE CAP IS DIRTY OR HAS BEEN WETTED IT SHOULD BE REPLACED.
9. CLEAN ALL DUST, DIRT AND DEBRIS FROM THE GRAPPLE PLATE, TORQUE REELS AND THE GRAPP COMPONENTS.
10. CHECK THE TORQUE REEL CABLES FOR WEAR, KNICKS OR DAMAGE. INSPECT THE TORQUE REEL C ATTACHMENTS ON THE GRAPPLE PLATE FOR WEAR, DEFORMATION AND TIGHTNESS.
11. CLEAN, AND INSPECT TRANSFER MACHANISM ROLLERS FOR WEAR, AND MOUNTING BOLTS FOR TIGHTNESS.
12. LUBRICATE THE LEAD SCREW ON THE GRAPPLE BY APPLYING TEXACO MULTIFAK EP-1 GREASE, EQUIVALENT, TO THE EXPOSED AREAS OF THE SCREW.
13. LUBRICATE THE BRONZE BUSHING AND PLATE ON THE GRAPPLE WITH LIGHT WEIGHT MACHINE C
14. INSPECT THE SCREW JACK, GEAR REDUCER AND MOTOR ON THE GRAPPLE FOR PROPER ALIGNMEN THE SHAFTS, MOUNTING BOLTS FOR TIGHTNESS AND ANY WEAR OR DETERIORATION.

.5. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EVIDENCE OF LEAKS AROUND DRIVE SHAFTS, PLUGS AND ACCESS PLATES. REPLACE SEALS AND/OR PACKINGS AND TIGHTEN PLUGS OR SCREWS THE PROBLEM WARRANTS.

16. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EXCESSIVE GEAR BACKLASH.
17. CHECK SCREW JACK WORM GEAR FOR EXCESSIVE END PLAY. END PLAY CAN BE ADJUSTED BY REMOVING THE BEARING CAP AND REMOVING OR ADDING SHIMS. REPLACE BEARING CAP AND TIGHTEN THE SCREWS.
18. CHECK SCREWS FOR SIDE PLAY AND END PLAY. IF PLAY IN EITHER DIRECTION APPEARS TO B EXCESSIVE, THE JACK SHOULD BE REMOVED, DISASSEMBLED AND INSPECTED FOR WORN OR DAMAGED PARTS.
19. LUBRICATE THE SCREW JACKS THROUGH THE GREASE FITTINGS WITH TEXACO MULTIFAK EP-1 GREASE OR ITS EQUIVALENT. ABOUT 3 PUMPS ON A HAND OPERATED GREASE GUN.

20. CHECK THE OIL IN THE GEAR REDUCERS FOR CONTAMINATION AND AT THE PROPER OPERATING LEVEL. IF CONTAMINATED THE GEAR REDUCER SHOULD BE DRAINED, FLUSHED AND REFILLED WITH MOBIL DTE EXTRA HEAVY OIL OR ITS EQUIVALENT.
21. CLEAN, AND INSPECT THE ROUND WAY BEARINGS FOR WEAR AND DAMAGE. LUBRICATE BEARINGS BY APPLYING TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT, TO EXPOSED AREAS OF THE BEARING RACE AND THE CHAIN ROLLER.
22. CHECK MOUNTING BOLTS ON BEARINGS FOR TIGHTNESS.

SHIELD PLUG CARRIAGE ASSEMBLY.: MONTHLY PREVENTIVE MAITNENANCE INSTRUCTION

TOOL REQUIREMENTS:

1. STANDARD MECHANICS TOOLS,
2. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE, OR EQUIVALENT.

---

1. CLEAN ALL DUST, DIRT AND DEBRIS FROM THE SHEILD PLUG CARRIAGE ASSEMBLY AND THE ROUNDWAY BEARINGS.
2. INSPECT THE ROUNDWAY BEARINGS FOR WEAR AND/OR DAMAGE. LUBRICATE THE BEARING BY APPLYING TEXACO MULTIFAK EP-1 GREASE TO THE EXPOSED AREA OF THE BEARING RACE AND CHAIN ROLLER.
3. CHECK BEARING MOUNTING BOLTS FOR TIGHTNESS.

ANNUAL PREVENTIVE MAINTENANCE INSTRUCTIONS

PMI NO.: M08C

TITLE: 52-I-003, RH EMPLACEMENT MACHINE ANNUAL PREVENTIVE MAINTENANCE INSTRUCTIONS.

CRAFT: MECHANIC

TASK: PERFORM ANNUAL INSPECTION, LUBRICATION AND ADJUSTMENT ON RH EMPLACEMENT MACHINE

REFERENCES: 1. WESTINGHOUSE O & M MANUALS VOL. 1, 2, 3

PRECAUTIONS AND LIMITATIONS: 1. DISCONNECT POWER, AND RELIEVE PRESSURE FROM HYDRAULIC AND AIR SYSTEMS PRIOR TO WORKING ON THE EQUIPMENT.

EQUIPMENT AND TOOL REQUIREMENTS: 1. SEE SPECIFIC COMPONENTS FOR REQUIREMENTS.

MATERIAL REQUIREMENTS: 1. SEE SPECIFIC COMPONENTS FOR REQUIREMENTS.

PREREQUISITES: 1. SURVEY OF THIS EQUIPMENT BY A HEALTH PHYSICS TECHNICIAN MUST BE COMPLETED PRIOR TO PERFORMING ANY OF THE PREVENTIVE MAINTENANCE.

ALIGNMENT FIXTURE.: ANNUAL PREVENTIVE MAINTENANCE INSTRUCTIONS.

TOOLS REQUIREMENTS:

1. STANDARD MECHANICS TOOLS.
2. GREASE GUN.
3. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE, OR EQUIVALENT.
2. MOBIL DTE EXTRA HEAVY OIL, OR EQUIVALENT.

---

1. CLEAN ALL DUST, DIRT AND DEBRIS FROM SCREW JACKS, GEAR REDUCERS, MITER GEAR BOXES SHAFTS WITH CLEAN DRY RAGS.
2. CHECK MOUNTING BOLTS AND NUTS ON GEAR REDUCERS, GEAR BOXES, SCREW JACKS, SWIVEL F AND MOTOR FOR WEAR, DAMAGE AND TIGHTNESS. REPLACE OR TIGHTEN AS CONDITION WARRANT
3. CHECK ALL DRIVE SHAFTS AND COUPLINGS FOR WEAR, ALIGNMENT AND TIGHTNESS.
4. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EVIDENCE OF LEAKS AROUND DRIVE SHAFT PLUGS AND ACCESS PLATES. REPLACE SEALS AND/OR PACKINGS AND TIGHTEN PLUGS OR SCREW THE PROBLEM WARRANTS.
5. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EXCESSIVE GEAR BACKLASH.
6. CHECK SCREW JACK WORM GEAR FOR EXCESSIVE END PLAY. END PLAY CAN BE ADJUSTED BY RE- THE BEARING CAP AND REMOVING OR ADDING SHIMS. REPLACE THE BEARING CAP AND TIGHTEN SCREWS.
7. CLEAN THE NEOPRENE COATED NYLON BOOTS AND INSPECT THEM FOR CUTS, CRACKS AND TEARS THE BOOTS ARE FOUND TO BE DAMAGED, THEY SHOULD BE REMOVED. THE SCREW JACK SHOULD CLEANED TO REMOVE ANY BUILD UP OF SALT DUST AND LUBRICATED LIGHTLY WITH TEXACO M EP-1 GREASE, OR ITS EQUIVALENT, AND NEW BOOTS INSTALLED.
8. CHECK LIFTING SCREWS FOR SIDE PLAY AND END PLAY. IF PLAY IN EITHER DIRECTION APP BE EXCESSIVE, THE JACK SHOULD BE REMOVED, DISASSEMBLED AND INSPECTED FOR WORN OR DAMAGED PARTS.
9. LUBRICATE THE SCREW JACKS THROUGH THE GREASE FITTINGS WITH ONE QUARTER OUNCE OF MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT. ABOUT 8 PUMPS ON A HAND OPERATED GREASE
10. DRAIN THE OIL FROM THE GEAR REDUCERS AND MITER GEAR BOXES.
    a) CHECK MAGNETIC PLUG FOR METAL FILINGS.
    b) CHECK OIL FOR CONTAMINATIONS (SLUDGE, DIRT, ETC).
    c) REFILL WITH MOBIL DTE EXTRA HEAVY OIL, OR EQUIVALENT, SEE VOLUME III, PAGE : FOR QUANTITY OF OIL REQUIRED AND PROPER OIL LEVEL.
    NOTE: IF METAL IS FOUND ON THE MAGNETIC PLUG, THE GEAR REDUCER SHOULD BE RE- AND REPLACED. THE DAMAGED (BAD) REDUCER RETURNED TO THE MAINTENANCE S OVERHAUL AND PLACED BACK IN THE SUPPLY POINT AS A SPARE.
11. INSPECT THE ALIGNMENT FIXTURE FOR EVIDENCE OF CORROSION, ALL WELDS AND ADJACENT FOR CRACKS.

LEVELING PLATFORM.: ANNUAL PREVENTIVE MAINTENANCE INSTRUCTIONS.

TOOL REQUIREMENTS:

1. STANDARD MECHANICS TOOLS.
2. GREASE GUN.
3. CLEAN RAGS.

MATERIAL REQUIREMENTS:

1. TEXACO MULTIFAK EP-1 GREASE, OR EQUIVALENT.
2. MOBIL DTE EXTRA HEAVY OIL, OR EQUIVALENT.
3. RUST INHIBITING LIGHT WEIGHT OIL.

---

1. CLEAN ALL DUST, DIRT AND DEBRIS FROM SHAFT RAILS AND CABLE TRACKS, WITH CLEAN DRY RAGS.
2. LUBRICATE THE CABLE TRACKS BETWEEN THE LINKS ,LIGHLTY, WITH A RUST INHIBITING LIGHT WEIGHT OIL.
3. CLEAN DUST, DIRT AND DEBRIS FROM FLANGED BEARINGS ON THE DRIVE SYSTEM SCREW JACK WITH CLEAN DRY RAGS. LUBRICATE BEARING THROUGH FITTING PROVIDED WITH TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT.
4. CLEAN ALL DUST, DIRT AND DEBRIS FORM SCREW JACKS, GEAR REDUCERS, MITER GEAR BOXES AND AND SHAFTS WITH CLEAN DRY RAGS.
5. CHECK MOUNTING BOLTS AND NUTS ON GEAR REDUCERS, GEAR BOXES, SCREW JACKS, SWIVEL FOOT AND MOTOR FOR WEAR, DAMAGE AND TIGHTNESS. REPLACE OR TIGHTEN AS CONDITION WARRANTS.
6. CHECK ALL DRIVE SHAFTS AND COUPLINGS FOR WEAR, DAMAGE, ALIGNMENT AND TIGHTNESS.
7. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EVIDENCE OF LEAKS AROUND DRIVE SHAFTS, PLUGS AND ACCESS PLATES. REPLACE SEALS AND/OR PACKINGS AND TIGHTEN PLUGS OR SCREWS AS THE PROBLEM WARRANTS.
8. CHECK GEAR REDUCERS AND MITER GEAR BOXES FOR EXCESSIVE GEAR BACKLASH.
9. CHECK SCREW JACK WORM GEAR FOR EXCESSIVE END PLAY. END PLAY CAN BE ADJUSTED BY REMOVING THE BEARING CAP AND REMOVING OR ADDING SHIMS, REPLACE THE BEARING CAP AND TIGHTEN THE SCREWS.
10. CLEAN THE NEOPRENE COATED NYLON BOOTS AND INSPECT THEM FOR CUTS, CRACKS AND TEARS. IF THE BOOTS ARE FOUND TO BE DAMAGED, THEY SHOULD BE REMOVED. THE SCREW JACK SHOULD BE CLEANED TO REMOVE ANY BUILDUP OF SALT DUST AND LUBRICATED LIGHTLY WITH TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT, AND NEW BOOTS INSTALLED.
11. CHECK THE BOOT SUPPORT WIRE FOR PROPER SUPPORT OF THE BOOT.
12. CHECK LIFTING SCREW FOR SIDE PLAY AND END PLAY. IF PLAY IN EITHER DIRECTION APPEARS TO BE EXCESSIVE, THE JACK SHOULD BE REMOVED, DISASSEMBLED AND INSPECTED FOR WORN OR DAMAGED PARTS.
13. LUBRICATE THE SCREW JACKS THROUGH THE GREASE FITTINGS WITH ONE QUARTER OUNCE OF TEXACO MULTIFAK EP-1 GREASE, OR ITS EQUIVALENT, ABOUT 8 PUMPS ON A HAND OPERATED GREASE GUN.
14. DRAIN THE OIL FROM THE GEAR REDUCERS AND MITER GEAR BOXES.
    a) CHECK MAGNETIC PLUG FOR METAL FILINGS.
    b) CHECK OIL FOR CONTAMINATIONS (SLUDGE, DIRT, ETC).
    c) REFILL WITH MOBIL DTE EXTRA HEAVY OIL, OR EQUIVELENT, SEE VOLUME III, PAGE 63-88 FOR QUANTITY OF OIL REQUIRED AND PROPER OIL LEVEL.
    NOTE: IF METAL IS FOUND ON THE MAGNETIC PLUG, THE GEAR REDUCER SHOULD BE REMOVED AND REPLACED. THE DAMAGED (BAD) REDUCER RETURNED TO THE MAINTENANCE SHOP FOR OVERHAUL AND PLACED BACK IN THE SUPPLY POINT AS A SPARE.
15. INSPECT THE LEVELING PLATFORM FOR EVIDENCE OF CORROSION, ALL WELDS AND ADJACEMENT

AREAS FOR CRACKS.

RH EMPLACEMENT MACHINE, 30 TON.: ANNUAL PREVENTIVE MAINTENANCE SIGN OFF SHEET.

ALIGNMENT FIXTURE:

WORK COMPLETED BY:_____DATE:_____M/H:_____

LEVELING PLATFORM:

WORK COMPLETED BY:_____DATE:_____M/H:_____

STAGING PLATFORM:

WORK COMPLETED BY:_____DATE:_____M/H:_____

TRANSFER CARRIAGE ASSEMBLY:

WORK COMPLETED BY:_____DATE:_____M/H:_____

SHEILD PLUG CARRIAGE ASSEMBLY:

WORK COMPLETED BY:_____DATE:_____M/H:_____

TRANSFER MACHINE TRANSPORT EQUIPMENT:

WORK COMPLETED BY:_____DATE:_____M/H:_____

LIST DISCREPENCIES NOTED DURING WORK AND GENERATE A 030 FORM TO PERFORM REPAIRS

SUPERVISOR SIGNATURE:_____DATE:_____

RH HOT CELL

RH - Hot Cell Inspection

AREA/EQUIPMENT PRE-OPERATIONAL AND WEEKLY INSPECTIONS								
	DATE							
	TIME							
*RH Hot Cell	√/U*							
**RH Transfer Cell	√/U*							
PERFORMER INITIALS	xxxxxxx							
WHE INITIALS	xxxxxxx							

* √ = Satisfactory U = Unsatisfactory N/A = Not Inspected

Canister Area Checks:

- Epoxy floor coating in good condition - free of cracks and gaps
- No evidence of spills or leaks from waste containers
- Canisters good condition/no visible deterioration
- Area free of debris and refuse
- Warning signs posted in area
- Telephone/Internal Communications - proper working order

* Physical inspections will not be performed while waste resides in the Hot Cell due to radiological concerns, however limited weekly camera inspections will be performed when RH waste is present.

** = Inspections will not be performed while waste is present, due to radiological concerns. Camera inspections cannot be conducted due to camera placement in the transfer cell.

PERFORMER NAME (PRINT) **INITIALS**

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

REMARKS:_____

VALIDATION:_____ / _____ / _____

WHE (Print Name) Signature Date

ROAD CASK TRANSFER CAR

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2/5/88

TORQUE VALUE TABLE

NATIONAL COURSE - GRADE 5

	FT. LBS		METER KILOGRAMS	
DIA	MIN	MAX	MIN	MAX
1/4	8	9	1.11	1.25
5/16	16	18	2.21	2.49
3/8	28	31	3.87	4.29
7/16	45	50	6.22	6.92
1/2	68	75	9.40	10.37
9/16	100	110	13.83	15.21
5/8	135	150	18.67	20.75
3/4	225	250	31.12	34.58
7/8	350	378	48.41	52.28
1	537	583	74.28	81.04
1 1/8	720	782	99.58	108.15
1 1/4	1010	1097	139.68	151.72

THE FOLLOWING VALUES ARE FOR NATIONAL COURSE - GRADE 8

1/4	12	13	1.66	1.80
5/16	25	28	3.46	3.87
3/8	41	46	5.67	6.36
7/16	68	75	9.40	10.37
1/2	104	115	14.38	15.91
9/16	149	165	20.61	22.82
5/8	203	225	28.08	31.12
3/4	340	370	47.02	51.17
7/8	544	591	75.24	81.74
1	822	893	113.68	123.50
1 1/8	1297	1410	179.38	195.00
1 1/4	1807	1964	249.91	271.62

EQPT. NO. 41-T-157
ROAD CASK TRANSFER CAR
M07C (SEMI-ANNUAL)

1. VERIFY EQUIPMENT IS OUT OF SERVICE AND PARKED IN A LOCATION ALLOWING EASE OF INSPECTION AND BOLT TORQUING.

2. VISUALLY INSPECT THE MACHINE FOR PHYSICAL DEFECTS SUCH AS BENT COMPONENTS, STRESS FRACTURES, BROKEN WELDS, ETC. RECORD FINDINGS ON DATA SHEET.

3. CHECK ROLLER GUIDE CLEARANCES. ACCEPTABLE CLEARANCE IS 1/8" TO 1/4" FROM THE TOP OF THE TRACK TO THE GUIDE. NO SIDE-TO-SIDE ADJUSTMENT IS POSSIBLE. TORQ THE RAIL GUIDES TO 295 FT. LBS. (-0 +30 FT LBS).

4. USING A CALIBRATED TORQUE, VERIFY PROPER TENSION ON ALL STRESS BEARING MECHANICAL FASTENERS. NOTE ON THE DATA SHEET (OR ADDITIONAL SHEETS WITH DRAWINGS IF NECESSARY) SPECIFIC INFORMATION ON WHICH FASTENERS ARE LOOSE IF A ARE DETECTED. REF. TORQUE VALUE SHEET FOR VALUES.

5. CHECK NON-ROLLER RAIL GUIDES FOR FIT TO THE RAIL AT EACH END OF MACHINE. CLEARANCE GUIDE TO RAIL SHOULD BE 1/8" TO 1/4". ADJUST AS REQUIRED.

RECOVERY:

NONE REQUIRED

RETEST:

NONE REQUIRED

TAGOUT:

NONE REQUIRED

EQPT. NO. 41-T-157
ROAD CASK TRANSFER CAR
DATA SHEET
M07C (SEMI-ANNUAL)

1. VERIFY EQUIPMENT IS POSITIONED SUITABLY _____
MAINT. TECH. / DATE / TIME

2. VISUALLY INSPECT: SPECIFY REASON FOR POSITIVE RESPONSE

BENT COMPONENTS	YES	NO
STRESS FRACTURE	YES	NO
CRACKED OR BROKEN WELDS	YES	NO
OTHER DEFECTS	YES	NO

3. ROLLER GUIDE CHECK; TORQUE TO 295 FT LB. OK ADJUSTED WORN

TORQUE WRENCH S/N_____

CAL DUE DATE_____

4. MECHANICAL FASTENER INSPECTION OK LOOSE CONNECTION*

*SPECIFY, USING SKETCHES IF NECESSARY, LOCATION OF LOOSE FASTENERS.

TORQUE WRENCH S/N_____

CAL DUE DATE _____

5. NON-ROLLER GUIDE CHECK OK ADJUSTED WORN

WORK COMPLETE _____
MAINT. TECH. / DATE / TIME

_____
SUPERVISOR / DATE

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20-TON FORKLIFT

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52-H-125
20 TON FORKLIFT
`104C (MONTHLY)

HOUR METER READING
CURRENT_____
PREVIOUS_____
TOTAL_____

1. CONTACT RADIATION SAFETY TO CONDUCT A CONTAMINATION SURVEY PRIOR TO PERFORMING THIS PMI.

2. HANG MAINTENANCE IN PROGRESS TAG ON STEERING WHEEL.

3. INSPECT SERVICE INDICATOR ON ENGINE AIR CLEANER. IF IN RED POSITION, SERVICE THE AIR CLEANER AND INSTALL A NEW FILTER ELEMENT.

4. VERIFY CORRECT MASTER CYLINDER FLUID LEVEL. MAINTAIN LEVEL 1/2 INCH FROM TOP WITH WAGNER HD FLUID.

5. VERIFY BATTERY TERMINALS ARE TIGHT ON POSTS AND HAVE A COATING OF NO-OXIDE GREASE. VERIFY CORRECT ELECTROLYTE LEVEL. DO NOT OVERFILL.

6. VERIFY ENGINE AIR INTAKE CONNECTIONS ARE TIGHT.

7. REMOVE THE AIR COIL LOCATED ON INJECTOR SIDE OF ENGINE AND CLEAN THE COOLING FINS, OIL COOLER AND TRANSMISSION COOLER WITH COMPRESSED AIR. MAXIMUM 30 PSI.

8. VERIFY CORRECT OIL LEVEL IN TRANSMISSION. ADD TEXACO TORQUE FLUID C-3 AS REQUIRED.

9. VERIFY CORRECT OIL LEVEL IN HYDRAULIC TANK. ADD TEXACO HYDRAULIC SAFETY FLUID 46 AS REQUIRED.

10. INSPECT HYDRAULIC LINES AND HOSES FOR LEAKS, DAMAGE AND DETERIORATION.

11. INSPECT HYDRAULIC CYLINDERS FOR LOOSE OR MISSING RETAINER PINS AND LEAKS.

12. INSPECT MAST ROLLERS FOR FLAT SPOTS.

13. LUBRICATE THE FOLLOWING WITH TEXACO MOLYTEX EP-2 GREASE REF. ATTACHMENT ONE LUBE CHART.
    A. MAST ASSEMBLY - 18 PLACES
    NOTE: GREASE FITTING ACCESS FOR INNER SECTION ROLLERS REQUIRE MAST OPERATION
    B. FORK CARRIAGE ASSEMBLY - 18 PLACES.
    C. STEER AXLE - 8 PLACES
    D. CHASSIS
    E. TILT CYLINDERS - 2 PLACES

14. VERIFY CORRECT OIL LEVEL IN DIFFERENTIAL. ADD TEXACO MEROPA 320 AS REQUIRED.

52-H-125
20 TON FORKLIFT
M04C (MONTHLY)

HOUR METER READING
CURRENT_____
PREVIOUS_____
TOTAL_____

15. VERIFY CORRECT OIL LEVEL IN PLANETARY HUBS. ADD TEXACO MEROPA 320 AS REQUIRED.

16. VERIFY CORRECT OIL LEVEL IN STEER AXLE HUBS. ADD TEXACO MEROPA 320 AS REQUIRED.

17. CLEAN DRIVE AXLE BREATHER.

18. VERIFY HYDRAULIC RETURN FILTER INDICATOR NOT SHOWING RED. REPLACE FILTER IF INDICATOR SHOWS RED.

19. VERIFY CORRECT OIL LEVEL IN ENGINE. ADD TEXACO URSA SUPER PLUS SAE 30 WT. TO MAINTAIN LEVEL.

20. INSPECT "V" BELTS FOR ALTERNATOR AND AIR COMPRESSOR FOR CRACKS, FRAYING AND DETERIORATION. VERIFY BELT TENSION. SHOULD BE 3/8" TO 5/8" DEFLECTION AT CENTER OF SPAN.

21. VERIFY AUTOMATIC DRAINS FOR AIR BRAKES FUNCTIONAL.

22. INSPECT BRAKE AIR LINES AND CONNECTIONS.

23. VERIFY TIRE PRESSURES.
   A. FRONT - 100 PSI
   B. REAR - 80 PSI

24. VERIFY CORRECT TORQUE ON WHEEL LUG NUTS. REFER TO DATA PLATE ON FORKLIFT FOR CORRECT TORQUE VALUE.

RECOVERY
1. ALL CAPS, COVERS AND PLUGS REPLACED.
2. REMOVE TAGOUT.

RETEST
NONE REQUIRED

TAGOUT
MAINTENANCE IN PROGRESS TAG HUNG ON STEERING WHEEL.

52-H-125
20 TON FORKLIFT
'04C (MONTHLY)
ATA SHEET

_____
START TIME / DATE
HOUR METER READING
CURRENT _____
PREVIOUS_____
TOTAL_____

_____
MAINT. TECH. / DATE / TIME

1.	RADIATION SURVEY SATISFACTORY.		
2.	MAINTENANCE IN PROGRESS TAG HUNG ON STEERING WHEEL	YES	NO
3.	ENGINE AIR CLEANER INSPECTED.	YES	NO
	FILTER ELEMENT REPLACED.	YES	NO
4.	BRAKE MASTER CYLINDER FLUID LEVEL VERIFIED.	YES	NO
	FLUID ADDED AMOUNT_____	YES	NO
5.	BATTERY CHECKED.	YES	NO
	WATER ADDED.	YES	NO
6.	ENGINE AIR INTAKE CONNECTIONS TIGHT.	YES	NO
7.	COOLING FINS, OIL COOLER AND TRANSMISSION COOLER CLEANED.	YES	NO
8.	TRANSMISSION OIL LEVEL VERIFIED.	YES	NO
	OIL ADDED AMOUNT_____	YES	NO
9.	HYDRAULIC TANK OIL LEVEL VERIFIED.	YES	NO
	OIL ADDED AMOUNT_____		
10.	HYDRAULIC LINES AND HOSES INSPECTED.	YES	NO
11.	HYDRAULIC CYLINDERS INSPECTED.	YES	NO
12.	MAST ROLLERS INSPECTED.	YES	NO
13.	LUBRICATED THE FOLLOWING.	YES	NO
	A. MAST ASSEMBLY		
	B. FORK CARRIAGE ASSEMBLY		
	C. STEER AXLE		
	D. DRIVE AXLE		
	E. CHASSIS		
	F. TILT CYLINDERS		
14.	DIFFERENTIAL OIL LEVEL VERIFIED.	YES	NO
	OIL ADDED AMOUNT_____	YES	NO

52-H-125
20 TON FORKLIFT
M04C (MONTHLY)

15.	PLANETARY HUBS OIL LEVEL VERIFIED.	YES	NO
	OIL ADDED	YES	NO
	LEFT AMOUNT _____		
	RIGHT AMOUNT _____		
16.	STEER AXLE HUBS OIL LEVEL VERIFIED.	YES	NO
	OIL ADDED	YES	NO
	LEFT AMOUNT _____		
	RIGHT AMOUNT _____		
17.	DRIVE AXLE BREATHER CLEANED.	YES	NO
18.	VERIFIED HYDRAULIC RETURN FILTER INDICATOR NOT SHOWING RED.	YES	NO
	FILTER ELEMENT REPLACED.	YES	NO
	PART # TBD		
19.	VERIFIED CORRECT OIL LEVEL IN ENGINE.	YES	NO
	OIL ADDED AMOUNT _____		
20.	"V" BELTS INSPECTED AND CORRECT TENSION VERIFIED.	YES	NO
	3/8" TO 5/8" DEFLECTION AT CENTER OF SPAN. ADJUSTMENT REQUIRED.	YES	NO
21.	AUTOMATIC DRAINS FOR AIR BRAKES FUNCTIONAL.	YES	NO
22.	BRAKE AIR LINES AND CONNECTIONS INSPECTED.	YES	NO
23.	TIRE PRESSURE VERIFIED.	YES	NO
	A. FRONT 100 PSI		
	B. REAR 80 PSI		
24.	CORRECT TORQUE VERIFIED ON WHEEL LUG NUTS.	YES	NO
	TORQUE WRENCH ISL NO _____		
	CAL DUE DATE _____		

_____
MAINT. TECH. / DATE / TIME

_____
MAINT. SUPERVISOR / DATE / TIME

RETEST
NONE REQUIRED

52-H-125
20 TON FORKLIFT
06C (QUARTERLY)

HOUR METER READINGS
CURRENT _____
PREVIOUS _____
TOTAL _____

1. CONTACT RADIATION SAFETY TO CONDUCT A CONTAMINATION SURVEY PRIOR TO PERFORMING THIS PMI.

2. PERFORM MONTHLY MAINTENANCE, PARAGRAPHS 1 THROUGH 22 IN CONJUNCTION WITH QUARTERLY MAINTENANCE. ATTACH MONTHLY DATA SHEET TO QUARATERLY DATA SHEET.

3. VERIFY CORRECT ELECTROLYTE LEVEL IN BATTERY. DO NOT OVERFILL. CLEAN BATTERY WITH A SOLUTION OF BAKING SODA AND WATER. 1 LB. SODA TO 1 GAL. WATER. VERIFY A COATING OF NO-OXIDE GREASE ON BATTERY TERMINALS.

4. CHANGE ENGINE FUEL FILTERS PART NO. TBD.

5. LUBRICATE THROTTLE CONTROL LINKAGE WITH TEXACO MOLYTEX EP-2 GREASE.

6. CLEAN TRANSMISSION BREATHER.

7. REPLACE HYDRAULIC TANK BREATHER.
PART NO. TBD.

NOTE

PERFORM THE FOLLOWING STEPS ONLY IF TOTAL HOURS EXCEED 200 SINCE LAST QUARTERLY PMI.

8. DRAIN ENGINE CRANKCASE AND REPLACE OIL FILTERS. PART NO. TBD.

9. FILL ENGINE CRANKCASE TO FULL MARK ON DIPSTICK WITH TEXACO URSA SUPER PLUS SAE 30 WT. OIL. APPROXIMATELY 22 QUARTS.

RECOVERY
1. ALL CAPS, COVERS AND PLUGS REPLACED.
2. REMOVE TAGOUT.

RETEST
1. SATISFACTORY FUNCTION OF FORKLIFT IN ALL MODES.
2. OBSERVE FOR ANY AIR OR OIL LEAKAGE.

TAGOUT
MAINTENANCE IN PROGRESS TAG HUNG ON STEERING WHEEL.

52-H-125
20 TON FORKLIFT
M06C (QUARTERLY)
DATA SHEET

_____
START TIME / DATE
HOUR METER READINGS
CURRENT _____
PREVIOUS _____
TOTAL _____

1. RADIATION SURVEY SATISFACTORY.

_____
MAINT. TECH. / DATE / TIME

2.	MONTHLY MAINTENANCE PERFORMED AND DATA SHEET ATTACHED	YES	NO
3.	ELECTROLYTE LEVEL VERIFIED AND BATTERY CLEANED.	YES	NO
4.	ENGINE FUEL FILTERS CHANGED.	YES	NO
5.	THROTTLE CONTROL LINKAGE LUBRICATED.	YES	NO
6.	TRANSMISSION BREATHER CLEANED.	YES	NO
7.	HYDRAULIC TANK BREATHER REPLACED.	YES	NO
	MORE THAN 200 HOURS SINCE LAST QUARTERLY PMI.	YES	NO
	ACTUAL HOURS_____		
8.	ENGINE CRANKCASE DRAINED AND OIL FILTERS REPLACED.	YES	NO
9.	ENGINE CRANKCASE REFILLED.	YES	NO
	AMOUNT _____QUARTS		

_____
MAINT. TECH. / DATE / TIME

_____
MAINT. SUPERVISOR / DATE / TIME

RETEST
SATISFACTORY / UNSATISFACTORY*
*EXPLAIN FAILURES

_____
OPERATIONS / DATE / TIME

52-H-125
20 TON FORKLIFT
'08C (ANNUAL)

HOUR METER READING
CURRENT _____
PREVIOUS _____
TOTAL _____

1. CONTACT RADIATION SAFETY TO CONDUCT A CONTAMINATION SURVEY PRIOR TO PERFORMING THIS PMI.

2. PERFORM QUARTERLY MAINTENANCE, PARAGRAPHS 1 THROUGH 11 IN CONJUNCTION WITH ANNUAL MAINTENANCE. ATTACH QUARTERLY DATA SHEET TO ANNUAL DATA SHEET.

3. CLEAN ENGINE CRANKCASE BREATHER.

4. STEAM CLEAN EXTERIOR OF ENGINE.

5. VERIFY ENGINE MOUNTS ARE SECURE.

6. REMOVE AIR COWL LOCATED ON THE INJECTOR SIDE OF THE ENGINE. CLEAN THE COOLING FINS, OIL COOLER, AND TRANSMISSION COOLER WITH STEAM OR SAFETY SOLVENT. DRY WITH COMPRESSED AIR. MAXIMUM 30 PSI.

NOTE

PERFORM THE FOLLOWING STEPS ONLY IF TOTAL RUNNING HOURS EXCEED 500 HOURS FROM LAST ANNUAL PMI.

7. CLEAN FILTER BOWL ON OIL COUPLING OF FILTER BLOWER.

8. VERIFY CORRECT VALVE CLEARANCE. ENGINE MUST BE COLD.
CLEARANCE: INLET VALVE 0.2 MM
EXHAUST VALVE 0.3 MM

9. REPLACE FUEL FILTERS 2 EACH. DO NOT USE WRENCH ON FILTERS. APPLY A SLIGHT FILM OF OIL TO RUBBER GASKET AND TIGHTEN BY HAND ONLY. DEUTZ PART # TBD.

10. CLEAN THE FUEL PREFILTER BY SLACKENING CLAMPING NUT, SWING WIRE CLIP ASIDE AND TAKE OUT BOWL AND SCREEN. CLEAN BOTH IN DIESEL FUEL AND RE-INSTALL.

11. VERIFY SECURENESS OF FOLLOWING.
A. EXHAUST MANIFOLDS
B. INTAKE MANIFOLDS
C. LUBE OIL LINES

12. REMOVE CYLINDER HEAD TEMPERATURE SENSORS AND TEMPERATURE INDICATOR AN SEND TO CALIBRATION FOR TESTING. SENSORS ARE LOCATED IN CYLINDERS TBD. TEST PROCEDURE IMMERSE SENSORS IN OIL AT 170 - 175°C. VERIFY THE RED "STOP" SECTOR APPEARS IN THE WINDOW OF THE TEMPERATURE INDICATOR. AFTER SATISFACTORY TEST, RE-INSTALL SENSORS AND INDICATOR ATTACH A COPY OF TEST RESULTS TO DATA SHEET.

13. SERVICE ENGINE AIR CLEANER. INSTALL NEW FILTER ELEMENT.

52-H-125
20 TON FORKLIFT
M08C (ANNUAL)

HOUR METER READING
CURRENT _____
PREVIOUS _____
TOTAL _____

14. DRAIN TRANSMISSION.

15. REPLACE TRANSMISSION FILTER ELEMENT. USE NEW GASKET. PART NO. TBD. CLEAN SUMP SCREENS.

16. REFILL TRANSMISSION WITH TEXACO TORQUE FLUID C-3, APPROXIMATELY 36 QUARTS.

17. DRAIN DIFFERENTIAL AND REFILL WITH TEXACO MEROPA 320. APPROXIMATE 31 QUARTS.

18. DRAIN PLANETARY HUBS AND REFILL WITH TEXACO MEROPA 320. APPROXIMAT 16 QUARTS.

19. DRAIN HYDRAULIC TANK. CLEAN INSIDE OF TANK INCLUDING FILTER SCREEN INSIDE TANK.

20. REFILL HYDRAULIC TANK WITH TEXACO HYDRAULIC SAFETY FLUID 46. APPROXIMATELY 64 GALLONS.

21. DRAIN STEER AXLE HUBS AND REFILL WITH TEXACO MEROPA 320 OIL. APPROXIMATELY 1 QUART EACH WHEEL.

22. INSPECT BRAKE LININGS. REPLACE IF LININGS LESS THAN 1/8 INCH THICK.

23. INSPECT BRAKE LINES AND HOSES FOR DETERIORATION, DAMAGE AND LEAKS.

RECOVERY
1. ALL CAPS, COVERS AND PLUGS REPLACED.
2. REMOVE TAGOUT.

RETEST
1. OBSERVE FOR ANY AIR OR OIL LEAKAGE.

TAGOUT
MAINTENANCE IN PROGRESS TAG HUNG ON STEERING WHEEL.

52-H-125
20 TON FORKLIFT
M08C (ANNUAL)
ATA SHEET

_____
START TIME / DATE
HOUR METER READING
CURRENT _____
PREVIOUS _____
TOTAL _____

1. RADIATION SURVEY SATISFACTORY. _____
MAINT. TECH. / DATE / TIME

2. QUARTERLY MAINTENANCE PERFORMED AND DATA SHEETS ATTACHED. YES NO

3. ENGINE CRANKCASE BREATHER CLEANED. YES NO

4. STEAM CLEANED EXTERIOR OF ENGINE. YES NO

5. ENGINE MOUNTS SECURE. YES NO

6. COOLING FINS, OIL COOLER AND TRANSMISSION COOLER CLEANED. YES NO

TOTAL RUNNING HOURS SINCE LAST ANNUAL PMI ARE _____HOURS.

7. FILTER BOWL ON OIL COUPLING CLEANED. YES NO

8. VALVE CLEARANCES VERIFIED WITH ENGINE COLD. YES NO
SHOULD BE: INLET - 0.2MM
EXHAUST - 0.3MM

CYL. 1_____MM CYL. 2_____MM CYL. 3_____MM CYL. 4_____MM
CYL. 5_____MM CYL. 6_____MM CYL. 7_____MM CYL. 8_____MM

9. FUEL FILTERS REPLACED. YES NO

10. FUEL PREFILTER CLEANED. YES NO

11. VERIFIED SECURENESS OF: YES NO
A. EXHAUST MANIFOLD
B. INTAKE MANIFOLD
C. LUBE OIL LINES

12. CYLINDER HEAD TEMPERATURE SENSORS TESTED AND REINSTALLED. YES NO

13. ENGINE AIR CLEANER SERVICED AND NEW ELEMENT INSTALLED. YES NO

52-H-125
20 TON FORKLIFT
M08C (ANNUAL)
REV. 1F1

14.	TRANSMISSION DRAINED.	YES	NO
15.	INSTALLED NEW TRANSMISSION FILTER.	YES	NO
16.	TRANSMISSION REFILLED. AMOUNT _____QUARTS	YES	NO
17.	DIFFERENTIAL DRAINED AND REFILLED.	YES	NO
18.	PLANETARY HUBS DRAINED AND REFILLED. AMOUNT _____QUARTS	YES	NO
19.	HYDRAULIC TANK DRAINED AND CLEANED.	YES	NO
20.	HYDRAULIC TANK REFILLED. AMOUNT _____GALLONS	YES	NO
21.	STEER AXLE HUBS DRAINED AND REFILLED. AMOUNT _____QUARTS	YES	NO
22.	BRAKE LININGS INSPECTED THICKNESS 1/8 INCH MINIMUM. LININGS REPLACED.	 YES YES	 NO NO
23.	BRAKE LINES AND HOSES INSPECTED.	YES	NO

ANNUAL MAINTENANCE COMPLETE.

_____
MAINT. TECH. / DATE / TIME

RETEST
SATISFACTORY / UNSATISFACTORY*
*EXPLAIN FAILURE

_____
OPERATIONS / DATE / TIME

APPENDIX H1

LIST OF HAZARDOUS WASTE MANAGEMENT JOB TITLES

APPENDIX H1
LIST OF HAZARDOUS WASTE MANAGEMENT JOB TITLES

RCRA Position Title
TRU Waste Handlers Non-TRU Waste Handlers Waste Operations Administrative Assistant WWIS Data Administrator Manager, Waste Operations
Radiological Control Technician Manager, Radiation Control
Technical Trainer Manager, Technical Training
Emergency Services Technician
Quality Assurance Technician Team Leader, Inspection Services
Sampling Team Member Manager, Environmental Compliance and Support
Operations Engineer Facility Shift Manager Central Monitoring Room Operator
Waste Hoist Operator Waste Hoist Shaft Tender Waste Hoisting Supervisor

APPENDIX H2

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTIONS

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: TRU Waste Handlers

Duties:

- Operates waste handling equipment and support systems to unload, handle and emplace TRU mixed waste and backfill into the repository
- Performs functional and operational checks of waste handling equipment and support systems as well as conduct waste container storage area inspections
- Performs spot decontamination of shipping casks, waste containers, and waste handling equipment
- Perform waste container overpacking operations

Requisite Skills, Experience and Education:

Academic or vocational high school graduate with courses in algebra and physics or chemistry, or equivalent, plus two years of college-level technical study with courses in nuclear waste management and health physics, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Waste Handling Operations Certification Card Signature Record (WH-01 Technicians or WH-02 Engineers) and Waste Handling Operations Guidebook (WH-GUIDE-1)
- Radworker II (RAD-201)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/631)
- Hazardous Waste Responder (HWR-101, 101A)
- Hazardous Waste Transportation (HMT-102)

NOTE: Waste Handling Technicians will not participate in TRU waste handling activities and integrated system functions until full certification is acquired.

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Non-TRU Waste Handlers

Duties:

- Supervises/oversees the preparation of hazardous waste for shipment
- Inspects and inventories hazardous waste staging areas
- Assists the transfer of site-generated hazardous waste to on-site staging areas
- Directs storage of hazardous waste in the hazardous waste staging areas
- Conducts inspections of Satellite Accumulation Areas

Requisite Skills, Experience and Education:

Associate degree in engineering, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Transportation of Hazardous Material (HMT-102)
- Hazardous Materials Qualification Card (TE-03)
- Hazardous Waste Shipments by Public Highway Qualification Card (TE-05)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Waste Operations Administrative Assistant

Duties:

- Review hazardous waste manifests and accompanying land disposal restriction notification forms upon receipt of TRU mixed waste shipments
- Interface with waste generators and external agencies to resolve manifest discrepancies
- Prepare hazardous waste manifests and supporting documentation for outgoing shipments of TRU mixed waste
- Provide generator sites with a signed copy of the hazardous waste manifest

Requisite Skills, Experience and Education:

Associate degree in engineering, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Transportation of Hazardous Material (HMT-102)
- Hazardous Waste Worker (HWW-101/102)
- Radioactive Transportation Qualification Card (TE-01)
- Federal Motor Carrier Safety Regulations Qualification Card (TE-02)
- Hazardous Materials Qualification Card (TE-03)
- Hazardous Waste Shipments by Public Highway Qualification Card (TE-05)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Waste Operations Data Specialist

Duties:

- Supervise the day to day operation of the WWIS
- Review and approve waste characterization, certification, and shipping data
- Manage the WWIS, including data change control, archival of the database, and reporting functions
- Review Waste Stream Profile Forms (WSPF) and compare with WWIS data on specific containers. Make approval/rejection recommendations to the WSPF review team

Requisite Skills, Experience and Education:

Bachelor of Science degree with technical courses in nuclear waste management, chemistry and health physics, or equivalent.

Training (Type/Amount):

- General Employee Training (GET-19X)
- Subject Matter Expert/On-The-Job Training (TRG-293/298)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Manager, Waste Operations

Duties:

- Oversee all TRU waste and non-TRU waste handling activities conducted by Waste Operations personnel

Requisite Skills, Experience and Education:

B.S. degree, or equivalent, in nuclear-related field.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Radiological Control Technician

Duties:

- Conducts routine surveys of all incoming shipping containers for radiation, contamination, and damage
- Conducts routine radiological surveys (monitoring for surface and airborne contamination and radiation exposure) of various areas at the WIPP site
- Serves as emergency response personnel for any event involving radiation and radioactive materials
- Oversees any radiological work at the facility. This duty involves writing radiological work permits (RWPs), issuing radiological protective clothing and supplemental dosimetry, conducting radiological monitoring of the job (including personnel, equipment, and areas involved), as well as providing any other radiological safety oversight function
- Monitors TRU waste handling and related operations, as well as any other radiological work, to determine compliance with radiological control documents and procedures
- Performs operational and functional checks of radiological detection and monitoring equipment
- In the unlikely event of personnel radiological contamination, the RadCon Tech is qualified to perform personnel decontamination and provide radiological oversight to medical personnel if an injury is contaminated
- Posts radiological areas with applicable signs and barriers
- Controls radioactive sources (including leak testing) used in the performance/functional checks and calibrations of radiological instrumentation
- Operates some non-radiological measurement equipment associated with radiological monitoring (gravimetric scale, chart recorders, data loggers, etc.)

Requisite Skills, Experience and Education:

Academic or vocational high school graduate, or equivalent, with courses in chemistry, physics, geometry, or trigonometry, or equivalent, plus associated degree in radiation safety or health physics, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Health Physics Technician Certification (RCT-01/02)
- Radiological Worker II (RAD-201)
- Respiratory Protection (SAF-630/631)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Responder (HWR-101/101A)
- Conduct of Shift Operations (OPS-115)
- First Aid/CPR (MED-101 or 101A)
- Fundamental Academic Lessons
- Site-Specific Academic Lessons

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Manager, Radiation Control

Duties:

- Supervises/oversees hazardous waste management duties performed by personnel in the Radiation Control section

Requisite Skills, Experience and Education:

B.S. degree in engineering, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Technical Trainer

Duties:

- Conduct Hazardous Waste Management training

Requisite Skills, Experience and Education:

B.A. in business or liberal arts, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Level II Trainer (TRG-300)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Manager, Technical Training

Duties:

- Directs hazardous waste management training

Requisite Skills, Experience and Education:

B.S. degree and 5 years nuclear experience, or seven years nuclear training experience, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Level II Trainer (TRG-300)
- Subject Matter Expert/On-the-Job Training (TRG-293/298)
- Hazardous Waste Supervisor ((HWS-101)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Emergency Services Technician

Duties:

- Responds to hazardous waste spills in emergency situations
- Provides emergency fire-response services
- Conducts routine inspections and maintains all response equipment on site
- Serves as incident commander
- Directs emergency teams to control hazardous situations

Requisite Skills, Experience and Education:

Vocational or commercial high school graduate, or equivalent, plus additional training in emergency fire and medical response, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- EST Certification Card (EST-01)
- Subject Matter Expert/On-The-Job Training (TRG-293/298)
- Level II Trainer (TRG-300)
- Hazardous Waste Worker (HWW-101/102)
- Respiratory Protection (SAF-630/ 631)
- Firefighter I (SAF-621)
- Hazardous Waste Responder (HWR-101/101A)

NOTE: The trainee may perform duties prior to certification only for those evolutions and/or operations for which training has been completed.

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Quality Assurance Technician

Duties:

- Observes waste handling operations and verifies adherence with hazardous waste handling procedures

Requisite Skills, Experience and Education:

Vocational, technical or high school graduate, or equivalent, plus two years of technical training with courses in inspection techniques, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Quality Assurance Inspector Certification Card

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Team Leader, Inspection Services

Duties:

- Ensures that items or services that do not conform with specified quality requirements are controlled to prevent use until disposition and corrective action, where applicable, are implemented
- Provides technical supervision for Quality Assessment Technicians inspecting and verifying waste handling operations

Requisite Skills, Experience and Education:

Associate of science degree in a technical field, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Sampling Team Member

Duties:

- Collects samples of waste for characterization and environmental media for determination of possible releases

Requisite Skills, Experience and Education:

Academic or vocational high school graduate, or equivalent, with courses in algebra and chemistry or biology, plus Associate degree in engineering or science with courses in computer science, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Responder (HWR-101/101A)
- Sampling Team Qualification (ST-001)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Manager, Environmental Compliance & Support

Duties:

- Supervises/oversees hazardous duties performed by Sampling Team members

Requisite Skills, Experience and Education:

B.S. degree in an environmental science, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Supervisor (HWS-101/101A)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Operations Engineer

Duties:

- Notifies emergency response personnel and on-call facility manager during emergency occurrences
- Serves as backup RCRA Emergency Coordinator

Requisite Skills, Experience and Education:

Associate degree in engineering or scientific discipline, or equivalent, and five years related practical experience, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Facility Operations Shift Supervisor Certification Card (FO-FOSS-3 or FO-FOSS-3R)
- Roving Watch Certification (FO-RW-1)
- Central Monitoring Room Operator Certification (FO-CMRO-2)
- Conduct of Shift Operations (OPS-115)
- Hazardous Materials Emergency Response (HMT-104)
- Root Cause Analysis (TRG-296)
- WIPP Occurrence Reporting for Facility Managers (OPS-110)
- WIPP Contingency Plan Procedure (SAF-645)
- Hazardous Waste Worker (HWW-101)

NOTE: Full Certification must be completed prior to the candidate operating any equipment or performing any operating evolutions without the direct supervision of a certified operator.

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Facility Shift Manager

Duties:

- Serves as RCRA Emergency Coordinator
- Notifies emergency response personnel and on-call facility manager during emergency occurrences

Requisite Skills, Experience and Education:

Academic or vocational high school (mechanical/electrical) graduate and eight years of nuclear plant operating experience, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Facility Operations Shift Supervisor Certification Card (FO-FOSS-3 or FO-FOSS-3R)
- Roving Watch Certification (FO-RW-1)
- Central Monitoring Room Operator Certification (FO-CMRO-2)
- Conduct of Shift Operations (OPS-115)
- Hazardous Materials Emergency Response (HMT-104)
- Root Cause Analysis (TRG-296)
- WIPP Occurrence Reporting for Facility Managers (OPS-110)
- WIPP Contingency Plan Procedure (SAF-645)
- Hazardous Waste Worker (HWW-101)

NOTE: Full Certification must be completed prior to the candidate operating any equipment or performing any operating evolutions without the direct supervision of a certified operator.

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Central Monitoring Room Operator

Duties:

- Notifies emergency response personnel
- Documents emergency actions

Requisite Skills, Experience and Education:

Vocational or academic high school graduate, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Roving Watch Certification (FO-RW-1)
- Central Monitoring Room Operator (FO-CMRO-2 or FO-CMRO-2R)
- Hazardous Materials Emergency Response (HMT-104)
- Conduct of Shift Operations (OPS-115)

NOTE: Full Certification must be completed prior to the candidate operating any equipment or performing any operating evolutions without the direct supervision of a certified operator.

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Waste Hoist Operator

Duties:

- Operates waste shaft hoist in accordance with established procedures
- Maintains daily hoist operations log
- Performs routine inspections of the Waste Shaft hoisting equipment

Requisite Skills, Experience and Education:

Vocational or academic high school graduate, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Waste Hoist Qualification (M-30)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Waste Hoist Shaft Tender

Duties:

- Oversees and directs loading and unloading of the Waste Hoist above and below ground

Requisite Skills, Experience and Education:

Vocational or academic high school graduate, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Waste Hoist Shaft Tender (M-31)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Waste Hoisting Supervisor

Duties:

- Coordinate and direct the daily operations and maintenance of the operating hoist and shaft
- Supervise/oversee hazardous waste management duties performed by hoisting personnel

Requisite Skills, Experience and Education:

B.S. degree, or equivalent.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Hazardous Waste Worker (HWW-101/102)
- Hazardous Waste Worker Supervisor (HWS-101/101A)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Chief Office Warden

Duties:

- Cooperate, participate, and comply with the provisions of WIPP Emergency Plan
- Primary function is to coordinate personnel accountability in the event of an evacuation
- Responsible for surface accountability at staging areas in the event of an evacuation

Requisite skills, Experience and Education:

High School Diploma or equivalent, approval from employee's manager, compliance with the requirements of the WIPP Emergency Plan, and current knowledge of emergency evacuations, staging and assembly areas, and the site notification system.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Office Warden Training (SAF-632)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Assistant Chief Office Warden

Duties:

- Cooperate, participate, and comply with the provisions of WIPP Emergency Plan
- Primary function is to coordinate personnel accountability in the event of an evacuation
- Responsible for surface accountability at staging areas in the event of an evacuation

Requisite skills, Experience and Education:

High School Diploma or equivalent, approval from employee's manager, compliance with the requirements of the WIPP Emergency Plan, and current knowledge of emergency evacuations, staging and assembly areas, and the site notification system.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Office Warden Training (SAF-632)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: Mine Rescue Team Member

Duties:

- Cooperate, participate, and comply with provisions of the Supplemental Emergency Response Program Plan (SERP)
- Trained in accordance with 30 CFR to respond to mine emergencies beyond that of the FLIRT
- Responsible for underground reentry and rescue after an underground evacuation

Requisite Skills, Experience and Education:

High School Diploma or equivalent, written approval from employee's manager (Authorization Card MRT-01), compliance with health and physical requirements, 1) Initial examination and clearance by the Occupational Medical Director, 2) Examined and cleared annually by the Occupational Medical Director, 3) Additional tests: pulmonary function test, cardiac stress test every five years, drug screen, 4) Encouraged to maintain good medical and physical condition, Compliance with requirements of the SERP, current knowledge regarding rescue and recovery of personnel involved in mine emergencies according to 30 CFR.

Training (Type/Amount):

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- First Aid and CPR (MED-101)
- Respiratory Protection (SAF-630/SAF-631 D)
- Radiological Worker II (RAD-201)
- Mine Rescue Team Initial training (EOC-101)
- Inexperienced Miner Training (SAF-501/502)

WASTE ISOLATION PILOT PLANT
RCRA HAZARDOUS WASTE MANAGEMENT FUNCTIONAL JOB DESCRIPTION

Position Title: First Line Initial Response Team member

Duties:

- Cooperate, participate, and comply with provisions of the Supplemental Emergency Response Program Plan (SERP)
- Primary function is to provide medical and hazardous material response to the WIPP underground

Requisite Skills, Experience, and Education:

High School Diploma or equivalent, written approval from employee's manager (Authorization Card FLIRT-01), compliance with health and physical requirements, 1) Initial examination and clearance by the Occupational Medical Director, 2) Examined and cleared annually by the Occupational Medical Director, 3) Additional tests: pulmonary function test, cardiac stress test every five years, drug screen, 4) Encouraged to maintain good medical and physical condition, compliance with requirements of the SERP, current knowledge regarding medical response and hazardous materials response.

Training (Type/Amount):

The following training must be completed and current prior to participation during an emergency response:

- General Employee Training (GET 19X)
- General Employee Training Refresher (GET 19XA)
- Inexperienced miner (SAF 501/502)
- Confined Space Training (SAF-515)
- Hazardous Waste Worker (HWW-101)
- Respiratory Protection (SAF-630 and SAF-631 D)
- First Aid and CPR (MED-101)
- Radiological Worker II (RAD-201)
- Eight hours of monthly training

APPENDIX H3

TRAINING COURSE AND QUALIFICATION/CERTIFICATION CARD OUTLINES

COURSE: GET19X - General Employee Training

DURATION: ≈ 16 Hours

PREREQUISITES: None

SCOPE:

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to perform their job in a safe manner and will have an overview of the site organization and description.

Mastery of the terminal objectives will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: GET-19XA annually

COURSE DESCRIPTION (by module)

1. Site Overview & WIPP Description
   ≈ 1 hour
   a. Mission of DOE and CAO
   b. Relationship of WIPP organizations
   c. Surface structures
   d. WIPP shafts
   e. Underground area

2. Emergency Preparedness
   (includes Occurrence Reporting)
   ≈ 1 hour
   a. Definition of occurrence
   b. DOE Order 5000.3B
   c. WP 12-918
   d. Occurrence reporting process
   e. Employee involvement with Emergency Preparedness
   f. Types of emergencies
   g. Emergency response by WIPP groups
   h. Off-site response groups
   i. WIPP emergency procedures
   j. Emergency equipment
   k. Employee actions during emergencies

3. General Safety
   ≈ 1 hour
   a. Personal Protective Equipment
   b. Requirements for PPE
   c. Warning Tags
   d. WIPP safety hazards
   e. Medical assistance
   f. Actions to take for injuries

g. Reporting injuries/accidents
h. Employee concerns

4. Computer Security
≈ 1 hour

a. Department to contact
b. WIPP policies and procedures for:
   1. Personally owned software
   2. Computer games
   3. Passwords/password protection
c. Computer virus prevention

5. Fire Protection
≈ 1 hour

a. WIPP Fire Protection Program
b. Fire sources at WIPP
c. Fire Tetrahedron
d. Classes of fires
e. Fire extinguisher
f. Office Warden Program
g. Employee responsibilities during a fire

6. RCRA & Storm Water Management
≈ 2 hours

a. RCRA history
b. RCRA goals
c. WIPP goals and relation to RCRA
d. Definition of RCRA wastes
e. Site generated waste program
f. Training requirements for treatment storage and disposal facilities
g. Contingency Plan
h. Waste Minimization Program
i. RCRA regulatory agencies
j. RCRA enforcement options
k. Application of Storm Water Management policy in relation to the general employee

8. Work Policies and Procedures
≈ 1 hour

a. DOE Orders and Westinghouse Procedures
b. Teamwork
c. Conduct of Operations Policy
   1. Elements of Conduct of Ops
d. Quality Assurance Program
e. Responsibility for following procedures
f. Resuming work after stoppage
g. Stopping work for unsafe acts
h. Purpose and uses of "Hold Tag"
i. Quality records and requirements
j. Correcting errors on QA Records

	k. Configuration Management and affected departments
9. Electrical Safety ≈ 1 hour	a. Variables of electrical circuits b. Severity of electrical shock c. Areas where electrical accidents occur d. WIPP policy on using damaged electrical equipment e. WIPP policy for modifying electrical protective devices f. Requirements for use of Ground Fault Interrupters. g. Purpose of GFI's h. WIPP policy for resetting breakers i. WIPP policy for using extension cords, plug-in devices, and other equipment exposed to energized electrical circuits
10. Hazard Communications ≈ 1 hour	a. Description of Haz Comm Std. b. Health and Safety hazards c. Protection from workplace hazards 1. PPE 2. Preparedness/Prevention 3. Employee responsibilities d. Emergency procedures e. WIPP Hazard Communication Prog. 1. Training 2. Container labels 3. Chemical transfers 4. Material Safety Data Sheets f. Other information sources
11. Personal Protective Equipment ≈ 1 hour	a. Requirements for head protection b. Requirements for hearing conservation c. Requirements for face/eye protection d. Requirements for foot protection
12. Bloodborne Pathogens ≈ 1 hour	a. Def. of Bloodborne Pathogens b. Def. of Hepatitis B and Human Immunodeficiency Virus c. Bloodborne Pathogen transmission d. Prevention of bloodborne pathogen infection e. WIPP Exposure Control Plan

13. Ergonomics
≈ 2 hours

a. Cumulative Trauma Disorder
b. Risk factors for CTD
c. Prevention of CTD
d. Recognition of CTD
e. Steps to take when CTD develops

14. Security
≈ 1 hour

a. Security Mission
b. Def. of Security Officer
c. Security Officer Tasks
d. Access and Property Control at WIPP
e. Badge accountability
f. Property Pass system
g. Physical security
h. Telephone threat list
i. Employee responsibilities during demonstration
j. Fitness for duty
k. Computer security
l. Parking requirements

15. General Employee Radiological Training (GERT)
≈ 1 hour

This program will be implemented prior to declaration of site readiness for all site employees. The standardized core materials for GERT include the following topics:

Sources of Radiation
Non-ionizing and Ionizing Radiation
Risk in Perspective
ALARA Concept
Radiological Controls
Monitoring/Dosimetry
Emergency Procedures
Employee Responsibilities

All times are approximate and do not reflect time spent on additional topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: GET19XA - General Employee Training Refresher

DURATION: Self-paced Course

PREREQUISITES: None

SCOPE:

TYPE: Self-paced Module

OBJECTIVES: Objectives are stated at the beginning of each module, including security, radiological basics, general safety, hazard communications, bloodborne pathogens, hearing protection, and OSHA/RCRA.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the module examination.

REFRESHER: Annually

COURSE DESCRIPTION (by module)

1. Introduction
   a. Self Paced Course
   b. Information about WIPP organizations
   c. Appendix Information
      1. Storm Water Management
      2. WIPP Land Withdrawal Act
      3. DOE Mission
   d. Exam Guidelines

2. General Security
   a. Prohibited Articles
   b. Primary responding agencies
   c. Wearing your badge
   d. Escort Responsibility
   e. Number of visitors an employee may escort
   f. When to turn off your computer
   g. Personal Property Passes

3. Computer Security
   a. Point of contact
   b. WIPP policies and procedures for:
      1. Personally owned software
      2. Computer games
      3. Passwords/password protection
   c. Computer virus prevention

4. Fitness for Duty	a.	Reasons for the Fitness for Duty Program
	b.	General Employee Responsibilities
5. RCRA	a.	Types of waste disposed
	b.	Waste Identification
6. Storm Water Management	a.	Application of Storm Water Management policy in relation to the general employee
7. Bloodborne Pathogens	a.	Transmission Identification of Bloodborne Pathogens
	b.	Prevention of Hepatitis B and Human Immunodeficiency Virus
	c.	Actions to take if exposed
8. Hazard Communications	a.	Purpose of MSDS
	b.	Responsibilities when transferring hazardous materials
	c.	WIPP Hazard Communication Prog.
		1. Training
		2. Container labels
		3. Chemical transfers
		4. Material Safety Data Sheets
9. Ergonomics	a.	Identification of CTD
	b.	Ways to prevent CTD
	c.	Required actions
10. Personal Protective Equipment	a.	Requirements for head protection
	b.	Requirements for hearing conservation
	c.	Requirements for face/eye protection
	d.	Requirements for foot protection
11. General Safety	a.	Requirements for obeying signs and tags
	b.	Requirements for reporting an occurrence
	c.	Actions for emergency situations
	d.	Resolving employee concerns
	e.	Proper uses of extension cords
	f.	WIPP Circuit Breaker Policy
	g.	Steps to take when responding to fire

h. Responsibilities when fighting a fire
i. When to use the sign-out board

12. Conduct of Operations

a. Goals of In-House Management Program
b. Required actions before posting information
c. Correcting a written record
d. Point of Contact for Records Management

COURSE: HWW-101 - Hazardous Waste Worker

DURATION: ≈ 24 hours

PREREQUISITES: None

SCOPE:

REFRESHER: HWW-102 Annually

COURSE DESCRIPTION (by module)

1. Course and Regulatory Overview
   ≈ 1 hour
   a. OSHA regulations and their applicability to RCRA facilities and operations
   b. RCRA standards for generator facilities and for TSDFs
   c. DOT/EPA regulations and applicability to hazardous waste transportation

2. Hazard Communications
   ≈ 1 hour
   a. Purpose of the Hazard Communication standard (29 CFR 1910.1200)
   b. Locations of Material Safety Data Sheets (MSDS)
   c. Labeling of containers
   d. Other resources for information on hazardous materials/waste including NFPA 704 hazard warning symbol, DOT United Nations Identification System, DOT Emergency Response Guidebook, NIOSH Pocket Guide to Chemical Hazards. Student exercises are included in this section on the use of these references.

3. Principles of Toxicology
   ≈ 3 hours
   a. Dose-response relationship with regard to exposures to hazardous materials
   b. Immediate and delayed effects (acute and chronic effects)
   c. Different ways substances enter the human body
   d. Effects of substances on the human body including target organ effects, systemic effects, carcinogens, and genetic effects

e. Exposure limits including Threshold Limit Value (TLV), Permissible Exposure Limit (PEL), Lethal Dose 50% (LD_{50}), Lethal Concentration 50%(LC_{50})
f. Effects of temperature extremes on the human body including signs and symptom heat stress and cold stress
g. Effects of ionizing radiation

4. Hazards
≈3 hours

a. Safety and health hazards when conducting hazardous waste operations including fire, explosion, oxygen deficiency, ionizing radiation, biological, electrical, heat and cold stress
b. Hazard classification including chemical, physical, mechanical, biological, and radiological
c. Airborne hazards including gases, vapors, and particulates
d. Properties of materials including corrosivity, pH, flammability, explosivity, (upper and lower explosive limits), specific gravity, vapor density, boiling point, solubility, and reactivity
e. Protection from hazards
f. Confined space hazards
g. Causes and prevention of accidents

5. Personal Protective Equipment
≈3 hours

a. Description and examples of Personal Protective Equipment (PPE)
b. Factors in the selection of PPE
c. Non-radiological and radiological hazards
d. Selection process for PPE
e. Ways substances enter PPE including permeation, degradation, penetration
f. Equipment included in each of the four levels of PPE adopted by the EPA (Levels A, B, C, and D), capabilities and limitations of each level
g. PPE inspection

h. Job scope planning
i. Human factors that limit the use of PPE
j. Demonstration on donning and removal of Level D PPE. Students perform a Level D dress out sequence and are evaluated by a Job Performance Measure.

6. Satellite Accumulation Areas
≈ 2 hours

a. Purpose of hazardous waste satellite accumulation areas (proper accumulation of hazardous waste to protect human health and the environment)
b. Key elements of satellite accumulation areas including maintenance of containers, labelling, maximum quantities allowed, and transfers to storage area
c. Inspection criteria including aisle space, stacking of containers, closing of containers, labelling requirements, containment structures, housekeeping, warning signs, alarms, fire extinguisher, spill control materials, and ignition sources

7. Decontamination
≈ 2 hours

a. Purpose of decontamination (prevent the spreading of contamination, prevention of exposure to workers, protection of the environment)
b. Causes and prevention of worker contamination
c. Decontamination planning including methods for decontaminating
d. Layout of decontamination stations
e. Emergency decontamination procedures

All times are approximate and do not reflect time spent on additional topics that arise due to class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HWW-102 - Hazardous Waste Worker Refresher

DURATION: 8 hours

PREREQUISITES: HWW-101, current completion of SAF630/SAF631

SCOPE: This course reviews precautions for safe handling and use of a hazardous material and the management of any hazardous waste generated during the these activities. This is accomplished by reviewing the concepts presented in HWW-101 and the application to a particular hazardous material by the use of a Material Safety Data Sheet (MSDS). Also included in this course is an overview of mixed waste.

TYPE: Classroom and Practical

COURSE DESCRIPTION (by lesson)

1. Material or Waste Information
   ≈ 2 hours
   a. Definition of TRU mixed waste
   b. Emergency actions in the event of a spill or leaking or punctured container of TRU mixed waste
   c. This module describes the information found in the supplier information section of a Material Safety Data Sheet (MSDS)
   d. This information is used in the event the user of the material needs more information than what is included in the particular MSDS
   e. Information
      1. This module describes the product's individual ingredients, relative concentration, and the exposure limit for each ingredient
   f. Physical/Chemical Data
      1. This module describes the chemical and physical properties of the material including; boiling point, specific gravity, melting point, vapor pressure, vapor density, evaporation rate, solubility, pH, and volatility

2. Hazard Data
≈ 2 hours

a. This module describes the fire and explosion hazards of the particular material including; flash point, lower explosive limit, upper explosive limit, auto-ignition temperature, NFPA 704M Hazard Classification Rating, fire extinguishing media, special fire fighting procedures, unusual fire and explosion hazards, toxic gases produced, and explosion data

b. Reactive Data Module
   1. This module describes the material's reactivity characteristics including stability, incompatibility, decomposition, and polymerization

c. Health Hazards Data Module
   1. This module describes the different ways the user may be exposed to the material and the adverse effects the material may have on the body including; lethal dose 50% (LD_{50}), lethal concentration 50 % (LC_{50}), target organ effects, carcinogenicity, acute and chronic effects, and emergency first aid procedures

3. Safety
≈ 2 hours

a. This module describes the precautions for the safe handling of the material including steps to take in the event the material is spilled, waste disposal method (EPA hazardous waste numbers), regulatory requirements (SARA Title III hazard categories/lists and CERCLA Hazardous Substance classification), labeling of containers, protective equipment, and site specific requirements

b. Control Measures Module
   1. This module describes safety control measures to take when using the material

including respiratory protection, ventilation requirements, work/hygiene practices and site specific requirements

c. Personal Protective Equipment Module

1. This module describes the purpose of personal protective equipment (PPE), the categories of protection, EPA Levels of Protection (A,B,C,D), PPE material and chemical resistance. In this module the donning and doffing of Level D PPE is demonstrated. The students are given an opportunity to practice and then are evaluated by completion of a Job Performance Measure.

4. Demonstration ≈ 1 hour

a. The effects the hazardous material has on various types of PPE material (degradation, permeation, and penetration effects), other common materials and neutralization effects are demonstrated

All times are approximate and do not reflect additional time spent on topics that arise due to class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HWR-101 Hazardous Waste Responder

DURATION: 20 hours

PREREQUISITES: GET-19X
Medical Physical
SAF 630/631- Respiratory Protection
HWW 101 - Hazardous Waste Worker

SCOPE: The instructor will present updated information needed for personnel who respond to hazardous material and/or hazardous waste emergencies at the WIPP site.

TYPE: Classroom and Field Exam

OBJECTIVE: Upon completion of this course, the student will be able to respond to hazardous materials emergencies at the WIPP site

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the post course examination, satisfactory performance on the job performance measure for donning and doffing level a PPE, and successfully participate as a team in the final practical

REFRESHER: HWR-101A Annually

COURSE DESCRIPTION (by lesson)

1.	Regulatory Requirements ≈ 1 hour	a.	29 CFR 1910.120(p)(8)(iii)(A)
2.	Evaluation of Incident ≈ 3 hours	a.	Physical data
	A. (Types of Information)		1. color
			2. odor
			3. sound
		b.	Cognitive
		c.	Technical
	B. Dispatch and Initial Response Phase	a.	Primary focus information
		b.	CMR information
		c.	During a response
	C. Product Information	a.	Product identification
		b.	Primary and secondary hazards
	D. Incident Elements	a.	Spill
		b.	Leak
		c.	Fire

E. Incident Priorities

3. Response Operations
≈1 hour

A. Size-up, Strategy, and Tactics

a. Size-up
1. Monitoring atmospheric conditions near the release
   a. Weather conditions
   b. Organic vapors, gases, particulates
   c. Oxygen deficiency
   d. Specific materials
   e. Combustible gases
   f. Inorganic vapors, gases, particulates
   g. Radiation
2. Visual observations
3. Unusual odors
4. Off-site samples
5. Entry team procedures
   a. Monitoring on-site ambient air
   b. Types of containers and impoundments
   c. Physical condition of material
   d. Leaks or discharges
   e. Labels and markings
6. Additional considerations
   a. Type, condition, and behavior of container
   b. Resources and control measures
7. Summary of size-up

b. Strategy and tactics
1. Definitions
2. Strategy
3. Tactics
4. Rescue
5. Prevent container failure
6. Containment
7. Confinement
8. Remove ignition sources
9. Extinguish fires
10. Tactical withdrawal

B. Incident Command System and Mitigation Plan at the WIPP
≈1 hour

a. Key elements required
b. Key personnel and functions
1. Incident commander

2. Science officer
3. Safety officer
4. Records keeper
5. Medical officer
6. Resource officer
7. Operations officer

c. Implementing response operations
1. Organize
2. Evaluate the situation
3. Develop a plan of action

4. Safety
≈5 hours

A. Responder Protection
a. Pre-entry evaluation
b. Deny entry
c. Hydration
d. Pre-entry briefing
e. Post-exit evaluation
f. Support location
g. Environmental temperature monitoring

B. Personal Protective Equipment
a. Selection of appropriate PPE
1. Levels
a. Level A
b. Level B
c. Level C
d. Level D
2. Optional equipment
3. Manufacturer recommendations/testing
a. Gloves

C. Donning and Doffing Level A PPE

D. Job Performance Measures
a. Students will Don and Doff Level A PPE with a partner

E. Decontamination

F. Emergency Medical Services

5. Table-top Drill
≈2 hours

6. Course Review

7. Written Examination

8. Practical
   ≈5 hours

a. Objective
b. Demonstration
c. Equipment needed
d. Have students develop Incident Commander and System
e. Evaluation

All times are approximate and do not reflect time spent on additional topics that arise due to class participation, student breaks, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HWR-101A, Hazardous Waste Responder, Refresher

DURATION: ≈8 hours

PREREQUISITES: HWR-101

OBJECTIVES: Upon Completion of this course, the student will be able to respond to hazardous materials emergencies at the WIPP site.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the post course examination, satisfactory performance on the job performance measure for donning and doffing level a PPE, and successfully participate as a team in the final practical

REFRESHER: Annually

COURSE DESCRIPTION (by module)

1. Review of HWR-101
   ≈2 hours

2. Changes in Regulations, procedures, and polices
   ≈2 hours

3. Lessons Learned
   ≈2 hours

4. Conclusion and Exam
   ≈2 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size and/or practical exercises (i.e., Job Performance Measures)

COURSE: HWS-101 Hazardous Waste Worker Supervisor

DURATION: ≈8 hours

SCOPE: This course will provide the students with the knowledge necessary to identify factors affecting individual and corporate liability under applicable hazardous waste laws and regulations. Students will be able to state the stages of criminal and civil litigation, identify the types of behavior that leads to criminal prosecution, and identify appropriate actions to ensure compliance with applicable hazardous waste operations.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student shall be able to perform supervisory functions in compliance with policies, procedures, and regulations, with regard to hazardous waste management.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: HWS 101A annually

COURSE DESCRIPTION (by lesson)

1. Liability and Responsibility
   ≈3 hours
   a. General requirements
   b. Definitions and key liability concepts
   c. Mental element in criminal litigation
   d. Typical litigation chronology
   e. Civil and criminal penalties under OSHA
   f. Criminal penalties under environmental laws
   g. Federal sentencing guidelines
   h. Mitigation credit under Federal Sentencing Guidelines
   i. Who will be defendants
      1. Direct involvement
      2. Direct supervisory involvement
      3. Indirect involvement and Responsible Corporate Officer doctrine
   j. Representation
   k. Indemnification
   l. Scope of employment
   m. Types of criminal cases being pursued

n. Recommended actions
o. Illustrative cases
   1. Knowledge
   2. Sovereignty
   3. Multiple prosecutions
   4. Pervasiveness of liability
   5. Potential for catastrophic corporate consequences
p. Conclusions

2. Health and Safety Program ≈3 hours
   a. Purpose
   b. Authority
   c. Supervisor responsibilities
      1. Hazard control
      2. Hazardous waste management
      3. Hazardous materials management
         a. Training
         b. Storage and handling
         c. Labeling containers
         d. General precautions and practices
   d. Personal protective equipment

   A. Industrial Hygiene
      a. Exposure limits
      b. Conversion and comparison of PPM

   B. Spill Containment (Emergency Response)
      a. Spill response plan

   C. Site Control
      a. Zoning

   D. Decontamination

   E. Reporting Requirements

3. Conclusion ≈1 hour

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e. Job Performance Measures)

COURSE: HWS-101A Hazardous Waste Worker Supervisor-Refresher

DURATION: ≈8 Hours

PREREQUISITES: HWS-101

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to perform supervisory functions in compliance with policies, procedures, and regulations with regard to hazardous waste management

Mastery of the terminal objective will be demonstrated by scoring 80% or higher on the course examination.

REFRESHER: Annually

COURSE DESCRIPTION (by lesson)

1. Review of HWS-101
   ≈2 hours
   a. Liability and Responsibility
   b. Health and Safety Program

2. Changes in regulations, procedures, policies
   ≈2 hours

3. Lessons Learned
   ≈2 hours

4. Conclusion and Exam
   ≈1 hour

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e. Job Performance Measures)

COURSE: SAF-630/631 Respiratory Protection

DURATION: ≈8 hours

PREREQUISITES: Medical physical

TYPE: Classroom and Practical

SCOPE: This program contains the requirements of respiratory protection as outlined in 29 CFR 1910.134, 10 CFR 20, ANSI, Z88.2-1980 and applicable WIPP procedures.

OBJECTIVE: Upon completion of this course the trainee will demonstrate a knowledge of the WIPP respiratory protection program; respiratory health hazards; and types of respiratory protection devices, their proper use and limitations.

Mastery of the terminal objective will be demonstrated by scoring 80% or higher on a closed book lesson examination.

COURSE DESCRIPTION (by lesson)

1. Introduction
   ≈2 hours
   - A. Basic Requirements
     - a. Regulations
     - b. DOE Orders
     - c. Industry Standards
     - d. Westinghouse
     - e. WIPP Procedures
       1. Physical exam
       2. Pulmonary test
       3. Training
       4. Fit Testing
       5. Identification of potential respirator activities
       6. Selection of Respirators
       7. Respirator usage, storage and sanitation
   - B. Nature, Extent, and Effects of Respiratory Hazards and the Need for Protection
     - a. Human Respiratory System
     - b. Respiratory Hazards
     - c. Contaminants (Identification)
       1. Physical Properties
       2. Chemical Properties
       3. Concentration
       4. Warning Properties
       5. MSDS

6. Toxicology
   a. Gases/Vapors
   b. Particulates

C. Engineering and Administrative Controls
   a. Hazard Control
      1. Engineering Controls
      2. Administrative Controls
   b. ALARA

2. Use of Respirators at WIPP
   ≈2 hours

A. Selection of Respirators
   a. Medical Verification
      1. Physical Exam
      2. Spirometer Testing
   b. Training
   c. Qualitative/Quantitative Fit Testing
   d. Selection Factors
      1. User Acceptance
      2. Psychological/Physiological Complications

B. Air Purifying Respirators
   a. Operation
   b. Limitations/Capabilities
      1. Particulate Air Filters
      2. Chemical Cartridge Respirators

C. Atmosphere Supplying Respirators
   a. Operation
   b. Limitations/Capabilities

D. Respirator Cleaning/Storage
   a. Cleaning Frequency
   b. Maintenance
   c. Storage

E. Respiratory Emergencies
   a. Actions for Air Purifying Respirators
   b. Self Contained Breathing Apparatus (SCBA) Emergency Actions
      1. Buddy System
      2. Regulator Failure
      3. Insufficient Air Flow
      4. Hyperventilation

3. Practical Session
   ≈2 hours
   a. Half-Facepiece, Air Purifying Regulators
      1. Types
      2. Mode of Operation
      3. Protection Factors

4. Inspection
5. Donning
6. Qualitative Test
7. Cartridge Type
8. Removal

b. Full Facepiece, Air Purifying Regulator
1. Types
2. Mode of Operation
3. Protection Factor
4. Inspection
5. Donning
6. Qualitative Test
7. Removal

c. Full Facepiece, SCBA
1. Types
2. Mode of Operation
3. Protection Factor
4. Inspection
5. Donning
6. Qualitative Test
7. Removal

All time are approximate and do not reflect time spent on additional topics that arise due to class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-515 - Confined Space/Heated Environment

DURATION: ≈ 12 hours

PREREQUISITES: GET-19X initial training
Medical physical
SAF-630/631 Respiratory Protection
Current OPS-08 Qual Card

SCOPE: The instructor will present hazards, personal protective equipment requirements, emergency action, and compliance with regulatory and WIPP procedures involving confined space/heated environment. Students will learn emergency retrieval techniques for removal of personnel from confined spaces.

Students will enter a simulated confined space using Personal Protective Equipment (PPE)

TYPE: Classroom and practical

OBJECTIVES: Upon completion of this course, the student will be able to state the requirements for entry into confined spaces, identify hazards which may exist, provide proper monitoring of the environmental conditions of spaces, and provide proper emergency response actions involving employees in distress.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: SAF-515A Annually

COURSE: SAF-515A - Confined Space/Heated Environment Refresher

DURATION: 6 Hours

PREREQUISITES: SAF-515 - Confined Space Initial Training
SAF-630 - Respiratory Protection
Current OPS-08 Qual Card

SCOPE: The instructor will present hazards, personal protective equipment requirements, emergency action, and compliance with regulatory and WIPP procedures involving confined space/heated environment. The course will also review several confined space fatalities lessons learned.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to describe the WIPP's Confined Space and Heated Environment Program

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination

REFRESHER: Annually

COURSE: RAD-101 Radiological Worker I

DURATION: ≈ 16 hours

PREREQUISITES: Written permission of the Radiological Control Manager

SCOPE: The instructor will present radiological theory and practical information necessary to allow unescorted entry into a controlled area, radioactive materials area, radiological buffer area, and radiation area as required by the DOE Radiological Control Manual.

TYPE: Classroom And Practical

OBJECTIVES: Upon completion of this course, the student will have the knowledge to work safely in areas controlled for radiological purposes.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination.

Completion of the course meets the training requirements necessary for Radiological Worker -I (RWT-I).

REFRESHER: Retraining every two years with an alternate year refresher.

COURSE DESCRIPTION (by lesson)

1. Radiological Fundamentals
   ≈ 2 hours
   - a. Introduction
     1. DOE Safety Policy
     2. Course Overview
     3. Radiological Worker (core academics)
        - a. Radiological Worker II (RW II) training
        - b. Course outline
        - c. Successful completion
   - b. Atomic Structure
     1. Basic Units of Matter
        - a. Protons
        - b. Neutrons
        - c. Electrons
     2. Stable and Unstable atoms
     3. Charge of the atom
   - c. Definitions
     1. Ionization
     2. Ionizing radiation
     3. Non-ionizing radiation
     4. Radioactivity

5. Radioactive material
6. Radioactive Contamination
7. Radioactive decay
8. Radioactive half-life

d. Four Basic Types of Ionizing Radiation
   1. Alpha particles
      a. Physical characteristics
      b. Range
      c. Shielding
      d. Biological hazard
      e. Sources
   2. Beta particles
      a. Physical characteristics
      b. Range
      c. Shielding
      d. Biological hazard
      e. Sources
   3. Gamma rays/x rays
      a. Physical characteristics
      b. Range
      c. Shielding
      d. Biological hazard
      e. Sources
   4. Neutron particles
      a. Physical characteristics
      b. Range
      c. Shielding
      d. Biological hazard
      e. Sources

e. Units of Measure
   1. Radiation
      a. Roentgen
      b. RAD (Radiation Absorbed Dose)
      c. Rem (Roentgen Equivalent Man)
      d. Radiation dose and dose rate
   2. Contamination/Radioactivity

f. 10 CFR Part 835, "Occupational Radiation Protection"

2. Biological Effects
   ≈ 1 hour

a. Introduction

b. Sources of Radiation
   1. Natural sources
      a. Cosmic radiation
      b. Sources in earth's crust (terrestrial)

c. Internal
d. Radon

2. Man-made sources
   a. Medical radiation sources
      1. X-rays
      2. Diagnosis and therapy
   b. Atmospheric testing of nuclear weapons
   c. consumer products
   d. Industrial uses

c. Effects of Radiation on Cells
   1. Biological effects
   2. Cell sensitivity
   3. Possible effects of radiation on cells
      a. No damage
      b. Cells repair damage and operate normally
      c. Cells are damaged and operate abnormally
      d. Cells die as a result of damage

d. Acute and Chronic Radiation Dose
   1. Acute radiation doses
   2. Chronic radiation doses
   3. Genetic effects
   4. Factors affecting biological damage due to exposure to radiation
      a. Total dose
      b. Dose rate
      c. Types of radiation
      d. Area of the body which receives a dose
      e. Cell sensitivity
      f. Individual sensitivity

e. Prenatal Radiation Exposure
   1. Sensitivity to the unborn
   2. Potential effects associated with prenatal exposures

f. Risks in Perspective
   1. Risk from exposures to ionizing radiation
   2. Comparison or risks

g. Summary

3. Radiation Limits
≈ 1 hour

a. Basis and Purposes for Radiation Dose Limits and Administrative Control levels for radiological workers
   1. Bases for DOE dose limits
   2. WIPP administrative control levels
b. Dose Limits and Administrative
   1. Whole body Control Levels
      a. Definition
      b. Limit and control levels
   2. Extremities
      a. Definition
      b. Limit and control levels
   3. Skin and other organs
      a. Definition
      b. Limit and control levels
   4. Lens of the eye
      a. Definition
      b. Limit and control levels
   5. Declared pregnant worker: Embryo/fetus
      a. DOE policy
      b. DOE limit
      c. Site policy
      d. WIPP administrative control level
   6. Visitors and public
c. Worker Responsibilities Regarding Dose Limits
d. Summary

4. ALARA Program
≈ 1 hour

a. ALARA Program
   1. ALARA Concept
   2. DOE Management Policy for the ALARA program
   3. Site policy
b. Responsibilities for the ALARA
   1. Management Program
   2. Radiological control organization
   3. Radiological workers
c. External and internal radiation
   1. Basic protective measures used to Dose Reduction reduce external doses
      a. Time
      b. Distance
      c. Shielding

2. Additional methods to reduce dose
3. Lessons learned

d. Internal Radiation Dose Reduction
   1. Pathways
      a. Inhalation
      b. Ingestion
      c. Absorption through the skin
      d. Absorption through wounds
   2. Methods to reduce internal radiation dose

e. Radioactive Waste Minimization
   1. Methods to minimize radioactive waste
   2. Separate radioactive waste from nonradioactive waste
   3. Separate compactable material from noncompactable material
   4. Minimize the amount of waste generated
   5. Use good housekeeping techniques

f. Summary

g. Evaluation

5. Personnel Monitoring Programs ≈ 1 hour

a. External Dosimetry
   1. Thermoluminescent dosimeters
   2. Direct reading dosimeters
   3. Alarming dosimeters
   4. Worker responsibility for external dosimetry

b. External Monitoring

c. Worker Dose Records

d. Summary

e. Evaluation

6. Radiological Postings and Controls ≈ 2 hours

a. Radiological Work Permits
   1. Use
   2. Types
      a. General radiological work permit
      b. Job specific radiological work permit
   3. Information to be included on the permit

4. Worker responsibilities

b. Radiological postings
   1. Uses
   2. Requirements
   3. Responsibilities of the worker associated with postings, signs, and labels
   4. Consequences of disregarding radiological postings, signs, and labels
   5. Requirements for entry, exit, and area working in radiologically posted areas

c. Radiological areas
   1. Radiological buffer areas
      a. Posting requirements
      b. Minimum requirements for unescorted entry
      c. Requirements for working in RBA's
      d. Requirements for exit
   2. Radiation areas
      a. Posting requirements
      b. Minimum requirements for unescorted entry
      c. Requirements for working in area
      d. Requirements for exit
   3. Contamination areas
      a. Posting requirements
      b. Require special training
   4. High contamination areas
      a. Posting requirements
      b. Require special training
   5. Airborne radioactivity areas
      a. Posting requirements
      b. Require special training
   6. Radioactive materials areas
      a. Posting requirements
      b. Minimum requirements for unescorted entry
      c. Requirements for working in area
      d. Requirements for exit
   7. Fixed contamination area
      a. Posting requirements

		b. Contact radiological control for entry requirements
		8. Soil contamination area
		a. Posting requirements
		b. contact radiological control for entry requirements
		9. Underground radioactive materials area
		a. Posting requirements
		b. General requirements
		10. Hot spots
		a. Posting requirements
		d. Summary
6.	Radiological Emergencies ≈ 1 hour	a. Emergency alarms and responses
		1. Area radiation monitors (ARMs)
		2. Continuous Airborne Monitors (CAMs)
		b. Disregard for radiological alarms
		c. Radiological emergency situations
		d. Considerations in Rescue and Recovery Operations
		e. Summary
7.	High/very High Radiation Area Training ≈ 1 hour	a. Definitions
		1. High radiation area
		2. Very high radiation area
		b. Signs and postings
		c. General entry, work, exit
		1. Entry requirements
		2. Working requirements
		3. Exit requirements
		d. Access controls
		1. Administrative controls
		2. Physical controls
		3. Consequences for violating radiological signs or postings or bypassing physical access controls
		e. Response to area radiation alarms and unusual conditions
		f. Considerations in Rescue and Recovery Operations
		g. Summary

8. Written Examination and Review
   ≈ 1 hour

9. JPM Review and JPM Evaluations
   ≈ 4 hours

All times are approximate and do not reflect time spent on additional topics that arise from class participation, student breaks, class size and/or practical exercises. (i.e. Job Performance Measures)

COURSE: RAD-201 Radiological Worker II

DURATION: ≈ 8 hours

PREREQUISITES: Written permission of the Radiological Control Manager

Respiratory Protection (SAF 630/SAF 631)
Radiological Worker I (RAD 101)

SCOPE: The instructor will present an intensive course intended for the radiological workers whose job assignments involve unescorted entry to high and very high radiation areas, contamination areas, high contamination areas, and airborne activity areas.

TYPE: Classroom And Practical

OBJECTIVES: Demonstrate the ability to work safely in radiologically controlled areas, use ALARA techniques in accordance with WIPP radiation protection procedures

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination

REFRESHER: Retraining every two years with an alternate year refresher

COURSE DESCRIPTION (by lesson)

1. Radioactive Contamination
   ≈ 3 hours
   a. Plutonium
   b. Comparison of ionizing radiation
      1. Ionizing radiation and radioactive contamination
      2. Radioactive contamination
      3. Radiation is energy, contamination is material
   c. Types of contamination
   d. Sources of radioactive contamination
      1. Sources
      2. Indicators of possible area contamination
      3. Employee response to a spill
   e. Contamination control methods
      1. Preventable methods
      2. Engineering control methods
      3. Personal protective measures
         a. Protective clothing
   f. Contamination monitoring equipment

1. Purpose
2. Types and uses
3. Frisking

g. Decontamination
1. Personnel decontamination
2. Material decontamination
a. General considerations
b. Methods available
c. Techniques

h. Contamination control requirements
1. Posting requirements
2. Requirements for entering
3. Donning double PC's
4. Exit requirements
5. Method for removing items from contamination areas

i. Unusual events involving radioactive materials
1. Unusual events
2. Use of the incident command system
3. Actions of emergency responders
4. Response techniques

j. Identification of radiation hazards
1. Placards
2. Labels
3. Shipping papers

k. Field operation protocol for radiation accidents

2. Practical Examination and review
≈ 1 hour

3. JPM Review and JPM Evaluations
≈ 4 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: TRG-293/298 Subject Matter Expert and On-the-job Training

DURATION: ≈ 4 hours

PREREQUISITES: Manager Approval

TYPE: Classroom

SCOPE: The instructor will provide the training skills and knowledge necessary to perform the role of subject matter expert (SME)/on-the-job trainer (OJT).

OBJECTIVE: Upon completion of this course the student will be able to perform the instructional duties of a Level I Instructor (SME/OJT trainer) In compliance with WIPP training policies.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: Biannual

COURSE DESCRIPTION (by lesson)

1. Requirements for Certification
   ≈ .5 hour
   a. Qualification card
   b. Designation letter to training
   c. Training course
   d. SME Certification Board
   e. Arranging the SME Board
   f. Conduct of the Board
   g. Maintaining certification
   h. Lapses in certification

2. Role of the Level I Instructor
   ≈ 1 hour
   a. Conduct formal OJT
   b. Develop/revise qualification cards
   c. Maintaining files related to area of expertise
   d. Limitations of Level I Instructors

3. On-The-Job (OJT) Training
   ≈ 1 hour
   a. Definition
   b. Formal training vs. informal training
   c. Process for OJT
      1. Introduction phase
      2. Explanation phase
      3. Knowledge evaluation phase
      4. Demonstration phase
      5. Practice phase
      6. Practical evaluation phase
      7. Rules

d. Trainee failures or slow learners
e. Good OJT practices
f. Common OJT instructor errors

4. Qualification Cards
≈ 1 hour

a. Purpose
b. Elements
c. Writing competency statements
d. Selecting competency statements for requalification
e. Reviewing qualification cards

5. Qualification Guide
≈ .5

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: TRG-300 Classroom Instructor - Level II

DURATION: ≈40 hours

PREREQUISITES: Manager's approval

SCOPE: The Instructor will present the student with the information and skills necessary to develop and preform classroom instruction based on DOE guideline "Good Practice For Training And Qualification of Instructors" DOE-NE-STD-100-91.

TYPE: Classroom and Practical

OBJECTIVES: Upon completion of this course the student will be able to develop, conduct, and document formal classroom training in compliance with current WIPP training policies.

Mastery of the terminal objective will be demonstrated by satisfactory performance on all practical sessions and maintaining 80 percent or higher for an overall course Average. No score less than 70 percent may be scored on any daily examination.

REFRESHER: TRG-292 Every six months

COURSE DESCRIPTION (by lesson)

1. Introduction
   ≈1 hour
   a. Course title
   b. Course terminal objective
      1. Part I
      2. Part II
   c. Course topics
      1. Qualities of a competent instructor
      2. Adult learning principles
      3. PBT
      4. Training sections
      5. Learning objectives
      6. Test development
      7. Development of lesson plans
      8. Use of instructional aids
      9. Presentation and facilitation skills
      10. Effective questioning techniques
      11. Behavioral problems
      12. Demonstration method
      13. Evaluations
      14. Administration
      15. Final practical examination

		a. Subject choices b. Time limit c. Requirements in the lecture d. Evaluation method e. Video taped
		d. Summary
2. Competencies of a Competent Instructor ≈ 1 hour		a. Motivator b. Role of the Instructor c. Role of the Level II Instructor 1. Develop instructional materials 2. Conduct formal classroom instruction in their technical area 3. Administer examinations 4. Document formal training d. Reasons for Qualified Instructors e. Categories of Instructor Qualities f. Qualities of competent instructor g. Common pitfalls to an instructor's success h. Summary
3. Adult Learning Principles ≈ 2 hours		a. Motivator b. Learning defined 1. Learning based on experience 2. Learning as an experience retained by the learner and produces a measurable change in behavior 3. How change can occur 4. Categories of learning c. Learning style d. Instructor learning principles 1. Learning principles and information processing 2. Learning principle equals motivation 3. Learning principle equals digestible chunks 4. Learning principle equals experience 5. Learning principle equals attention 6. Learning principle equals reinforcement

7. Learning principle equals retention
8. Learning principle equals retrieval
9. Learning principle equals transfer
10. Summarize concepts

e. Adults as Learners
1. Four adult learning principles
2. Concept of the learner
3. Role of experience
4. Readiness to learn
5. Orientation to learning
6. Internal summary

f. Barriers to learning in adults
1. Physical barriers
2. Emotional barriers
3. Intellectual barriers
4. Learning style barriers

g. Summary

4. Overview of PBT/TAP
≈ 1 hour

a. Motivator
b. Performance Based Training
1. Definition
c. Five Phases of PBT System
1. Analysis
2. Design
3. Development
4. Implementation
5. Evaluation
d. Reasons for using the PBT process
e. Definitions of five phases
1. Analysis
a. Purpose
b. Process/products
1. Job analysis
2. Task analysis
2. Design
a. Purpose
b. Process/products
3. Development
a. Purpose
b. Process/products
4. Implementation
a. Purpose
b. Process/products
5. Evaluation
a. Purpose
b. Process/products

f. DOE Order
   1. DOE Order 5480.18
h. Summary

5. Methods of Instruction
   ≈ 1 hour

a. Motivator
b. Training sessions
   1. Definition
   2. Training sessions common to DOE
   3. Classroom setting
   4. On-the-Job
   5. Laboratory setting
   6. Self-paced instruction setting
   7. Simulator setting
c. Setting selection criteria
   1. Setting criteria
d. Training methods
   1. Lecture
   2. Discussion
   3. Role-play
   4. Self-study
   5. Walk-through
   6. Case study
e. Summary

6. Development of Learning Objectives
   ≈ 1 hour

a. Motivator
b. Definition of learning objective
   1. Definition
   2. Why write objectives
   3. When to write objectives
   4. Basic assumptions
c. Component parts of learning objectives
   1. Action statement
   2. Conditions
   3. Standard
   4. Implied conditions and standards
d. Definition of Terminal Objective
   1. Definition
   2. First sentence
   3. Second sentence
e. Source of Information for Terminal Objectives
f. Definition of Enabling Objective
   1. Definition
g. Information source for enabling objectives
h. Exercise

1. Terminal objective
2. Enabling objective

i. Summary

7. Methods of Testing
≈2 hours

a. Motivator
b. Purpose of testing
   1. Purpose of testing
   2. Selection and placement
   3. Feedback to trainers and trainees
   4. Motivation
   5. Improvement to training programs
c. When are tests developed?
   1. Analysis phase
   2. Design phase
      a. Training settings
      b. Learning objectives
      c. Entry-level skills
      d. Design
      e. Written tests
      f. Oral tests
   3. Development phase
   4. Implementation phase
   5. Evaluation phase
d. Guidelines for question development
   1. Approved test question formats at the WIPP
      a. True/false
      b. Multiple choice
      c. Matching
      d. Completion/short answer
      e. Draw/label
   2. General guidelines
   3. True/false format
   4. Multiple choice
   5. Matching
   6. Completion/short answer
   7. Draw/label
e. Approved examination format
   1. Two items per objective
   2. Meet the intent of the objective
   3. Use acceptable format
f. Examination format
   1. Version vs. multiple exam
   2. Required formats

3. Approval
g. Control of examinations
1. Examination preparation
2. Administering the examination
3. Grading examination
h. Examination failure
i. Summary

8. Developing Lesson Plans
≈ 2 hours

a. Motivator
b. Function of a Lesson Plan
1. Defined as TAP
2. Accomplish objective
3. Promote consistency
4. Serve as guide
c. Elements of Lesson Plan format
1. Cover page
2. Instructor pages
d. Definition of "Introduction"
1. Goal of introduction
2. Preliminaries
a. Instructor name and background
b. Lesson title
c. Trainee comfort
d. Solicit participation for questions and comments
3. Learning objectives
4. Overview
e. Development of the Body
1. Outline content
2. Topics sequence
3. Detail of content
f. Definition of Summary
g. Summary

9. Development of Instructional Aids
≈ 2 hours

a. Motivator
b. Definition of instructional aid
c. Purpose of instructional aids
d. General guidelines for instructional aids
1. Design and development guidelines
2. Utilization guidelines
e. Guidelines for the use of visual aids
f. Writing boards (white and chalk)
1. Introduction

2. Development tips
3. Utilization tips

g. Flip charts
1. Introduction
2. Development tips
3. Utilization tips

h. Overhead transparencies
1. Introduction
2. Development tips
3. Utilization tips

i. Handout materials and study guides/workbooks
1. Introduction
2. Purpose
3. Development tips
4. Utilization tips

j. Videos/films
1. Introduction
2. Development tips
3. Introduce video
4. Utilization tips

k. Training aids
1. Transition
2. Types of training aids
3. Purpose

l. Consideration for selecting training aids

m. Summary

10. Use of Presentation and Facilitation Skills ≈ 2 hours

a. Motivator
b. Understanding speaking fears
c. Presentation skills
1. Personal space
2. Body movements/ gestures/eye contact/voice
3. Exercise

d. Communications model
e. Facilitation skills
1. Transition
2. Attending skills
3. Observing skills
a. Exercise
4. Listening skills

f. Summary

11. Effective Questioning Techniques ≈ 2 hours

a. Motivator
1. Why trainers do not ask questions
a. Control

b. Time
c. Discomfort for self and trainees
d. Other

b. Advantages of questioning
c. Characteristics of effective questions
d. Difference between comprehension and interaction questions
e. Types of questions
1. Overhead question
2. Rhetorical question
3. Direct question
4. Relay questions
5. Reverse question
6. Pointed question
7. Offensive question
f. Asking questions
g. Responding to answers
h. Summary

12. Handling Behavioral Problems
≈ 1 hour

a. Motivator
b. Characteristics of behavioral problems
1. Argumentative
2. Belligerent
3. Bored
4. Chronic questioner
5. Clown
6. Late to class
7. Monopolizer
8. Preoccupied
9. Shy
10. Slow learner
11. Superior learner
12. Exercise
c. Guidelines for determining
1. Determining need a personal conference
d. Guidelines for personal conference
1. Planning the conference
a. Presenting alternatives
b. Selecting the best solution from alternatives and develop the action plan
c. Follow-up review dates

2. Physical arrangement for the conference
3. Conducting the conference
4. Strategies for active listening

e. Methods for correcting behavioral problems

f. Summary

13. Use of Demonstration Methods
≈ 1 hour

a. Motivator
b. Purpose of the demonstration method
c. Effective areas of demonstration method
1. Concepts
2. Manipulative skills
3. Attitudes
4. Practice
d. Training aids
e. Advantages and disadvantages
1. Advantages
2. Disadvantages
f. Preparing for the lesson
g. Steps in the demonstration method
1. Introduction
2. Presentation
3. Practice
4. Summary
h. Actual presentation
i. Exercise
j. Summary

14. Purpose of Evaluations
≈ 1 hour

a. Motivator
b. Definition of evaluation
c. Purposes of evaluation
d. Sections of evaluation process
e. Evaluations performed
1. Trainee questionnaire
2. Post training survey (trainee)
3. Post training survey (supervisor)
4. Annual instructor observation form
f. Results of the evaluation
g. Summary

15. Training Administration
≈ 1 hour

a. Motivator
b. Course package
1. Lesson plan
2. Exam, quizzes, and JPM's

3. Trainee handouts
4. Overheads
5. Approval
   a. Training records
   b. Cognizant manager
   c. Training manager
   d. Material given back to instructor

c. Course preparation
   1. Lesson plan
   2. Exams and quizzes
   3. Trainee handouts
   4. Overheads
   5. Paperwork

d. Training attendance sheet

e. Post class activities

f. Summary

16. Final Practical
    ≈ 6 hours

17. Examinations
    ≈ 2 hours

18. Work Time
    ≈ 8 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: MED-101 First Aid and CPR

DURATION: 12 hours

PREREQUISITES: None

SCOPE: The instructor will provide basic life support training including one-rescuer CPR and the Heimlich maneuver.

TYPE: Classroom and CPR Practical

OBJECTIVES: Upon completion of this course, the student will be able to administer basic first aid and one-rescuer cpr in accordance with the national safety council. Identify heart disease factors, signs, and symptoms of a heart attack and perform one-rescuer cpr and the Heimlich maneuver.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination.

REFRESHER: MED 101A Annually

COURSE DESCRIPTION (by lesson)

1. Definitions and Legal Aspects
   ≈ 1 hour
   a. Duty to act
   b. Consent for treatment
   c. Abandonment
   d. Good Samaritan law
   e. Confidentiality

2. Assessment
   ≈ 1 hour
   a. Purpose
   b. Systematic approach considerations
   c. Parts
   d. Scene assessment
   e. Primary survey
   f. Secondary survey

3. Cardiopulmonary Resuscitation (CPR)
   ≈ 1 hour
   a. Anatomy of cardiovascular system
   b. Physiology of the heart
   c. Anatomy of the respiratory system
      1. Upper airway
      2. Lower airway
      3. Alveoli
      4. Pulmonary arteries, veins, capillaries

d. Physiology of the respiratory system
e. Heart disease

Treatment of Various Conditions
≈4 hours

4. Shock
   a. Hypovolemic shock
   b. Fainting
   c. Anaphylactic shock

5. Bleeding
   a. Types
   b. Control
   c. Treatment
   d. AIDS and HBV

6. Head Injury
   a. General information
   b. Scalp lacerations
   c. Skull fractures
   d. Spinal injuries
      1. Treatment

7. Burns
   a. Classifications
   b. Causes
   c. Treatment

9. Heat Related Injuries/Illnesses
   a. Types
      1. Heat cramps
         a. Treatment
      2. Heat exhaustion
         a. Signs and symptoms
         b. Treatment
      3. Heat stroke
         a. Signs and symptoms
         b. Treatment

10. Bone and Joint Injuries
    a. General information
    b. Signs and symptoms
    c. Treatment

11. Summary

12. Written examination

13. Practical
    ≈3 hours

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: MED-101A - First Aid and CPR Refresher

DURATION: ≈8 Hours

PREREQUISITES: The instructor will provide refresher training Basic CPR (one-rescuer) and basic first aid techniques

TYPE: Classroom and practical

OBJECTIVES: Upon completion of this course, the student will able to administer basic first aid and one-rescuer CPR

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination

REFRESHER: Annually

COURSE: HMT-102 Hazardous Materials and Waste Transportation

DURATION: ≈ 16 Hours

PREREQUISITES: Manager approval and/or assignment to transportation duties in accordance with 49 CFR

SCOPE: Instruction meeting 49 CFR Subpart H provided in a modular format. This course covers: awareness, the hazards material table, packaging, marking, labeling, placarding, material separation and segregation, special or unique transportation moves, safety, and site specific transportation issues.

TYPE: Classroom lecture including exercises to enhance trainee learning and retention

OBJECTIVES: Upon completion of the course, the trainee will be able to define, locate, apply and maintain compliance with the DOT regulations involving the transportation and/or offering for transportation of a hazardous material or waste.

Mastery of this objective will be demonstrated by scoring a minimum of 80 percent on the course examinations using "approved course" reference material.

REFRESHER: Bi-annually

COURSE DESCRIPTION (by lesson)

1. Awareness/familiarization
   ≈ 1 hour
   a. Introduction
      1. Instructor
      2. Lesson
      3. Course content
      4. Lesson objectives
   b. Lesson materials
      1. Department of Transportation (DOT) Regulations
         a. Brief history
         b. Purpose
         c. Scope
         d. Terminology
         e. Application of regulations
      2. Training programs
         a. Module assignments
            1. Basic modules
            2. Additional modules
   b. Training program objectives
   c. Training requirements

d. General transportation responsibility
e. General transportation liability
f. Potential exposures
    1. Number of shipments
    2. Events leading to exposures
    3. Causes for events
g. Compliance mandate
    1. Regulator responsibility
    2. Penalties
    3. Trends
h. DOE guidance
    1. DOE Orders
    2. Interaction of DOE Orders and Federal Regulations
i. Enforcement
j. Application of DOT Regulations at DOE facility
k. Introduction to Title 49 CFR
    1. Overview transportation regulations
    2. Navigating within the code book
l. Shippers acronym
m. Standardized DOT communications
n. Summary
o. Review
p. Questions and answer

2. The Hazardous Materials Table ≈3 hours

a. Introduction
b. Lesson body
    1. Lesson objectives
c. Shipper's Star
d. Definition
    1. Hazardous material
    2. Hazardous waste
    3. Hazardous substance
e. Hazard classes
    1. 9 classes
    2. Special cases
    3. Class system
    4. Identification
    5. Shipper's responsibility
    6. Material identification
f. The Hazardous Materials Table
    1. 10 columns
    2. Navigating the hazardous materials table
g. Summary

h. Review
i. Questions and answers

3. Packaging
≈ 1.5 hours

a. Introduction
   1. Lesson
b. Lesson body
   1. Lesson objectives
c. Terminology
   1. Packaging vs. package
      a. Packaging
      b. Package
d. Identifying packaging by code
   1. Recognition types
   2. Code interpretation for UN packaging
      a. Packaging type
      b. Packaging group
e. Limited quantity packing exemptions
   1. Describe "Limited Quantity"
   2. General criteria
f. Package Acceptance Criteria
   1. Acceptable packaging
   2. Unacceptable packaging
g. Summary
h. Review
i. Questions and answers

4. Marking
≈ 1.5 hours

a. Introduction
b. Lesson body
   1. Lesson objectives
   2. Purpose
   3. Material identification
      a. The PSN
      b. UN/UA number
      c. Shipments containing multiple materials
   4. Physical markings
      a. Location
      b. Marking format
      c. PIH
      d. Arrows
      e. Reportable quantities
      f. Consignor/consignee information
   5. Exemptions
c. Summary
d. Review
e. Questions and answers

5. Labeling
≈ 1.5 hours

a. Introduction
b. Lesson body
   1. Lesson objective
   2. Purpose
   3. Label selection
      a. HMT table
   4. General placement of labeling
   5. Primary vs. secondary labeling
      a. Primary label
      b. Secondary
   6. Specific labeling requirements
      a. Gas cylinders
      b. Alterative labeling
   7. Mixed shipment in one package
      a. Special requirements
   8. Combination package in one
      a. Special requirements of outer package
c. Summary
d. Review
e. Questions and answers

6. Shipping Papers
≈ 1.5 hours

a. Introduction
   1. Lesson
b. Lesson body
   1. Lesson objectives
c. Types of shipping documents
   1. Standard bill of lading
   2. Waste manifest
d. Basic components of a proper shipping paper
e. Specific shipping paper
   1. Shipper information
   2. Quantity of packages
   3. Hazardous materials
   4. Quantity of material
   5. Emergency response information
   6. Certification statement signature
f. Shipping paper format
g. Additional information

1. Hazardous and non-hazardous shipping paper
h. Emergency information
i. Summary
j. Review
k. Questions and answers

7. Placarding
≈ 1.5 hours

a. Introduction
b. Lesson material
c. Lesson objectives
d. Purpose
1. Hazardous material identification
2. Materials with certain exemptions
e. Application
1. Placards should not be used
2. Selection criteria
a. Table application
b. Aggregate gross weight
3. Authorized placards
a. Displaying requirements
b. Placard identification
f. Shipper's requirements
g. Other placards
1. Explosives
2. Residue
3. Spontaneously combustible
4. Organic peroxide
5. Harmful
6. Class 9
h. Displaying of subsidiary placards
1. Criteria
j. Displaying placards
1. Single trailer or bobtail type truck
2. Multiple trailers
k. Summary
l. Review
m. Questions and answers

8. Separation and Segregation
≈ 1 hour

a. Introduction
b. Lesson material
1. Lesson objectives
2. Purpose
c. The table
1. Layout
2. Symbols
d. Summary

e. Review
f. Questions and answers

9. Special and Unique Moves
≈ 1 hour

a. Introduction
b. Lesson material
   1. Lesson objectives
   2. Terminology
      a. Empty
      b. Residue
c. Treatment of "empty" shipments
d. Overpack and salvage drums
   1. Overpack drums
      a. Intended use
      b. Use requirements
   2. Salvage drums
      a. Intended use
      b. Package requirements
e. Shipment of samples
   1. Material identification
   2. Unknown material
f. Summary
g. Review
h. Questions and answers

10. Safety
≈ 1 hour

a. Introduction
b. Lesson material
   1. Lesson objectives
   2. Emergency response information
      a. Transportation
      b. Resources
c. Emergency Response Guide
   1. Purpose
   2. Emergency Response Guidebook layout and overview
d. Using the emergency
   1. Locate chemical identity in Response Guidebook
   2. Review concerns and response recommendations
e. Potential risk and actions
   1. Risk
   2. Actions
f. Response principles
   1. "Never"
   2. Consider
g. Documentation
   1. DOT Form F5800.1

		2. When to document
	h.	Summary
	i.	Review
	j.	Questions and answers
11. Site Specific Transportation ≈ 1 hour	a.	Introduction
	b.	Lesson material
		1. Lesson objectives
		2. Department/sect/individual
		a. Employee involvement for shipment from the WIPP
		b. Material control
		c Procurement
		d. Health physics
		e. Hazardous waste operations (HWO)
	c.	The shipping process
	d.	Additional information requirements by HWO
	e.	Hazardous waste shipments
	f.	Summary
	g.	Review
	h.	Questions and answers

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: HMT-104 DOT Emergency Response Information

DURATION: ≈ 3 hours

PREREQUISITES: None

SCOPE: This course is designed for central monitoring room operators and facility operations personnel involved with providing emergency response information for hazardous materials shipments from the WIPP. Subjects covered are in accordance with DOT regulations for emergency response information 49 CFR 172.600 through 172.604.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to respond to a request for emergency information from off-site emergency personnel in the event of an incident with an off-site shipment of hazardous material in accordance with 49 CFR 172.600.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: None

COURSE DESCRIPTION (by lesson)

1. Regulations ≈ .5 hour
   a. Emergency response information
   b. Applicability
   c. Availability

2. Logistics of an Emergency Response ≈ 2.5 hours
   a. Central Monitoring Room Operator response to a request for emergency
      1. Request received at CMR
      2. Requestor need further information
   b. Organization of Emergency Response Guidebook
      1. By placard
      2. By shipping papers
      3. By package hazardous waste label
      4. Highlighted entries
      5. No available reference Information

c. Log entries
d. Summary

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-501 Inexperienced Miner Training

DURATION: 40 Hours

PREREQUISITES: None (Steel-toe shoes/boots required for underground tour)

SCOPE: The instructor will present the required information to allow unescorted underground access

OBJECTIVES: Fulfill all requirements of 30 CFR part 48 for underground access.

Mastery of the terminal objective will be demonstrated by satisfactory performance on all practical sessions and by averaging 80 percent or higher on the daily exams with no score less than 70 percent.

REFRESHER: SAF-502 Annually

COURSE DESCRIPTION (by lesson)

1. Introduction
   ≈.5 hour
   a. Paperwork
   b. Course attendance
      1. Required attendance
      2. Special instructions
   c. Overview of the WIPP Underground Operations
      1. Similarity to other mining operations
         a. Potash mining
      2. Differences to other mining operations
         a. Potash mining
         b. Coal mining
   d. Summary

2. Act of 1977
   ≈1 hour
   a. Creation of the Federal Mine Safety and Health Act of 1977
      1. Congressional Act
   b. Purpose
   c. Coverage under the Act of 1977
      1. Mandatory safety and health standards
      2. Inspection rights
      3. Accident investigations
      4. Record keeping
      5. Guidelines for correcting dangerous conditions
      6. Mandatory posing of violations and warnings
      7. Required training

		d. Summary
3. Miner's Representative ≈ 1 hour		a. Definition
		b. The miner's representative under the Act of 1977
		c. The miner's representative system at WIPP
		d. Protection of the employee
		e. Need for employee participation in the inspection of the site
		f. Summary
4. Reporting of Hazards ≈ .5 hour		a. Hazards
		b. Reporting of hazards
		1. Responsibilities
		a. Miner operator
		b. Supervisor
		c. Employee
		c. Method of reporting
		1. Potential minor hazard
		2. Hazards involving possible imminent dangers
		d. Disciplinary actions and the employee
		e. Need for employee involvement
		f. Summary
5. Lines of Authority ≈ .5 hour		a. WIPP organization
		1. Department of Energy
		2. Westinghouse Electric Corporation
		3. Management of the underground
		b. Hazard reporting lines of authority
		1. General safety issues
		a. Organization
		b. Reporting procedures
		2. Imminent danger issues
		c. Summary
6. Self-Rescuer ≈ 1 hour		a. Purpose
		b. Service life
		c. Inspection
		d. Mine operator quarterly inspection
		e. The self-rescuer
		1. Features
		2. The assembly
		f. Operation
		g. Demonstration

		h. Practical application
		i. Summary
7. Respirators ≈ .5 hour		a. Respiratory protection
		1. The WIPP program
		2. Requirements
		b. Lung capacity testing
		c. Physical examination
		d. Respiratory fit testing
		1. Fitting of respirator
		2. Selection of respirator
		e. Types of respirators
		1. Dust mask
		2. Cartridge
		3. Supplied air
		f. Training
		g. Hazards
		h. Summary
8. Entering and Leaving the Mine ≈ 1 hour		a. Access requirements
		1. Miner training
		b. Certification period
		c. Lamproom location
		1. Miner color code
		2. Proper safety equipment
		3. Sign-in procedure
		4. Brass tag
		d. Summary
9. Transportation ≈ 1 hour		a. General
		1. Surface
		2. Underground
		b. Hazards
		c. Hazard preventive equipment
		1. Lighting
		2. Alarms
		d. Personnel warning systems
		e. Interaction with pedestrians
		1. Normal travel patterns
		2. Variations
		f. Samples of hazards
		1. Conveyance
		2. Electric carts
		3. Haulage trucks
		4. Fork lift trucks
		g. Summary/exam
10. Communications ≈ 1.5 hours		a. WIPP communications systems overview

1. Personnel
2. Artificial

b. System breakdown
1. Personnel communication
a. Lamp signals
b. Hand signals
c. Appropriate uses
2. Artificial communications
a. Commercial telephone
b. Mine phone
c. Gia-tronics
d. Alarms systems
e. Alarm warning lights

c. Summary

11. Mine Map
≈ 1 hour

a. Definitions
b. Map legends
c. Directions and locations
1. Underground reference point
2. Boundary limits
d. Primary drifts
1. North/South
2. East/West
e. Drifts by area name
1. North
a. East/West
b. North/South
2. Other North area drifts
3. South non-radiation monitoring area
4. South radiation monitoring area
f. Assembly areas
g. Summary

12. Evacuation and Escape Routes
≈ 1 hour

a. WIPP underground evacuation procedures
1. Authorization for evacuation
2. Notifications
3. Initial actions
b. Escapes
1. Purpose
2. Primary
3. Secondary
c. Non-routine egress
1. Combination usage
2. Blocked access
d. Summary

13. Barricades/Refuge
≈ 1 hour

a. Define a barricade
b. Function of barricades
c. Permanent barricade
d. Temporary barricades
e. Methods of erecting a temporary barricade
f. Barricades in relationship with WIPP design
g. Summary

14. Ground Control
≈ 2.5 hours

a. Evaluation of ground control
b. Federal regulations
c. State mining regulations
d. WIPP procedures
e. Introduction to ground control and ventilation
f. Introduction to barring down and scaling
g. Demonstration of bar down and scaling techniques
h. Geological formation at WIPP
i. Review of class room instruction
j. Field activities
    1. Identification of bad back or rib
    2. Bar down operations
    3. Scaling down operations
    4. Safety issues
k. Summary/exam

15. Ventilation
≈ 1.5 hours

a. Ventilation
    1. General requirements
b. Intake volume
c. Intake points
    1. Air Intake Shaft
    2. Salt Handing Shaft
    3. Waste Shaft
d. Exhaust volume
e. Primary air-flow routes
    1. North mine area air flow (intake)
    2. North mine area air flow (exhaust)
    3. South mine area air flow (intake)
    4. South mine area air flow (exhaust)
f. Air quality
g. Air flow balancing

1. The plan
2. Adjustments
3. Unapproved adjustments

h. Escapeways

i. Summary

16. Health
≈ 1 hour

a. Air quality
1. Dust
2. Other vapors
3. Personal protective equipment

b. Noise
1. Acceptable working levels
a. 8 hour shift
b. Short term
2. Protection against damage
a. In-ear protection
b. Over-the-ear protection

c. Chemicals
1. Use
2. Personal protective equipment
3. Training
4. Health effects
5. Pre-event planning

d. Potable water

e. Toilet facilities
1. Chemical toilets

f. Waste receptacles
1. General

g. Food consumption
1. Restriction

h. Radiation exposure
1. ALARA
2. External
3. Internal
4. Through wounds

i. Summary

17. Hazard Recognition
≈ 1 hour

a. General hazard recognition
1. Mining as a whole
2. Comparing WIPP with general mining industry

b. Mobile equipment
1. Size
2. Construction
3. Other hazards

c. Ground control

1. Over confidence in work place
2. Barriers
3. Improper installation of control devices

d. Electrical hazards
1. Cables
2. Substations and switch racks
3. Unauthorized personal equipment

e. Loss of ventilation
1. Air quality
2. Radiation

f. Housekeeping
1. General
2. Risk to personnel

g. Laser operations

h. Seismic activity

i. Summary

18. Electrical
≈ 1.5 hours

a. Underground supply voltage

b. Circuit protection of electrical equipment and supply lines

c. Location of primary substations and switch gear

d. Primary line separation

e. Electrical equipment inspection
1. Preoperational inspections
2. Post-operational inspections

f. Handling of live cables

g. Lock-out/Tag-out
1. Underground procedure identification
2. Definitions
3. Procedure highlights

h. Summary

19. Fire Fighting
≈ 1 hour

a. Define fire

b. Fire behavior

c. Classes of fire
1. Class "A"
2. Class "B"
3. Class "C"
4. Class "D"

d. Introduction to fire extinguisher or systems
1. Fixed
2. Portable

e. Fire fighting principles for portable extinguisher
f. Fixed system activation
g. Summary

20. Job Task Safety
≈1 hour

a. Job task
1. General task
2. General task description
a. Miner operator
b. Miner operator helper
c. Haul truck operator
d. Bottom lander
e. Rock bolter
f. Driller operator

b. Summary/exam

21. MED-101 (including exam)
≈8 hours

22. Underground Tour
≈8 hours

a. Complete tour of the underground
b. OJT session for ground control (practical demonstration)

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-502 Mine Safety-Experienced Miner Refresher

DURATION: ≈8 Hours

PREREQUISITES: SAF-501

SCOPE: The instructor will update personnel of any change or modification in the underground

TYPE: Classroom

OBJECTIVES: Fulfill requirements of 30 CFR part 48, for annual experienced miner refresher training

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination

REFRESHER: Annually

COURSE DESCRIPTION (by lesson)

1. Introduction
   ≈.5 hour
   a. Hand out 5000-23 MSHA Forms
   b. Workplace overview
      1. Ground control
      2. Electrical
      3. Air quality
      4. Equipment
         a. Accidents
         b. Fires
         c. Noise
   c. Summary

2. Authority and Responsibility of Supervisors, Miner's Representatives
   ≈.5 hour
   a. Miner's representative
   b. Miner's rights and responsibilities
   c. Normal reporting of safety issues
   d. Safety issues with eminent danger
      1. Verbal notification
      2. Protection from reporting safety issues
      3. Work refusal
   e. Summary

3. Ventilation
   ≈1 hour
   a. Intake volume
   b. Intake points
      1. Air Intake Shaft
      2. Salt Handling Shaft
      3. Waste Shaft
   c. Exhaust volume
      1. Exhaust Shaft

		2. EFB capabilities
		d. Primary air-flow routes
		1. North mine area air flow (intake)
		2. North mine area air flow (exhaust)
		3. South non-storage air flow (intake)
		4. South non-storage air flow (exhaust)
		5. South storage area air flow (intake)
		6. Waste Shaft station area
		e. Air quality
		1. Required testing
		2. Ventilation failure
		3. Adjustments
		4. Unapproved adjustments
		f. Summary
4.	Ground Control ≈ 1 hour	a. Ground control
		1. General employee responsibility
		2. Typical ground failures
		3. Ground control practices
		b. Summary
5.	Entering and Leaving the Mine Transportation and Controls ≈ .5 hour	a. Underground access procedure
		1. General employee responsibility
		2. Violation of restricted areas
		b. Personal protective equipment
		c. Transportation
		1. The conveyance
		2. Mobile equipment
		3. Airlocks and doors
		d. Summary
6.	Communication, Warning Alarms and signals ≈ .5 hour	a. Communication systems
		1. GTE telephone
		2. Mine telephone
		3. Public address system
		b. Alarm systems
		1. Fire
		c. Emergency staging areas
		1. Assembly areas
		2. Station areas
		d. Alarm notification actions

		1. Escapeways 2. Retreat to station for evacuation 3. Retreat to assembly areas
		e. Summary
7. Mine Map, Escapeway, Emergency Evacuation and Barricades ≈ 1 hour		a. Escapeways b. Assembly areas 1. Purpose 2. Locations 3. Personnel duties during emergencies c. Barricade equipment d. Summary
8. Accident Prevention ≈ .5 hour		a. Definition b. Event happenings c. Changing events d. Pre-event recognition e. Lessons learned f. Summary
9. Self-Rescuer ≈ .5 hour		a. Definition b. Purpose c. Inspections d. Methods of conversion - catalytic conversion e. Protection from deadly gas f. Conversion to what compound? g. Effect time limit h. Compounds and operation i. Practical applications j. Summary
10. First Aid ≈ 1 hour		a. Bleeding 1. Arterial 2. Veinous 3. Capillary b. Control bleeding 1. Direct pressure 2. Elevation 3. Pressure dressing 4. Pressure points 5. Tourniquet c. Summary

All times are approximate and do not reflect additional time spent on topics that arise from class participation. student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: RIG-001 Incidental Rigger

DURATION: ≈ 16 Hours

PREREQUISITES: None

SCOPE: The instructor will present types of rigging, how to size up the load to be lifted, and the mechanical lifting devices.

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to perform incidental rigger duties in compliance with the DOE Hoisting and Rigging Manual.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: None

COURSE DESCRIPTION (by lesson)

1. Identifying Rigging Components ≈ 4 hours
   a. Qualifications
   b. Definitions
   c. Wire rope components
      1. Core
      2. Strand
      3. Wire
   d. Core
      1. Strand
      2. Wire
      3. Lay of the rope
      4. Length of the rope lay
      5. Inspection
   e. Web slings
   f. Polyester slings
   g. Wire rope slings
      1. Inspection
      2. Hooks
      3. Spreader beam
      4. Eyebolts
      5. Shackles - anchor and chain
      6. Wire rope clips - U bolt and twin base
      7. Turnbuckles

2. Inspection and Storage - Weight Calculation ≈ 4 hours
   a. Rigging inspection
      1. Improper sling use
      2. Inspection techniques

3. Rigging storage
4. Load weight determination
5. Calculations
6. Center of gravity
7. Slings and hitches
8. Load angle
9. Choker hitch rated capacity adjustment
10. Load cell

3. Identity Lifts/Long Term Check-Out Hand Signals
≈4 hours

a. Load indicating devices
   1. Ordinary lift
b. Critical lifts
   1. Determination
   2. Requirements
c. Pre-engineered production lift
d. Rigging check-out
e. Long-term checkout
f. Standard signals and signaler identification

4. Identify rigging Attachments, Accessories and Uses
≈4 hours

a. Beam Clamps
   1. Types
   2. Inspection
   3. Hand operated hoists
      a. Chain hoist
      b. Lever operated hoist
         1. Link chain
         2. Roller chain
         3. Wire rope
b. Jacks
c. Using jacks
d. Cribbing
e. Cribbing assembly

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: OPS-115 Conduct of Shift Operations

DURATION: ≈8 hours

PREREQUISITES: None

SCOPE: The instructor will describe how shift operation will be conducted at the site.

OBJECTIVES: Upon completion of this course, the student will be able to perform their job in accordance with Operations Department "Conduct of Operations" DIOPS-003.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination.

REFRESHER: NONE

COURSE DESCRIPTION (by lesson)

1. DOE Guidance for Conduct of Operations and Basic Requirements ≈1 hour
   a. DOE Policy
   b. DOE Orders
   c. Conduct of operations sections
      1. Operations organization and administration
      2. Shift routines and operating practices
      3. Control area activities for the WIPP
      4. Communications
      5. Control of on-shift training
      6. Investigation of abnormal events
      7. Notifications
      8. Control of equipment and system status
      9. Tagouts and lockouts
      10. Independent verification
      11. Logkeeping
      12. Operations turnover
      13. Operations aspects of facility unique processes
      14. Required reading
      15. Timely orders to operators
      16. Operations procedures
      17. Operator aid postings
      18. Equipment and piping labeling

d. Operations organization and administration
   1. Operations Policies
   2. Resources
   3. Monitoring of operating performance
   4. Accountability
   5. Management training
   6. Planning for safety
e. Procedures
   1. Use of procedures
   2. Working copies

2. Sections of Conduct of Operations
   ≈5 hours

A. Communications
   a. Emergency communications
   b. Public address system usage
   c. Contacting operators
   d. Radios
   e. Abbreviations and acronyms
   f. Oral instructions and informational communications

B. Control Area Activities
   a. Control area access
   b. Professional behavior
   c. Monitoring the main control panels
   d. Control operator ancillary duties
   e. Operation of control area equipment

C. Control of Equipment and System Status
   a. Status change authorization and reporting
   b. Equipment and systems alignment
   c. Equipment locking and tagging
   d. Equipment deficiency identification and documentation
   e. Work authorization and documentation
   f. Equipment post-maintenance testing and return to service
   g. Alarm status
   h. Temporary modification control
   i. Distribution and control of equipment and system documents

D. Independent Verification
   a. Components requiring independent verification
   b. Occasions requiring independent verification

		c. Verification techniques
E.	Operator Aid Postings	
F.	Equipment and Piping Labeling	a. Requirements b. Identifying labeling deficiencies
G.	Shift Requirements	a. Routines and operating practices 1. Status practices 2. Safety practices 3. Operator inspection tours 4. Round/tour inspection sheets 5. Personnel protection 6. Response to indications 7. Resetting protective devices 8. Load changes 9. Authority to operate equipment 10. Shift operating bases
H.	Control of On-Shift Training	a. Adherence to training programs b. On-shift instructor qualification c. Supervision and control of trainees d. Operator qualification program approval e. Training documentation f. Suspension of training g. Maximum number of trainees
I.	Logkeeping	a. Establishment of operating logs b. Timeliness of recordings c. Information to be recorded d. Legibility e. Corrections f. Log review g. Care and keeping of logbooks
J.	Operations Turnover	a. Turnover checklists b. Document review c. Control panel walk-down d. Discussion and exchange of responsibility e. Shift crew briefing f. Reliefs occurring during the shift
K.	Operations Aspects of Facility Unique Processes	a. Operator responsibilities b. Operator knowledge c. Operator response to process problems

		d. Communications between operations and process personnel
L. Required Reading	a.	File Index
	b.	Reading assignments
	c.	Required dates for completion of reading
	d.	Documentation
	e.	Review
M. Timely Orders to Operators	a.	Content and format
	b.	Issuing, segregating, and reviewing orders
	c.	Removal of orders

3. Summary

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: TRG-296 Root Cause Analysis

DURATION: ≈ 8 hours

PREREQUISITES: None

SCOPE: The instructor will provide personnel with the knowledge and skills necessary to identify the root cause of unplanned plant events, in accordance with DOE standards. Students will analyze incidents to identify corrective action necessary to prevent the incidents from recurring. This training is recommended for all operators, technicians, supervisors, and managers.

TYPE: Classroom And Practical

OBJECTIVES: Upon completion of this course, the student will be able to perform root cause analysis in accordance with DOE order 5000.3B.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on the course examination and satisfactory performance on the practical examination.

REFRESHER: None

COURSE DESCRIPTION (by lesson)

1. Introduction to Root Cause Analysis ≈ 2 hours
   a. Case study
   b. Root cause
   c. Other causes
   d. Event
   e. Event/cause relationship
   f. Root cause analysis
   g. Reason for root cause analysis
      1. Overview
      2. Specifics
      3. Concern - employees
      4. Concern - facility
      5. Concern - company permanent image
      6. Concern - public and environment
      7. Concern - economic
      8. Concern - legal

2. Root Cause Analysis Process ≈ 4 hours
   a. Phases and sub-phases
      1. Collect data
      2. Correct
      3. Inform
      4. Follow-up

b. Phase one - collect data
   1. What to collect
   2. How to collect
   3. Data review
c. Phase two - assess
   1. Purpose
   2. Methods
   3. Use, advantages, and disadvantages
   4. Event and casual factor charting
   5. Consists of two phases
   6. Cause and effect
   7. Cause and effect charting
d. Phase three - correct
e. Phase four - communications
   1. Internal
   2. External
f. Phase five - follow-up

3. Root Cause Analysis at the WIPP
   ≈ 1 hour

a. Investigations
b. Reportable and non-reportable events
c. Root cause analysis team report
d. Reportable events
e. Non-reportable events
f. Follow-up

4. Summary
   ≈ 1 hour

5. Homework

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises. (i.e. Job Performance Measures)

COURSE: SAF-645 WIPP Contingency Plan Procedure

DURATION: N/A

PREREQUISITES: None

SCOPE: This self-paced lesson uses the WIPP Contingency Plan Procedure as the student material. The examination is based on the enabling objectives given to the student.

TYPE: Self-paced

OBJECTIVES: Upon completion of reading the WIPP Contingency Plan Procedure (WP 02-12), the reader will understand the concepts and contents of the WIPP Contingency Plan.

Mastery of the terminal objective will be demonstrated by scoring 80 percent or higher on a closed book examination.

REFRESHER: None

1. State how the RCRA Emergency Coordinator is contacted in the case of an emergency.
2. State what type of events will cause the Contingency Plan to be implemented.
3. State how to contact the CMR operator in the event of an emergency.
4. State the proper chain of command to determine if an actual emergency exists.
5. State the proper chain of command to communicate with outside agencies, the general public, and which agencies are to be contacted.
6. State the qualification of a RCRA Emergency Coordinator and authorities possessed.
7. State the methods used to warn site personnel that an emergency exists.
8. State who is responsible for emergency equipment restoration.
9. State where the assembly areas and staging areas are on site.

10. State the resources available to the RCRA Emergency Coordinator to assist that person in making compatibility determinations during an emergency.

COURSE: SAF 632 - Office Warden

DURATION: ≈ 2 Hours

PREREQUISITES: None

SCOPE:

TYPE: Classroom

OBJECTIVES: Upon completion of this course, the student will be able to state the responsibilities and duties of the Office Warden, in accordance with WIPP Procedure WP 12-ER4907.

REFRESHER: SAF-632 annually

1. Objectives
   ≈ 10 minutes
   a. Define role of Office Warden
   b. List responsibilities
   c. Describe emergency notification system
   d. Describe operation of pagers and plectrons
   e. Describe purpose of assembly areas
   f. State purpose of Bloodborne Pathogen kits

2. Presentation
   ≈ 70 minutes
   a. Role of Office Warden
   b. Office Warden responsibilities
      1. Day-to-day
      2. Emergency situations
      3. Bomb threats
      4. Inclement weather
      5. Personnel accountability w/no assembly
   c. Emergency Notification System
      1. Different evacuation notifications
      2. Reporting emergencies
   d. Operation of pagers and plectrons
   e. Assembly areas
      1. Purpose
      2. Locations
   f. Bloodborne Pathogen kit
      1. Purpose
      2. Office Warden responsibilities

3. Practical Exercise

≈ 20 minutes

4. Review and Exam
≈ 20 minutes

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e. Job Performance Measures)

COURSE: SAF-621 - Firefighter I

DURATION: ≈40 hours

PREREQUISITES: None

SCOPE: This class prepares the student to respond to fires. This class is taught by the New Mexico Fire Academy

OBJECTIVES:

REFRESHER: Training is conducted 8 hours monthly

COURSE DESCRIPTION (by lesson)

1.	Inspection ≈.5 hour classroom	a.	Common causes of fires and their prevention
		b.	Fire protection procedures
		c.	Define importance of public relations
		d.	Define dwelling inspection procedures
2.	Sprinklers ≈.5 hour classroom	a.	Identify a fire department sprinkler connection and water motor alarm
		b.	Connect hose lines to a fire department connection of a sprinkler or standpipe system
		c.	Define how automatic sprinkler heads open and release water
		d.	Temporarily stop flow of water from a sprinkler head
3.	Overhaul ≈2 hours classroom	a.	Demonstrate searching for hidden fires
		b.	Demonstrate exposure of hidden fires by opening ceilings, walls, floors, and pulling apart burned material
		c.	Demonstrate how to separate and remove charred materials from unburned material
		d.	Define duties of fire fighters left at the scene for fire and security surveillance
		e.	Identify the purpose of overhaul

4. Salvage
   ≈1.5 hours classroom
   ≈.5 hours practical

   a. Identify the purpose of salvage and its value
   b. Demonstrate folds and rolls of salvage covers
   c. Demonstrate salvage cover throws
   d. Demonstrate the techniques of inspection, cleaning, and maintaining salvage equipment

5. Fire Streams
   ≈1.5 hours classroom
   ≈2.5 hours practical

   a. Define a fire stream
   b. Manipulate a nozzle so as to attack Class A and Class B fires
   c. Define water hammer and at least one method for its prevention
   d. Demonstrate how to open and close a nozzle

6. Fire Hoses, Nozzles, and Appliances
   ≈2.5 hours classroom
   ≈3.5 hours practical

   a. Identify the sizes, types, amounts, and uses of hose carried on a pumper
   b. Demonstrate the use of nozzles, hose adapters, and hose appliances carried on a pumper
   c. Advance dry hose lines of two different sizes from a pumper:
      1. Into a structure
      2. Up a ladder into an upper floor window
      3. Up an inside stairway to an upper floor
      4. Up an outside stairway to an upper floor
      5. Down an inside stairway to a lower floor
      6. Down an outside stairway to a lower floor
      7. To an upper floor by hoisting
   d. Advance charged hose lines of two different sizes from a pumper
      1. Into a structure
      2. Up a ladder into an upper floor window
      3. Up an inside stairway to an upper floor
      4. Up an outside stairway to an upper floor
      5. Down an inside stairway to a lower floor
      6. Down an outside stairway to

		a lower floor 7. To an upper floor by hoisting
	e.	Demonstrate the techniques for cleaning fire hose, couplings, and nozzles and inspecting for damage
	f.	Connect a fire hose to a hydrant and fully open and close the hydrant
	g.	Demonstrate the loading of fire hose on a fire apparatus and identify the purpose of at least three types of hose loads and finishes
	h.	Demonstrate three types of hose rolls
	i.	Demonstrate two types of hose carries
	j.	Demonstrate coupling and uncoupling of the fire hose
	k.	Work from a ladder with a charged attack line which shall be 1.5" or larger
	l.	Demonstrate carrying hose into a building to be connected to a standpipe
	m.	Demonstrate the methods for extending a hose line
	n.	Demonstrate replacing a burst section of hose line
7. Forcible Entry ≈ 3 hours classroom ≈ 1 hour practical	a.	Identify and demonstrate each type of manual forcible entry tool
	b.	Identify the method and procedure of properly cleaning, maintaining, and inspecting each type of forcible entry tool and equipment
8. Ladders ≈ 1.5 hours classroom ≈ 2.5 hours practical	a.	Identify each type of ladder and its intended use
	b.	Demonstrate the following ladder carries: 1. One person carry 2. Two person carry 3. Three person carry 4. Four person carry 5. Five person carry 6. Six person carry
	c.	Raise each type and size of ground

		ladder
	d.	Climb the full length of every type
	e.	Climb the full length of each type of ground and aerial ladder carrying fire fighting tools or equipment while ascending and descending
	f.	Climb down the full length of a ground and aerial ladder carrying an injured person
	g.	Demonstrate the techniques of working from ground and aerial ladders with tools and appliances
	h.	Demonstrate the techniques of cleaning ladders
9. Rescue ≈5 hour classroom ≈1.25 hours practical	a.	Demonstrate the removal of injured persons from immediate hazards practical by use of carries, drags, and stretchers
	b.	Demonstrate searching for victims in burning, smokefilled buildings, or other hostile environments
	c.	Define the use of a life belt
	d.	Define safety procedures as they apply to rescue
10. Self-Contained Breathing Apparatus ≈2 hours classroom ≈2 hours practical	a.	Identify at least four hazardous respiratory environments encountered in fire fighting
	b.	Demonstrate the use of all types of self-contained breathing apparatus in a dense smoke environment
	c.	Identify the physical requirements of the wearer, the limitations of the self-contained breathing apparatus, and the safety features of all types of self-contained breathing apparatus
	d.	Demonstrate donning self-contained breathing apparatus while wearing protective clothing
	e.	Demonstrate that the self-contained breathing apparatus is in a safe condition for safe use

	f.	Identify the procedure for cleaning and sanitizing the self-contained breathing apparatus for future use
11. Ropes ≈ 2 hours class room and practical	a.	Identify and describe the purpose for specific knots
	b.	Identify the construction characteristics and appropriate uses of natural and synthetic fiber rope
	c.	Demonstrate tying a bowline knot, a clove hitch, rescue knot, figure of eight knot, a becket or sheep bend, and an overhand safety knot
	d.	Demonstrate the bight, loop, round turn, and half hitch as used in tying knots and hitches
	e.	Using an overhand knot, hoist any selected forcible entry tool, ground ladder, or appliance to a height of 20 feet
	f.	Demonstrate the techniques of inspecting, cleaning, maintaining, and storing rope
12. Ventilation ≈ 5 hours classroom	a.	Define the principals of ventilation, and identify the advantages and effects of ventilation
	b.	Identify the dangers present and precautions to be taken when performing ventilation
	c.	Demonstrate opening various types of windows from inside and outside, with and without tools
	d.	Demonstrate breaking window and door glass and its removal
	e.	Using an ax, demonstrate the ventilation of a room and a floor
	f.	Define the theory of a back draft explosion
13. Safety ≈ 1 hour classroom	a.	Identify dangerous building conditions created by fire
	b.	Demonstrate techniques for action when trapped or disoriented in a fire situation
	c.	Define procedures to be used in electrical emergencies

d. Define fire service lighting equipment
e. Identify safety procedures when using fire services lighting equipment
f. Demonstrate the use of portable power plants, lights, cords, and connectors
g. Define safety procedures as they apply to emergency operations, specifically:
   1. Protective equipment
   2. Team concept
   3. Portable tools and equipment
   4. Riding and apparatus
   5. Hazardous materials incidents

14. Fire Behavior
≈3 hours

a. Define fire
b. Define the fire triangle and fire tetrahedron
c. Identify two chemical, mechanical, and electrical energy sources
d. Define the following stages of fire:
   1. Incipient
   2. Flame spread
   3. Hot smoldering
   4. Flash over
   5. Steady state
   6. Clear burning
e. Define the three methods of heat transfer
f. Define the three physical stages of matter in which fuels are commonly found
g. Define the hazard of finely divided fuels as they relate to the combustion process
h. Define flash point, fire point, and ignition temperature
i. Define concentrations in air as it affects combustion
j. Identify three products of combustion found in structural fires which create a life hazard

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size, and/or practical exercises (i.e., Job Performance Measures)

COURSE: EOC-101 - Initial Mine Rescue

DURATION: 20 Hours

PREREQUISITES: Physical, underground experience

SCOPE:

TYPE: Classroom, field, hands-on

OBJECTIVES: Upon completion of this training, the student will be able to wear and maintain a Drager self-contained breathing apparatus, and perform all the functions required as a member of a mine rescue team.

REFRESHER: Training is conducted 8 hours monthly

COURSE DESCRIPTION (by lesson)

1. MSHA 2004 (Drager BG 174-A) ≈8 hours
   a. Description
   b. Major parts
   c. Wearing and testing
   d. Limitations
   e. Maintenance

2. MSHA 2202 (Mine Gases) ≈2 hours
   a. Meaning of terms
      1. Specific gravity
      2. Explosive range
      3. Toxicity
      4. Asphyxiate
      5. Solubility
   b. Physical properties and characteristics
      1. Normal air
      2. Oxygen
      3. Nitrogen
      4. Carbon dioxide
      5. Carbon monoxide
      6. Oxides of nitrogen
      7. Hydrogen
      8. Hydrogen sulfide
      9. Sulfur dioxide
      10. Methane
   c. Composition, physical properties, and characteristics
      1. Smoke
      2. Rock strata gases
      3. Damps

3. MSHA 2203 (Mine Ventilation)
   ≈ 2 hours
   a. Purpose and methods
   b. Ventilation controls
   c. Proper chain-of-command when altering ventilation
   d. Air measurement devices
   e. Construction of ventilation controls

4. MSHA 2204 (Mine Exploration)
   ≈ 2 hours
   a. Examination of mine openings
   b. Barefaced exploration
   c. The fresh air base
   d. Apparatus teams
   e. Briefing
   f. Going underground
   g. Exploration procedures
   h. Traveling procedures
   i. Ground testing
   j. Debriefing

5. MSHA 2205 (Firefighting)
   ≈ 2 hours
   a. Classification of fires
   b. Firefighting equipment
   c. Firefighting techniques
      1. Indirect
      2. Direct
   d. Explosions

6. MSHA 2206 (Rescue of Survivors)
   ≈ 2 hours
   a. Rescuing survivors
      1. Rescue techniques
      2. First aid
   b. Recovery of bodies

7. MSHA 2207 (Mine Recovery)
   ≈ 2 hours
   a. Assessing conditions
   b. Reestablishing ventilation
   c. Clearing and rehabilitating

All times are approximate and do not reflect additional time spent on topics that arise from class participation, student breaks, class size and/or practical exercises (i.e., Job Performance Measures)

COURSE: Radiological Control Technician Fundamental Academic Lessons

DURATION: ~ 52 hours
Students may elect to test out of these courses with Radiological Control Manager approval

PREREQUISITES: Lesson specific

SCOPE: Lesson specific

REFRESHER: Recertification every two years

COURSE DESCRIPTION (by module)

1. Basic Mathematics and Algebra (CL1.01) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson is a review of arithmetic and algebraic methods used to perform various radiological control calculations required by the RCT to perform his/her daily duties. These calculations include scientific notation, unit analysis and conversion, radioactive decay calculations, dose rate/distance calculations, shielding calculations, and stay-time calculations.
c. Outline - Introduction
- Basic math operations with fractions
- Basic math operations with decimals
- Convert fractions to decimals and vice-versa
- Convert percent to decimal and vice-versa
- Basic math operations with signed numbers
- Basic math operations with exponents
- Find rational square roots
- Convert scientific notation to standard form and vice-versa
- Basic math with scientific notation
- Solving equations using the "Order of Mathematical Operations"
- Performing algebraic functions
- Solving equations with common and natural logarithms
- Exam

2. Unit Analysis and Conversion (CL1.02) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson is a review of the unit analysis and conversion process necessary for the RCT to perform air and water sample activity calculations, contamination calculations, and many other applications.
c. Outline - Introduction
- Unit systems of measurement and base units for mass, length and time
- SI prefix values and abbreviations

- Using conversion factors/tables
- Using formulas
- Exam

3. Physical Sciences (CL1.03) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson is a review of basic physics since the RCT may work in environments where materials can undergo changes in state, resulting in changes in the radiological work environment.
c. Outline - Introduction -
- Work/force/energy in relation to physics
- Identify and describe four forms of energy
- State the Law of Conservation of Energy
- Solid/liquid/gas in regards to shape and volume
- Basic atom structure
- Defining physical science terms
- Identifying symbols
- Periodic Table element arrangement
- Identifying Periodic Table layout
- Defining terms relative to atomic structure
- Exam

4. Nuclear Physics (CL1.04) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson is designed to provide an understanding of the forces present within an atom.
c. Outline - Introduction
- Definitions: Nucleon, Nuclide, Isotope
- Mass-Energy Equivalence Concept
- Definitions: Mass Defect, Binding Energy
- Definitions: Fission, Criticality, Fusion
- Exam

5. Sources of Radiation (CL1.05) ≈4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding that radiation sources are not limited to nuclear facilities. The study of radiation sources provides data for:
- The basis for occupational exposure
- Showing the effects from high source exposures
- Assessing the impact on radiation background from nuclear facilities
- Determining the use of building materials
c. Outline - Introduction
- Identifying natural background radiation sources
- Identifying artificially produced radiation sources and dose magnitudes from each source

- Exam

6. Radioactivity and Radioactive Decay (CL1.06) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of the radioactive decay processes from different types of radionuclides.
c. Outline - Introduction
- Neutron to proton ratio
- Definitions: radioactivity, radioactive decay
- Characteristics of alpha, beta, and gamma
- Identifying radioactive decay modes
- Decay of radioactive nuclides
- Differences: natural and artificial radioactivity
- Unstable fission products
- Three naturally-occurring radioactive families and their end products
- Identify nuclide attributes with Nuclide Chart
- Tracing nuclide decay and stable end-product
- Definitions: curie, Becquerel
- Definitions: specific activity, half-life
- Calculate activity using the decay formula
- Defining exposure, absorbed dose, dose equivalent, and quality factor
- Defining roentgen, rad/gray, and rem/sievert
- Exam

7. Interaction of Radiation with Matter (CL1.07) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson provides an understanding of how different types of radiation interacts with different types of matter.
c. Outline - Introduction
- Define ionization, excitation, bremsstrahlung
- Defining specific ionization, linear energy transfer (LET), stopping power, range, and W-value
- Alpha particle energy transfer
- Energy transfer for beta particulate radiation
- Gamma photon interaction with matter
- Kinetic energies of various types of neutrons
- Slow neutron capture
- Scattering interactions for fast neutrons
- Characteristics of materials shielding alpha, beta, gamma and neutron radiations
- Exam

8. Biological Effects of Radiation (CL-1.08) ≈ 4 hours

a. Prerequisites - None

b. Scope -This lesson provides a basic understanding of the methods in which radiation may cause biological damage so that the RCT may protect themselves and the workers from unnecessary exposure to ionizing radiation.

c. Outline - Introduction
- Function of various cell structures
- Effects of radiation on cell structures
- Law of Bergonie and Tribondeau
- Factors affecting radiosensitivity of cells
- Most and least radiosensitive cells
- Reactions on cells from ionizing radiation
- Definitions: stochastic, non-stochastic effect
- LD 50/30 value for humans
- Somatic effects of chronic radiation exposure
- Three types of acute radiation syndromes and associated exposure levels and symptoms
- Radiation exposure risks to embryo and fetus
- Somatic and heritable effects
- Exam

9. Radiological Protection Standards (CL1.09) ≈ 4 hours

a. Prerequisites - None

b. Scope -This lesson provides an understanding of the history of the development of the limits to show why the current limits of exposure are imposed. This lesson also provides an awareness of the current CFRs and DOE Orders that may affect the RCTs at the work place.

c. Outline - Introduction
- Role of advisory agencies in developing radcon recommendations
- Role of regulatory agencies in developing standards and regulations
- DOE RCM purpose and scope
- DOE RCM use of "shall" and "should"
- Exam

10. ALARA (CL1.10) ≈ 4 hours

a. Prerequisites - None

b. Scope - This lesson provides an understanding of the ALARA philosophy and shows the methods for the RCT to establish and maintain the commitment to ALARA that all personnel at the facility must have for a safe radiological work place.

c. Outline - Introduction
- Base assumptions for ALARA philosophy
- Collective personnel and individual exposure
- Effective radiological ALARA program
- Purposes of pre- and post-job reviews
- RCT responsibilities for implementation

- Exam

11. External Exposure Control (CL1.11) ≈ 4 hours

a. Prerequisites - None
b. Scope -This lesson provides an understanding of external exposure reduction and control measures available to the RCT to provide the best coverage and support at the radiological work site.
c. Outline - Introduction
- Four basic methods for minimization
- Calculating gamma exposure rates
- Source reduction techniques
- Time-saving techniques
- Calculating remaining allowable dose equivalent or stay time
- "Distance to radiation sources" techniques
- Calculating exposure rate or distance for a point source of radiation
- Calculating exposure rate or distance for a line source of radiation
- Effects of distance on exposure rates from a plane source
- Mass and linear attenuation coefficients
- Defining "density thickness"
- Density-thickness values for skin, lens of the eye, and the whole body
- Using equations to calculate shielding thickness and exposure rates for gamma/x-ray radiation
- Exam

12. Internal Exposure Control (CL1.12) ≈ 4 hours

a. Prerequisites - None
b. Scope - This lesson is designed to familiarize the technician with those actions necessary as a result of the entry of radioactive materials into the body and the basis for those actions.
c. Outline - Introduction
- Four ways radioactive material enters the body
- Methods to prevent/minimize entry of radioactive material
- Defining and distinguishing ALI and DAC
- Determining basis for ALI
- Defining "reference man"
- Using DACs to minimize internal exposure
- Behavior of radioactive materials in the body
- Natural reductions of radionuclides in body
- Relationship between physical, biological and effective half lives
- Calculating effective half life
- Medical elimination methods
- Exam

13. Radiation Detector Theory (CL1.13) ≈ 4 hours

a. Prerequisites - None

b. Scope - This lesson provides a good theoretical understanding of radiological instrumentation to help RCTs understand the data obtained by that instrumentation.

c. Outline - Introduction

- Fundamental laws of electrical charges
- Defining current, voltage, resistance, and their respective units
- Functions of detector and readout circuitry components in radiation measurement system
- Parameters affecting ion pair numbers in a gas-filled detector
- Regions of gas amplification curves
- Characteristics of a detector used in gas amplification curve regions
- Defining resolving time, dead time, and recovery time
- Discriminating between various types of radiation and various radiation energies
- Operation of scintillation detector and associated components
- Operation of neutron detector
- Principles of GeLi and HPGe detectors
- Exam

COURSE: Radiological Control Technician Site-Specific Academic Lessons

DURATION: ≈ 88 hours

PREREQUISITES: Lesson specific

SCOPE: Lesson specific

1. Counting Errors and Statistics (CL2.03) ≈ 4 hours

   a. Prerequisites - CL1.01 through CL1.13
   b. Scope - This lesson provides a basic knowledge of the random process of detecting and measuring radioactivity and the associated counting errors involved with that process. The RCTs will use this knowledge when obtaining the radioactivity measurements to make decisions that may affect the health and safety of workers at the facility and its surrounding environments
   c. Outline - Introduction
      - Analyzing errors and their effect on sample measurements
      - Sample analysis statistics applications
      - Defining mean, median, and mode
      - Determining mean, median, and mode
      - Defining variance and standard deviation
      - Calculating the standard deviation
      - Purpose of Chi-squared test
      - Criteria for acceptable Chi-squared values at the WIPP
      - Purpose of creating quality control charts
      - WIPP QC chart maintenance and review requirements
      - Purpose of warning and control limits
      - Purpose of efficiencies and correction factors
      - Calculating efficiencies and correction factors
      - Meaning of counting data reported as "$x \pm y$"
      - Reporting results to desired confidence level
      - Purpose of determining background
      - WIPP methods and requirements for determining background
      - Purpose of performing sample planchet maintenance
      - WIPP method and requirements of performing planchet maintenance for counting systems
      - Methods to improve statistical validity of sample measurements
      - Defining and explaining "detection limits"
      - Calculate detection limit values at WIPP
      - Purpose, method, and criteria for acceptable values of determining crosstalk at the WIPP
      - Purpose and method of performing voltage plateau
      - Exam

2. Dosimetry (CL2.04) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson introduces the types of dosimeters used to measure external radiation to people at the facility. The material presented in this lesson is valuable to RCTs since dosimeters are the only direct method to measure and document personnel radiation exposure and ensure regulatory compliance with applicable limits.
c. Outline - Introduction
- DOE occupational worker external exposure limits
- DOE established limits for embryo/fetus
- WIPP administrative exposure control guidelines for radiation/non-radiation workers, incidents and emergencies, and unborn children
- Requirements for pregnant worker
- Theory of operation of a TLD
- Theory of operation of a TLD reader
- Advantages and disadvantages of a TLD
- WIPP beta-gamma TLDs
- WIPP neutron TLDs
- WIPP TLD use requirements
- WIPP personnel neutron dosimeter types and principle of operation
- WIPP self-reading dosimetry (SRD) principle of operation
- WIPP alarming dosimeter use guidelines and principle of operation
- WIPP bioassay monitoring methods
- Exam

3. Contamination Control (CL2.05) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson shows that contamination control is probably one of the most difficult and challenging tasks the RCTs will encounter. This lesson covers the methods to prevent personnel contaminations and releases of radioactive material into the environment which is the ultimate purpose of a radiological control organization.
c. Outline - Introduction
- Removable and fixed surface contamination
- Components of the radiation monitoring program
- Basic goal of the program
- Basic principles
- Possible engineering control methods
- Use of protective clothing
- Basic factors which determine protective clothing requirements
- Exam

4. Airborne Sampling Program/Methods (CL2.06) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson provides an overview of the air sampling program

and the methods for obtaining airborne radioactivity concentration in an area to ensure that the control measures assigned are effective and continue to be effective.

c. Outline - Introduction
   - Primary objectives of air monitoring program
   - Three physical states of radiation contaminants
   - Ensuring a representative air sample
   - Defining "isokinetic sampling"
   - Six methods for obtaining samples and their principle of operation
   - Selection of air monitoring methods
   - Purpose of five types of samplers/monitors
   - Factors affecting accuracy of measurements
   - WIPP air monitoring program
   - Exam

5. Airborne Sampling Laboratory (CL2.06A) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This training laboratory provides the initial on-the-job training for the job performance measures (JPMs) pertaining to the Airborne Sampling Program/Methods.
c. Outline - Introduction
   - Collecting FAS filters
   - Analyzing air sample for radioactivity
   - Changing 'Station A' FAS filters
   - Determining appropriate respiratory equipment based on air activity

6. Radiological Source Control (CL2.08) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson provides an understanding of the purposes, uses, methods to control radioactive sources that are necessary at a nuclear facility.
c. Outline - Introduction
   - DOE Radiological Controls Manual requirements for radioactive sources
   - WIPP sources that must be controlled
   - Packaging, marking and labeling requests
   - Storage area approval and posting requests
   - WIPP procedures for storage and accountability of radioactive sources
   - Exam

7. Access Control and Work Area Setup (CL2.10) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson presents instruction in Radiological Work Permits,

various types of postings used in radiological areas, setting up radiological areas, access controls, and releasing of material from radiological areas.

c. Outline - Introduction
- Purpose and information on Radiological Work Permit (RWP) including WIPP classifications
- Responsibilities in using or initiating RWP
- WIPP document that governs our ALARA program
- WIPP establishment of exposure/performance goals
- WIPP conditions requiring a pre-job ALARA review
- WIPP conditions requiring a post-job ALARA review
- Purpose of postings, signs, labels and barricades; and RCTs responsibilities for them
- WIPP postings, requests for postings/barriers, and entry requests for various radiological areas
- Setting up radiological areas
- Containment device discrepancies
- Setting up portable ventilation systems and count rate meters
- Requirements while working in RBAs
- Requirements for removing or releasing materials from any radiological area
- Exam

8. Radiological Work Coverage (CL2.11) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13

b. Scope - This lesson covers the methods of job coverage by RCTs to assist radiological workers in keeping their radiation exposures ALARA.

c. Outline - Introduction
- Three purposes of job coverage
- Continuous and intermittent job coverage
- Conditions that require job coverage
- Planning job coverage
- Pre-job briefing discussions
- Worker and technician exposure control techniques
- WIPP in-progress radiological surveys
- WIPP documentation of in-progress surveys
- Actions taken for unexpected survey results
- Contamination control techniques
- Preventative job coverage techniques
- Overall job control techniques
- DOE RCM reasons to stop radiological work activities
- Exam

9. Shipment/Receipt of Radioactive Material (CL2.12) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13

b. Scope -

c. Outline - Introduction
- Regulatory agencies for radioactive material transport
- Defining the DOT terms: LSA, Limited Quantity, Transport Index, Exclusive Use, and Closed Transport Vehicle
- Determining radionuclide contents of a package
- Radiation and contamination surveys and applicable limits performed on packages
- Radiation and contamination surveys and applicable limits performed on exclusive use vehicles
- Placement of placards on transport vehicles
- WIPP shipment release inspection criteria
- WIPP procedures for receipt and shipment
- WIPP procedures for shipments exceeding limits
- WIPP procedures for opening packages
- Exam

10. Radiological Incidents and Emergencies (CL2.13) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson covers the necessary immediate and supplementary actions for responding to radiological emergencies and abnormal events. This lesson also reveals that, although most people do not take incident response planning seriously because they do not expect the unexpected, incidents do occur, and experience has shown that best response comes from workers who have prepared themselves with a plan for dealing with incidents.
c. Outline - Introduction
- RCT general response and responsibilities
- Emergency equipment and facilities, including location and contents of emergency equipment kits
- RCT response to CAM alarm
- RCT response to personnel contamination monitor alarm
- RCT response to off scale or lost dosimetry
- RCT response to radiation levels or area alarm
- RCT response to dry or liquid spill
- RCT response to fire in a radiological area or involving radioactive materials
- RCT response to other incidents
- Emergency response levels
- Incident documentation procedures
- Emergency response team structure
- Offsite incident support groups
- Plant incidents, including cause, prevention, and response
- Exam

11. Personnel Decontamination (CL2.14) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lessons outlines the best methods available to control or

oversee the decontamination of a contaminated individual.

c. Outline - Introduction
   - Three factors in personnel decontamination
   - Required RCT preliminary actions and notifications for contaminated individual
   - RCT response to clothing contamination
   - RCT response to skin contamination
   - Using decontamination reagents to decontaminate personnel
   - Exam

12. Radiological Considerations for First Aid (CL2.15) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13

b. Scope - This lesson introduces the special considerations for injuries in radiological areas. It is incumbent on the RCT to use his/her knowledge and training to make judgement calls based on available facts and conditions. Often there is more than one "right way" to handle the situation, with many alternatives which may all work equally well.

c. Outline - Introduction
   - Treatment of minor radiation injuries
   - Treatment of major radiation illness/injury
   - RCT's responsibility at scene of major radiation injury after arrival of medical personnel
   - WIPP treatment and transport of contaminated injured personnel
   - Exam

13. Radiation Survey Instrumentation (CL2.16) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13

b. Scope - This lesson provides an understanding of radiation survey instruments to ensure the data obtained is accurate and appropriate for the source of radiation. This lesson contains information about widely used portable radiation survey instruments.

c. Outline - Introduction
   - Appropriate external radiation survey instruments and their selection
   - WIPP ion chamber instrument features and specifications
   - WIPP high range instrument features and specifications
   - WIPP neutron detection and measurement instrument features and specifications
   - Exam

14. Radiation Survey Instrumentation Laboratory (CL2.16A) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13

b. Scope - This training laboratory provides the initial on-the-job training for the job performance measures (JPMs) pertaining to the radiation

survey instruments used at the WIPP.

c. Outline - Introduction
- Operating WIPP Geiger-meuller dose rate meters
- Operating WIPP ion chamber dose rate meters
- Operating WIPP digital alarming dosimeters

15. Contamination Monitoring Instrumentation (CL2.17) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson provides an understanding of contamination monitoring (count rate) instruments to provide the basis for assignment of practical contamination and internal exposure controls, to establish the proper controls, and to identify personnel contamination prior to exiting radiological areas at the facility.
c. Outline - Introduction
- Portable contamination monitoring equipment selection
- WIPP beta/gamma and/or alpha survey count rate meter probe features and specifications
- WIPP count rate instrument features and specifications
- WIPP personnel contamination monitor features and specifications
- WIPP contamination monitor (tool, bag, laundry monitors) features and specifications
- Exam

16. Contamination Monitoring Instrumentation Laboratory (CL2.17A) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This training laboratory provides the initial on-the-job training for the job performance measures (JPMs) pertaining to the contamination monitoring instruments used at the WIPP.
c. Outline - Introduction
- Operating and performance checks of WIPP alpha contamination detection instruments
- Operating and performance checks of WIPP beta contamination detection instruments
- Operability checks of WIPP personnel contamination monitors
- Performing personnel frisk with WIPP personnel contamination monitors

17. Air Sampling Equipment (CL2.18) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope
c. Outline - Introduction
- WIPP portable air sampler (PAS) selection
- Physical and operating characteristics and limitation(s) of WIPP portable air samplers
- Physical and operating characteristics and limitation(s) of WIPP

motor air pumps
- Pre-operational checkout of WIPP PASs
- Physical and operating characteristics and limitation(s) of WIPP beta-gamma CAMs
- Physical and operating characteristics and limitation(s) of WIPP alpha CAMs
- Exam

18. Air Sampling Equipment Laboratory (CL2.18A) ≈ 8 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This training laboratory provides the initial on-the-job training for the job performance measures (JPMs) pertaining to the air sampling <u>and</u> air monitoring equipment used at the WIPP.
c. Outline - Introduction
- Operability checks of RMS CAMs
- Operability checks of portable CAMs
- Alarm set points on the RMS CAMs
- Operating the portable air sampling units
- Functional checks of RMS CAMs
- Functional checks of portable CAMs

19. Counting Room Equipment (CL2.19) ≈ 4 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This lesson covers counting room equipment in relation to types used, purpose for, radiation monitored, operational requirements, and specific limitations and characteristics. The RCT uses information from these counting instruments to identify and assess the hazards presented by contamination and airborne radioactivity and establish protective requirements for work performed in radiological areas.
c. Outline - Introduction
- WIPP Scintillation Alpha and Beta laboratory counter/scalers' features and specifications
- WIPP low background auto alpha/beta proportional and liquid scintillation counting systems' features and specifications
- WIPP alpha and gamma spectroscopy systems' features and specifications
- Exam

20. Counting Room Equipment Laboratory (CL2.19A) ≈ 8 hours

a. Prerequisites - CL1.01 through CL1.13
b. Scope - This training laboratory provides the initial on-the-job training for the job performance measures (JPMs) pertaining to the counting room equipment used at the WIPP.
c. Outline - Introduction
- Operating and performance checks of WIPP beta laboratory counters

- Operating and performance checks of WIPP scintillation alpha
- WIPP low background automatic alpha/beta proportional counting system quality control checks and sample analysis
- WIPP alpha spectroscopy system quality control checks and sample analysis
- WIPP gamma spectroscopy system quality control checks and sample analysis
- WIPP liquid scintillation counting system quality control checks and sample analysis

CERTIFICATION CARD: CH Waste Handling Technician (WH-01)
CH Waste Handling Engineer (WH-02)

DURATION: Nine to twelve months

CLASSROOM TRAINING: Various classroom courses are utilized to provide operators the requisite training as part of the certification process. The candidate must satisfactorily complete the classroom training courses prior to completion of the certification card.

SCOPE: The CH Waste Handling Technician Certification Card (WH-01) and CH Waste Handling Engineer Certification Card (WH-02) provide the minimum knowledge and competency requirements for certification. The requirements of the applicable certification must be completed by the candidate prior to performing those duties without direct supervision.

REFERENCES: CH Waste Handling Technician Certification Card (WH-01)
CH Waste Handling Engineer Certification Card (WH-02)
Waste Handling Operations Certification Card Guide Book (WH-GUIDE-1)

CERTIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge Requirements

Demonstrate knowledge of the following for the various pieces of CH waste handling equipment and systems:

- General principle of equipment operation
- Understanding of alarms, indications, and readings
- Proper response to abnormal equipment conditions
- Precautions and limiting conditions of operation
- Basic safety requirements for equipment operation

2. Equipment Operation Practical Requirements

Demonstrate competency in conducting CH waste handling equipment and system functional and operational inspections.

Demonstrate competency in standard operation of CH waste handling equipment and systems.

3. Integrated Process Knowledge Requirements

Demonstrate knowledge of the following for the various integrated support functions.

- Administrative activities for equipment/system isolation, modification and control
- Management of site derived waste
- Proper response to abnormal facility conditions
- Container storage area inspections
- Facility support systems

4. Integrated Process Practical Requirements

Demonstrate competency in performing administrative duties for equipment/system isolation and control.

Demonstrate competency in management of site derived waste

Demonstrate competency in performing container storage area inspections

Walkdown the various facility support systems that affect waste handling

QUALIFICATION CARD: WWIS Data Administrator

DURATION: Two years

CLASSROOM TRAINING: Various classroom courses are utilized to provide the WWIS Data Administrator with the knowledge and background on the WIPP waste operations. OJT connected with the everyday operation of the database will be provided by the WWIS SME. The candidate must satisfactorily complete the classroom training courses and the OJT prior to qualification.

SCOPE: The WWIS Certification Card provides the minimum knowledge and competency requirements for qualification. The requirements of the qualification must be completed to the satisfaction of the current WWIS SME prior to the candidate performing any of the WWIS data functions without direct supervision by a qualified WWIS DA.

REFERENCES: WWIS Data Administrator Qualification Card

QUALIFICATION CARD (by category)

1. Equipment Knowledge Requirements

Demonstrate knowledge of the following WWIS hardware and software systems:

- General computer operation principles and communication terminal techniques
- IBM PC and Internet techniques
- Bar Code Reader System operation

2. Equipment Operation Practical

- Obtain and maintain local and Internet IDs
- Access WWIS and produce reports
- Demonstrate operation of bar code reader interface to WWIS

3. Integrated Process Knowledge Requirements

Demonstrate knowledge of the following project document data requirements:

- WIPP Waste Acceptance Criteria
- WIPP Quality Assurance Program Plan
- Waste Analysis Plan

Demonstrate knowledge of the following WWIS Specific documentation:

- WWIS Software Requirements Specification
- WWIS Software Configuration Management Plan
- WWIS Software Quality Assurance Plan

- WWIS Software Design Description

4. Integrated Process Practical Requirements

Demonstrate competency in performing the administrative duties of the WWIS DA

Demonstrate competency in accessing the local area network (LAN) and the Internet.

Demonstrate the WIPP data interface to the WWIS via a walkdown of the receipt and emplacement operations that provide data to the database.

QUALIFICATION CARD: Radioactive Transportation (TE-01)
Federal Motor Carrier Safety Regulations (TE-02)
Hazardous Materials (TE-03)
Hazardous Waste Shipments by Public Highway (TE-05)

DURATION: Six to twelve months

CLASSROOM TRAINING: Various classroom courses are utilized to provide candidates the requisite training as part of the qualification process. The candidate must satisfactorily complete the classroom training courses listed on the individual qualification card as a prerequisite to beginning that process.

SCOPE: The Transportation Engineer qualification cards (TE-01 through TE-05) provide the minimum knowledge and competency requirements for qualification. The requirements of the individual qualification cards must be completed by the candidate prior to performing those duties without direct supervision.

REFERENCES: Radioactive Transportation (TE-01)
Federal Motor Carrier Safety Regulations (TE-02)
Hazardous Materials (TE-03)
Hazardous Waste Shipments by Public Highway (TE-05)

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate knowledge of the following regulatory arenas:

- Radioactive Material Transportation
- Federal Motor Carrier Safety Regulations
- Hazardous Materials
- Hazardous Waste Shipments by Public Highway

2. Practical Requirements

Demonstrate competency in performing the following for a given shipment:

- Determine the proper shipping name
- Determine the proper labeling and placement requirements
- Determine the proper application and marking requirements
- Prepare the proper shipping documents (i.e., Hazardous Waste Manifest, Bill of Lading, LDR notification form, etc.)

CERTIFICATION CARD: Radiological Control Technician (RCT)

DURATION: ≈9 working months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the certification card. The candidate is required to complete

SCOPE:

REFERENCES: WP 12-5, WIPP Radiological Control Manual
WP 12-HP, WIPP OHP Procedures Manual
WP 12-RE, Rad Engineering Procedures Manual

CERTIFICATION CARD DESCRIPTION (by category)

1. Academics Training

There are 13 lessons associated with the core academics program and 15 lessons and two labs associated with the site academics program.

2. Practical Training

There are 33 job performance measures associated with the practical training element of the RCT certification program covering the following areas:

Demonstrate generation of a Radiological Work Permit.

Demonstrate how a radiological area should be posted.

Demonstrate applicable emergency response to various events.

Demonstrate competency in operating various types of monitoring equipment.

3. Written Examination

This exam is administered after successful completion of academic lessons and practical lessons. Successful completion of the comprehensive written exam is necessary prior to participation in the oral examinations.

4. Oral Examination Board

The oral board consists of members of Radiation Safety, Operational Health Physics, Facility Operations, and Technical Training. This board will assess the candidate's response to normal and emergency situations encountered by a Radiation Control Technician.

CERTIFICATION CARD: EST-01 Emergency Services Technician

DURATION: 2 Years

PREREQUISITES: The candidate must be currently certified in CPR and possess an EMT-I License.

CLASSROOM TRAINING: Additional classroom training courses are required prior to completion of this certification card.

SCOPE: This certification card must be completed by all candidates prior to standing a watch unsupervised. Certification is a six month process. The individual may perform duties without direct supervision only for those evolutions and/or operations for which training has been completed.

All signatures must be made by an approved Subject Matter Expert. The signatures indicate that the trainee has demonstrated satisfactory knowledge and performance of the task(s) indicated.

REFERENCES: Emergency Services Technician Certification Card Guide Book (EST-01G)
Field Emergency Response Program Plan (WP 12-10)

CERTIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate basic knowledge of emergency management procedures and protocols such as:

- The purpose and types of dry chemicals utilized in large and portable dry chemical systems.
- Inspection and testing principles of sprinkler systems, buildings, pull boxes, and fire detection systems.
- The general operation and hazards of fixed halon systems.
- Principles and procedures for operation of various fire and rescue apparatus.
- Selection and use of personal protective equipment.
- Selection and use of hazardous material equipment and supplies for control and mitigation.

2. Practical Requirements

Demonstrate competency in the following areas:

- Use of fire suppression apparatus and equipment.
- Use of rescue apparatus and equipment.
- Inspection and testing techniques and completion of corresponding forms.

- Operation of ambulance and operation and application of all ambulance equipment and supplies.
- Application of all hazardous materials equipment and supplies for control and mitigation.

CERTIFICATION CARD: Quality Assurance Inspector

DURATION: Six to nine months

CLASSROOM TRAINING: Various formal classroom courses are utilized to support the training received as part of the certification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the certification card.

SCOPE: The Quality Assurance Certification card establishes the minimum education, skill, training, knowledge, and experience requirements for Quality Assurance personnel who perform inspection activities.

REFERENCES: WP 13-1, WID QA Program Manual
QAI PD2-3, Qualification and Certification of Inspection Personnel

CERTIFICATION CARD DESCRIPTION (by category)

1. General Knowledge

Demonstrate knowledge of the minimum site specific procedures:

- ASME NQA-1
- WID QA Program Manual
- Safety Manual
- Hoisting and Rigging Procedures
- Work Authorization Procedures
- Document Control Procedures

2. On-the-Job Training

Perform at least 20 hours of the following activities while supervised by a certified inspector:

- Receiving inspection
- Dimensional inspection
- Mechanical inspection
- Electrical inspection
- Civil inspection

3. Job Performance Measure

Perform the following tasks:

- Receipt inspection
- Conduct an inspection

- Hold/witness point inspection
- Issuance of a corrective action request
- Hold tag issuance
- Verification of corrective action
- Conduct a corrective action receipt inspection

QUAL CARD: Sampling Team (ST-01)

DURATION: 1 month

PREREQUISITES: HWW101 - Hazardous Waste Worker

SCOPE: This qualification card must be completed by all candidates prior to performing sampling tasks without the direct supervision of a qualified person. This qualification ensures that the sampler will collect samples in a way that will protect the sampler and the integrity of the sample collected.

REFERENCES: WIPP Sampling Team Qualification Guide ST-01G
WP 02-EM1 Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling
WP 02-EM2 WIPP Site Effluent and Hazardous Materials Sampling Plan

QUALIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

Demonstrate basic knowledge of hazardous waste sampling protocol such as:

- Preventing cross-contamination of samples and equipment
- Importance of the a chain-of-custody
- Purpose of the field logbook and documentation
- Labeling and sealing procedures
- Methods of obtaining various sample types (i.e. TCLP organics, volatile organic compounds, TCLP metals)

2. Safety Requirements

Demonstrate knowledge of the safety requirements for sampling activities such as:

- Level of personal protective equipment (PPE) needed for various sampling situations
- Actions to take when encountering damaged or bulging containers
- Importance of the "Buddy System"

3. Practical Requirements

- Correct and safe use of sampling equipment
- Collection of a given sample preventing cross-contamination
- Labeling and sealing sampling containers
- Completion of the Chain-of-Custody form

CERTIFICATION CARD: Facility Operations Roving Watch

DURATION: Six to nine months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the certification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the certification card.

SCOPE: The Facility Operations Roving Watch certification is the foundation for all of the Facility Operations certifications. The certifications developed utilizing the Facility Operations Roving Watch certification are the Central Monitoring Room Operator Certification (FO-CMRO-2) and the Facility Operations Shift Supervisor Certification (FO-FOSS-3) (for FSM). This certification is used by all Facility Operations personnel certifying. All of the requirements of the applicable certifications must be completed by the candidate before operating any equipment or performing any operating evolutions without direct supervision of a certified operator.

REFERENCES: Facility Operations Roving Watch Certification Card (FO-RW-1)
WIPP Operations Watchstation Certification Card Guide Book (FO-GUIDE-1)

CERTIFICATION CARD DESCRIPTION (by category)

1. System Knowledge

Demonstrate knowledge of the critical facility operating systems, such as:

- Theory of the system and equipment
- System design
- Differences in the various building systems around the facility
- Alarms and sequence of actions that follow alarms

The systems covered include:

- Facility electrical and backup electrical systems
- Heating, air conditioning, and ventilation systems
- Underground ventilation systems
- Domestic water and fire protection systems

2. System Operation Practical Evaluation

Demonstrate system startup/shutdown for the various facility systems according to procedures.

Demonstrate maintenance of applicable records pertaining to the operation of facility systems.

Demonstrate ability to conduct periodic required testing of facility systems.

Demonstrate competency to respond to alarms and emergency situations according to procedures.

3. Integrated Plant Knowledge

Discuss the site policies on equipment lockout/tagout.

Discuss the process of notifications and authorizations that is involved in making temporary plant modifications.

Discuss the site process for work authorization.

Discuss the role and responsibilities of Facility Operations on the site.

Discuss Conduct of Operations as it applies to Facility Operations.

4. Integrated Plant Practical Evaluation

Demonstrate the lockout/tagout process.

Prepare paperwork associated with a temporary plant modification.

Demonstrate ability to maintain the Facility Operations logs.

Demonstrate the actions that are taken in various facility emergencies.

Demonstrate ability to stand watch as RW during various shifts.

5. Oral Certification Exam

This final portion of the certification consists of an oral board exam conducted by board members who are knowledgeable in the certification program areas.

CERTIFICATION CARD: Central Monitoring Room Operator

DURATION: Three to five months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the certification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the certification card.

SCOPE: The Facility Operations Central Monitoring Room Operator Certification (FO-CMRO-2) in conjunction with the Roving Watch certification make up the support for the Facility Operations Shift Supervisor Certification (FO-FOSS-3). This certification is used by Facility Operations personnel certifying as CMR operators or Facility Operations Shift Supervisors. All of the requirements of the applicable certifications must be completed by the candidate prior to operating any equipment or performing any operating evolutions without direct supervision of a certified operator. Certifications are valid for two years.

REFERENCES: Central Monitoring Room Operator Certification Card (FO-CMR-2)
WIPP Operations Watchstation Certification Card Guide Book (FO-GUIDE-1)

CERTIFICATION CARD DESCRIPTION (by category)

1. System Knowledge

   Demonstrate knowledge of the following for the various systems in the Central Monitoring Room:

   - Theory of the system and equipment
   - System design
   - Alarms and sequence of actions that follow the alarms

2. System Operation Practical Evaluation

   Demonstrate competency in standard operation of the systems in the Central Monitoring Room including obtaining various pieces of information such as:

   - System status
   - Alarm Status
   - Meteorological data

   Demonstrate what actions are to take place in the event of an alarm.

   Demonstrate storage of information and subsequent retrieval.

3. Integrated Plant Knowledge

State the actions that must be taken to remove a CMS point scan/alarm check.

Discuss the sequence of events that must occur during a facility emergency.

4. Integrated Plant Practical Evaluation

Demonstrate how the CMR log is maintained.

Demonstrate the sequence of events that are involved in CMS point scan/alarm check removal.

Demonstrate ability to stand watch as CMRO during different shifts.

Demonstrate the sequence of events involved in a facility emergency.

5. Oral Certification Exam

This final portion of the certification consists of an oral board exam conducted by board members who are knowledgeable in the certification program areas.

CERTIFICATION CARD: Facility Operations Shift Supervisor

DURATION: Three to five months

CLASSROOM TRAINING: Various classroom courses are utilized to reinforce the training received as part of the certification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the certification card.

SCOPE: The Facility Operations Shift Supervisor Certification (FO-FOSS-3) is the final certification developed from the Central Monitoring Room Operator Certification and Roving Watch Certification. This certification is used by Facility Operations personnel, Facility Operations Engineer, and Facility Shift Manager. The candidate must be recommended by the Facility Operations Manager to perform this certification. All of the requirements of the applicable certifications must be completed by the candidate prior to operating any equipment or performing any operating evolutions without direct supervision of a certified operator. Certifications are valid for two years.

REFERENCES: Facility Operations Shift Supervisor (FO-FOSS-3)
WIPP Operations Watchstation Certification Card Guide Book (FO-GUIDE-1)

CERTIFICATION CARD DESCRIPTION (by category)

1. System Knowledge

Completed certification through Central Monitoring Room Operator Certification and Roving Watch Certification

2. System Operation Practical Evaluation

Completed certification through Central Monitoring Room Operator Certification and Roving Watch Certification

3. Integrated Plant Knowledge

Discuss the site work authorization process and the role of the FSM.

Discuss the use of operator aids.

Discuss the responsibilities of the FSM.

Discuss the use of shift instructions.

Discuss the role of the FSM in facility emergencies and the actions that are to be taken by the FSM.

Discuss the role of the Quality Assurance and Safety programs on the site.

Discuss the Contingency Plan and its implementation.

Discuss site regulatory compliance as it applies to hazardous waste and hazardous materials.

4. Integrated Plant Knowledge Evaluation

Complete the required documentation for a lockout/tagout.

Complete the proper documentation relating to temporary plant modifications.

Perform various work authorization actions.

Demonstrate a review of the Facility Operations logs.

Demonstrate the response required for various facility emergencies.

Demonstrate ability to stand watch as FSM during different shifts.

5. Oral Certification Exam

This final portion of the certification consists of an oral board exam conducted by board members who are knowledgeable in the certification program areas.

QUALIFICATION CARD: Equipment Tagout/Lockout Procedure, Authorizing Supervisor (OPS-01)

DURATION:

CLASSROOM TRAINING: Various classroom courses are used to reinforce the training received as part of this qualification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the qualification card.

SCOPE: All requirements of this Qualification Card must be completed by the candidate prior to performing any tagout/lockout evolutions without the direct supervision of a qualified operator or supervisor.

REFERENCES: WP 04-AD3001, Equipment Tagout/Lockout
WP 10-AD3005, Control and Use of Maintenance Locks

CERTIFICATION CARD DESCRIPTION (by category)

1. Knowledge requirements

   A. Know the purpose of:

   - Danger tag
   - Caution tag

   B. Know:

   - Conditions that require Operations lock
   - What sources may be utilized to determine proper placement of danger tags
   - Personnel authorized to place Operations locks and tags
   - When Operations locks and tags are placed/removed with respect to maintenance locks
   - Precautions observed while placing tags
   - Conditions to be met if maintenance lock is to be removed and technician is not available
   - Requirements for stored energy devices
   - Requirements for tagging mobile equipment
   - Conditions required for removal of a tagout/lockout
   - Consequences of intentionally violating a tagout/lockout
   - Actions taken if a discrepancy is found during tagout/lockout audit
   - Frequency of tagout/lockout audit performance
   - How to add work packages to Tagout/Lockout Control Sheet

   C. Know the concurrence requirements for:

   - Tagouts involving fire protection systems

- Tagouts involving operational safety requirement equipment or controlled area/radioactive materials boundaries

2. Practical Requirements

- Prepare an equipment Tagout/Lockout Control Sheet per WP 04-AD3011
- After tagout/lockout is authorized, place equipment tagout/lockout on per WP 04-AD3011
- Remove the equipment tagout/lockout per WP 04-AD3011
- Perform tagout/lockout audit per WP 04-AD3011
- Authorize a Tagout/Lockout Control Sheet for placement in the facility per WP 04-AD3011
- Authorize an equipment tagout/lockout removal per WP 04-AD3011

QUALIFICATION CARD: Equipment Tagout/Lockout Procedure, Operations Technician (OPS-01T)

DURATION:

CLASSROOM TRAINING: Various classroom training courses are utilized to reinforce the training received as part of this qualification card. The candidate is required to complete the classroom training courses, satisfactorily, prior to completion of the qualification card.

SCOPE: All requirements of this Qualification Card must be completed by the candidate prior to performing any tagout/lockout evolutions without the direct supervision of a qualified operator or supervisor.

REFERENCES: WP 04-AD3011, Equipment Tagout/Lockout
WP 04-AD3005, Control and Use of Maintenance Locks

CERTIFICATION CARD DESCRIPTION (by category)

1. Knowledge Requirements

A. Know the purpose of:

- Danger tag
- Caution tag

B. Know:

- Conditions requiring an Operations lock to accompany tagout
- What sources may be utilized to determine proper placement of danger tags
- Personnel authorized to place Operations locks and tags
- When Operations locks and tags are placed/removed with respect to maintenance locks
- Precautions observed while placing tags
- Conditions to be met if maintenance lock is to be removed and technician is not available
- Requirements for stored energy devices
- Requirements for tagging mobile equipment
- Conditions required for removal of a tagout/lockout
- Consequences of intentionally violating a tagout/lockout
- Actions taken if a discrepancy is found during tagout/lockout audit
- Frequency of tagout/lockout audit performance
- How to add work packages to Tagout/Lockout Control Sheet

C. Know the Concurrence Requirements for:

- Tagouts involving fire protection systems

- Tagouts involving Operational Safety Requirement equipment or Controlled Area/Radioactive Materials boundary

2. Practical Requirements

- Prepare equipment Tagout/Lockout Control Sheet per WP 04-AD3011
- Place equipment tagout/lockout on specified component per WP 04-AD3011
- Remove equipment tagout/lockout per WP 04-AD3011

QUALIFICATION CARD: Waste Handling Hoist Equipment Operator

DURATION: Approximately 12 to 15 months

SCOPE: The Waste Handling Hoist Equipment Operator Qualification (M-30) prepares the candidate to be a qualified man-hoist operator. All of the requirements for the applicable qualification must be completed prior to operating the Waste Handling Hoist unless under the direct supervision of a qualified operator.

REFERENCES: Waste Handling Hoist Equipment Operator Qualification Card Guide (M-30G)
Waste Handling Shaft Operation Procedure

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge

Demonstrate knowledge of the following systems associated with the Waste Hoist:

- Major components of the Waste Hoist in the headframe and collar areas
- Major components of the Waste Hoist electrical systems
- Be able to describe the correct operations of all Waste Hoist systems and their interrelationships

2. Equipment Safety

Demonstrate knowledge of all safety systems associated with the Waste Hoist and how their functions affect hoist operation.

Describe the correct response of the operator when safety features are actuated.

3. Equipment Maintenance

Describe the maintenance activities and requirements for the Waste Hoist systems.

State the actions of the Waste Hoist operator during the performance of maintenance activities.

4. Equipment Practical

Perform normal startup and shutdown of all Waste Hoist systems.

Perform normal hoisting operations for material and personnel in all modes of operation.

5. Oral Qualification Exam

This final portion of the certification consists of an oral board exam conduced by board members who are knowledgeable in the certification program areas.

QUALIFICATION CARD: Waste Handling Shaft Tender Operator

DURATION: Approximately 7 months

SCOPE: The Waste Handling Shaft Tender Operator Qualification (M-31) prepares the candidate to operate controls and systems located at both the collar area (surface) and the station area (underground) at the Waste Shaft. All the requirements for this qualification must be completed prior to operation of Waste Shaft systems unless under the direct supervision of a qualified operator.

REFERENCES: Waste Handling Shaft Tender Qualification Guide (M-31G)
Waste Handling Shaft Operation Procedure

QUALIFICATION CARD DESCRIPTION (by category)

1. Equipment Knowledge

   Demonstrate knowledge of the following Waste Shaft equipment at the collar and station:

   - Waste Shaft controls
   - Communication systems
   - Conveyance control panels
   - Cage and its capacity

2. Equipment Safety

   Demonstrate knowledge of all safety systems and devices associated with the Waste Hoist.

   Describe the position responsibilities with regard to shaft safety and who to contact during abnormal conditions.

3. Personnel Safety

   Demonstrate knowledge of the requirements for all personnel who wish to enter the underground via the Waste Shaft.

   Demonstrate knowledge of actions required during all work in and around the Waste Shaft or surrounding areas.

4. Equipment Maintenance

   Describe the maintenance and inspection duties of both the collar and station tender.

5. Equipment Practical

Perform pre-shift inspections of the collar and station areas.

Perform all record keeping duties of the shaft tender.

Demonstrate proper operation of the Local Control Stations, Pivot Rail System, and Bell Systems.

6. Oral Qualification Exam

This final portion of the qualification consists of an oral board exam conducted by board members who are knowledgeable in the certification program areas.

DETAILED DESIGN REPORT FOR AN OPERATIONAL PHASE PANEL-CLOSURE SYSTEM

DOE/WIPP-96-2150

Any comments or questions regarding this report
should be directed to the U.S. Department of Energy
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List of Abbreviations/Acronyms

ACI	American Concrete Institute
AISC	American Institute for Steel Construction
*CFR	Code of Federal Regulations
cm	centimeter
°C	degrees celsius
°F	degrees Fahrenheit
DOE	U.S. Department of Energy
DRZ	disturbed rock zone
EEP	Excavation Effects Program
ESC	expansive salt-saturated concrete
FLAC	Fast Lagrangian Analysis of Continua
ft	foot (feet)
GPR	ground-penetrating radar
Kips	1,000 pounds
m	meter(s)
MB 139	Marker Bed 139
MPa	megapascal(s)
MSHA	Mine Safety and Health Administration
NaCl	sodium chloride
NMVP	no-migration variance petition
psi	pound(s) per square inch
RCRA	Resource Conservation and Recovery Act
SMC	Salado Mass Concrete
TRU	transuranic
VOC	volatile organic compound(s)
Westinghouse	Westinghouse Electric Corporation
WID	Waste Isolation Division
WIPP	Waste Isolation Pilot Plant

Certification

I certify under penalty of law that this document was prepared under my supervision for Westinghouse Electric Corporation, Waste Isolation Division, Waste Isolation Pilot Plant, by IT Corporation according to the IT Environmental Engineering and Services Quality Assurance Program. This program is designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

John B. Case, P.E.

John B. Case, P.E.
New Mexico
Certification No. 8049
Expires December 31, 1997

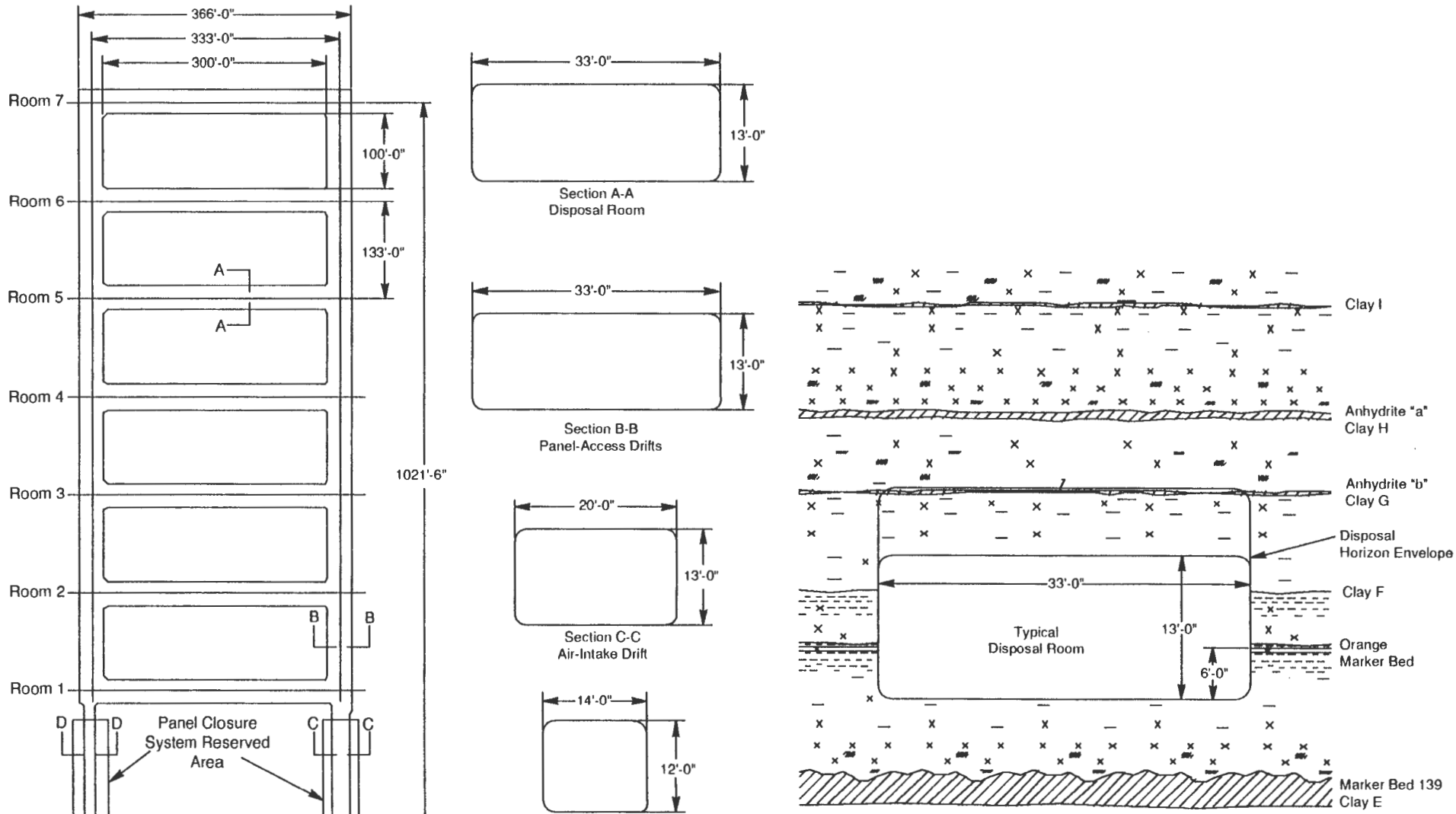
Executive Summary

Scope. Under contract to Westinghouse Electric Corporation (Westinghouse), Waste Isolation Division (WID), IT Corporation has prepared a detailed design of a panel-closure system for the Waste Isolation Pilot Plant (WIPP). Preparation of this detailed design of an operational-phase closure system is required to support a Resource Conservation and Recovery Act (RCRA) Part B permit application and a no-migration variance petition. This report describes the detailed design for a panel-closure system specific to the WIPP site. The recommended panel-closure system will adequately isolate the waste-emplacement panels for at least 35 years.

Purpose. This report provides detailed design and material engineering specifications for the construction, emplacement, and interface-grouting associated with a panel-closure system at the WIPP repository, which would ensure that an effective panel-closure system is in place for at least 35 years. The panel-closure system provides assurance that the limit for the migration of volatile organic compounds (VOC) will be met at the point of compliance, the WIPP site boundary. This assurance is obtained through the inherent flexibility of the panel-closure system. The panel-closure system will be located in the air-intake and air-exhaust drifts (Figure ES-1). The system components have been designed to maintain their intended functional requirements under loads generated from salt creep, internal pressure, and a postulated methane explosion. The design complies with regulatory requirements for a panel-closure system promulgated by RCRA and the Mine Health and Safety Administration (MSHA). The design uses common construction practices according to existing standards.

Background. The engineering design considers a range of expected subsurface conditions at the location of a panel-closure system. The geology is predominantly halite with interbedded anhydrite at the repository horizon. During the operational period, the panel-closure system would be subject to creep from the surrounding host rock that contains trace amounts of brine.

During the conceptual design stage, two air-flow models were evaluated: (1) unrestricted flow and (2) restricted flow through the panel-closure system. The "unrestricted" air flow model is defined as a model in which the gas pressure that develops is at or very near atmospheric pressure such that there exists no back pressure in the disposal areas. Flow is unrestricted in this model. The "restricted" air flow model is defined as a model in which the



Note: Figure is Not to Scale
All Dimensions Shown are Nominal

Figure ES-1
Typical Facilities-Typical Disposal Panel
(After Westinghouse, 1995c)

back pressure in the waste emplacement panels develops due to the restriction of flow through the barrier, and the surrounding disturbed rock zone. The analysis was based on an assumed gas generation rate of 8,200 moles per panel per year (0.1 moles per drum per year) due to microbial degradation, an expected volumetric closure rate of 28,000 cubic feet (800 cubic meters) per year due to salt creep, the expected headspace concentration for a series of nine VOCs, and the expected air dispersion from the exhaust shaft to the WIPP site boundary. The analysis indicated that the panel-closure system would limit the concentration of each VOC at the WIPP site boundary to a small fraction of the health-based exposure limits during the operational period.

Alternate Designs. Various options were evaluated considering active systems, passive systems, and composite systems. Consideration of the aforementioned factors led to the selection of a passive panel-closure system consisting of: (1) a standard concrete barrier, rectangular in shape, or (2) an enlarged tapered concrete barrier. Options (1) and (2) will be grouted at the interface and may contain an explosion-isolation wall or a construction-isolation wall. This system provides flexibility for a range of ground conditions likely to be encountered in the underground repository. No other special requirements for engineered components beyond the normal requirements for fire suppression and methane explosion or deflagration containment exist for the panel-closure system during the operational period.

The panel-closure system design incorporates mitigative measures to address the treatment of fractures and therefore minimizes the potential migration of contaminants. The design option for mitigating fractures includes excavating the disturbed rock zone (DRZ) and emplacing an enlarged concrete barrier.

To be effective, the excavation and installation of the panel-closure system must be completed within a short time frame to minimize disturbance to the surrounding salt. A rigid concrete barrier will promote interface stress buildup, as fractures are expected to heal with time. For this purpose, the main concrete barrier would be tapered to reduce shear stress and to increase compressive stress along the interface zone. If ground conditions are more favorable, the design can be simplified to a standard concrete barrier with an explosion-isolation or construction-isolation wall without DRZ removal.[1]

---

[1]DRZ removal is used in the context of the removal of fractured rock.

Design Classification. Procedure WP 09-CN3023 (Westinghouse, 1995a) was used to establish a design classification for the panel-closure system. It uses a decision-flow-logic process to designate the panel-closure system as a Class IIIB structure. This is because during the methane explosion the concrete barrier would not fail.

Design Evaluations. To investigate several key design issues, design evaluations were performed. These design evaluations can be divided into those that satisfy (1) the operational requirements of the system and (2) the structural and material requirements of the system.

The conclusions reached from the evaluations addressing the operational requirements are as follows:

- Based on an air-flow model used to predict the mass flow rate of carbon tetrachloride through the panel-closure system for the alternatives, the air-flow analysis suggests that the fully enlarged barrier provides the highest protection for restricting VOCs during the operational period of 35 years.

- Results of the Fast Lagrangian Analysis of Continua (FLAC) analyses show that the recommended enlarged configuration is a circular rib-segment excavated to Clay G and under MB 139. Interface grouting would be performed at the upper boundary of the concrete barrier.

- The results of the transverse plane-strain models show that higher stresses would form in MB 139 following excavation, but that after installation of the panel-closure system, the barrier confinement will result in an increase in barrier-confining stress and a reduction in shear stress. The main concrete barrier would provide substantial uniform confining stresses as the barrier is subjected to secondary salt creep.

- The removal of the fractured salt prior to installation of the main concrete barrier would reduce the potential for flexure. The fracturing of MB 139 and the attendant fracturing of the floor could reduce structural load resistance (structural stiffness), which could initially result in barrier flexure and shear. With the removal of MB 139, the fractured salt stiffens the surrounding rock and results in the development of more uniform compression.

- The trade-off study also showed that a panel-closure system with an enlarged concrete barrier with the removal of the fractured salt roof and anhydrite in the floor was found to be the most protective.

The conclusions reached from the design evaluations addressing the structural and material requirements of the panel-closure system are as follows:

- Existing information on the heat of hydration of the concrete supports placing concrete with a low cement content to reduce the temperature rise associated with hydration. Plasticizers might be used to achieve the required slump at the required strength. A thermal analysis, coupled with a salt creep analysis, suggests installation of the enlarged barrier at or below ambient temperatures to adequately control hydration temperatures.

- In addition to installation at or below ambient temperatures, the concrete used in the main barrier would exhibit the following:

  - An 8 inch (0.2 meter) slump after 3 hours of intermittent mixing

  - A less-than-25-degree Fahrenheit heat rise prior to installation

  - An unconfined compressive strength of 4,000 pounds per square inch (psi) (28 megapascals [MPa]) after 28 days

  - Volume stability

  - Minimal entrained air.

- The trace amounts of brine from the salt at the repository horizon will not degrade the main concrete barrier for at least 35 years.

- In 20 years, the open passage above the waste stack would be reduced in size. Further, rooms with bulkheads at each end would be isolated in the panel. It is unlikely that a long passage with an open geometry would exist; therefore, the dynamic analysis considered a deflagration with a peak explosive pressure of 240 psi (1.7 MPa).

- The heat-transfer analysis shows that elevated temperatures would occur within the salt and the explosion-isolation wall; however, the elevated temperatures will be isolated by the panel-closure system. Temperature gradients will not significantly affect the stability of the wall.

- The fractures in the roof and floor could be affected by expanding gas products reaching pressures on the order of 240 psi (1.7 MPa). Because the peak internal pressure from the deflagration is only one fifth of the pressure, fractures could not propagate beyond the barrier.

A composite system is selected for the design with various components to provide flexibility. These design options are described below.

Design Options. Figure ES-2 illustrates the options developed to satisfy the requirements for the panel-closure system. The basis for selecting an option depends on conditions at the panel-closure system locations as would be documented by future subsurface investigations.

These design options provide flexibility in satisfying the design migration limit for the flow of VOCs out of the waste-emplacement panel. An enlarged concrete barrier would be selected for the air-intake and air-exhaust drifts that have fractured rock to eliminate significant flow of VOCs. Several methods are available for detecting the location and extent of fractures in the DRZ for optimum placement of an enlarged concrete barrier. These detection methods include ground-penetrating radar (GPR) and inspection of observation boreholes.

For future waste panels, GPR would be used to monitor fracture development. Radar surveys would be conducted shortly after excavation to provide a baseline for comparison to future radar surveys. GPR would be used periodically to monitor the development of brittle deformation in the new air-intake and air-exhaust drifts of a panel.

Observation boreholes would be drilled into the roof or floor of an excavation and would be inspected for fractures and bed separation. Observations in the boreholes can be made with a small video camera, or a simple scratch rod.

While no specific requirements exist for barricading inactive waste areas under the MSHA, their intent is to safely isolate these abandoned areas from active workings using barricades of "substantial construction." A previous analysis (DOE, 1995) examined the issue of methane gas generation from transuranic waste and the potential consequence in closed areas. The principal concern is whether an explosive mixture of methane with an ignition source would result in deflagration. If a methane explosion is considered possible, a concrete block wall of sufficient thickness will be used to resist dynamic and salt creep loads. A construction isolation wall will be used in the absence of explosive conditions.

It was shown (DOE, 1995) that an explosive atmosphere may exist after approximately 20 years. A panel-closure system with a closure life less than 20 years would not require an explosion-isolation wall, because an explosive mixture could not accumulate. A construction-isolation wall will suffice to provide isolation during construction of the main concrete barrier.

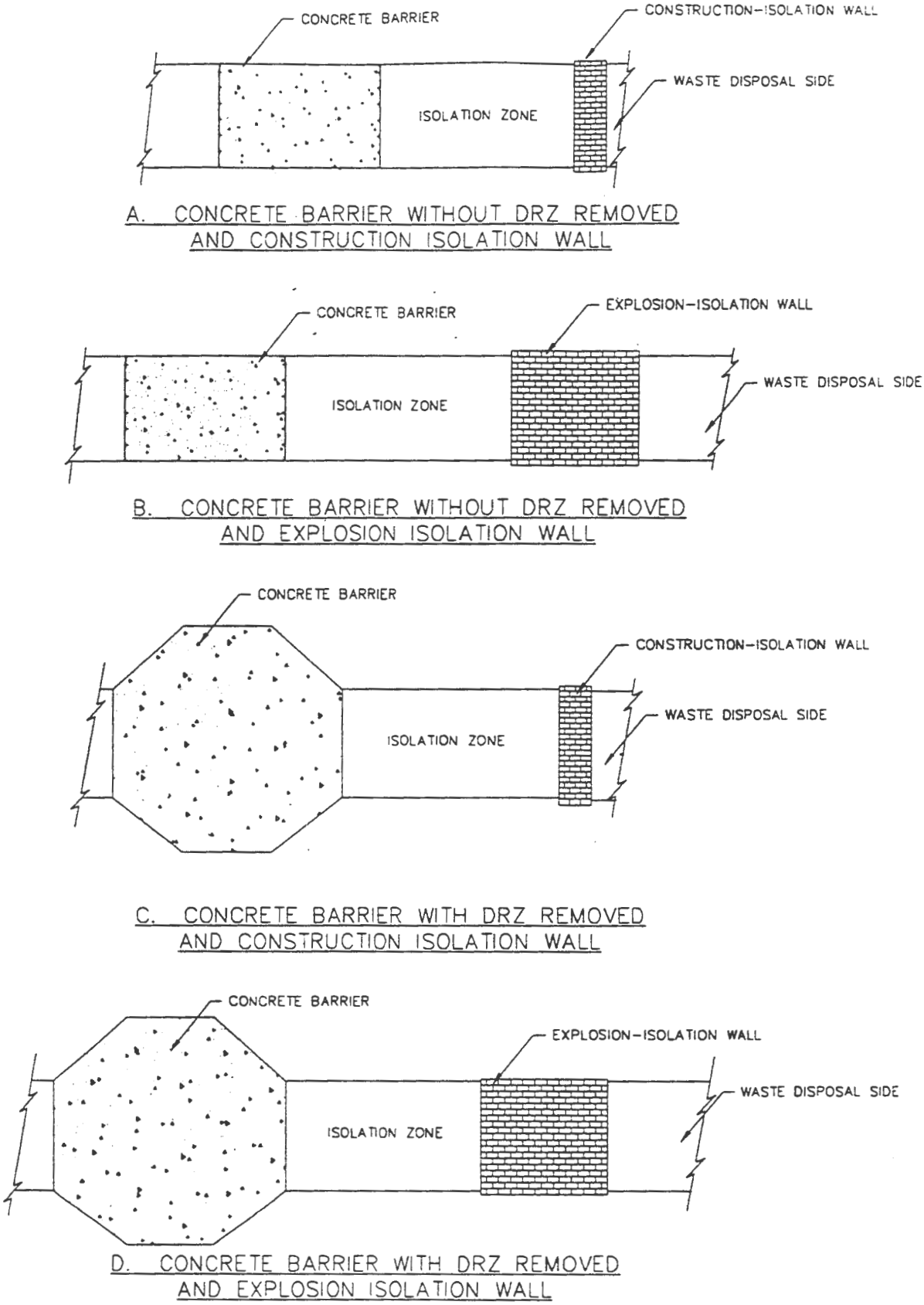


Figure ES-2
Main Barrier with Wall Combinations

Design Components. The enlarged concrete barrier will be located at the optimum location in the air-intake and air-exhaust drifts following observation of subsurface conditions. The enlarged concrete barrier will be composed of plain concrete with sufficient unconfined compressive strength. The barrier will consist of a circular rib segment excavated into the surrounding salt where the central portion of the barrier will extend just beyond Clay G and MB 139. FLAC analyses showed that plain concrete will develop adequate confined compressive strength.

The enlarged concrete barrier will be placed in four cells, with construction joints formed perpendicular to the direction of potential air flow. The concrete will be placed through 6-inch (15.2 centimeter) diameter steel pipes and will be vibrated from outside the formwork. The formwork is designed to withstand the hydrostatic loads that would occur during installation with minimal bracing onto exposed salt surfaces. This will be accomplished by a series of steel plates that are stiffened by angle iron, with load reactions carried by spacer rods. Some exterior bracing will be required when the concrete is poured into the first cell at the location for the enlarged concrete barrier. All structural steel will be American Society of Testing and Materials [grade] A36 in conformance with the latest standards specified by the American Institute for Steel Construction. After concrete placement, the formwork will be left in place and will stiffen the enlarged concrete barrier if nonuniform reactive loadings should occur after panel closure.

After completion of the enlarged concrete barrier installation, it will be grouted through a series of grout supply and air return lines that terminate in grout boxes. The boxes will be mounted near the top of the barrier. The grout will be injected through one set of lines and returned through a second set of air lines.

An explosion-isolation wall, constructed with concrete-blocks, will mitigate the effects of a methane explosion. The explosion-isolation wall would consist of 3,500 psi (24 MPa) concrete blocks mortared together with a bonding agent. The concrete-block wall design complies with MSHA requirements, because it consists of noncombustible materials of "substantial construction." The concrete-block walls will be keyed into the salt. For the WIPP, an explosion-isolation wall is designed to resist loading from salt creep.

The compliance of the detailed design was evaluated against the design requirements established for the panel-closure system. The design complies with all aspects of the design basis established for the panel-closure system.

1.0 Introduction

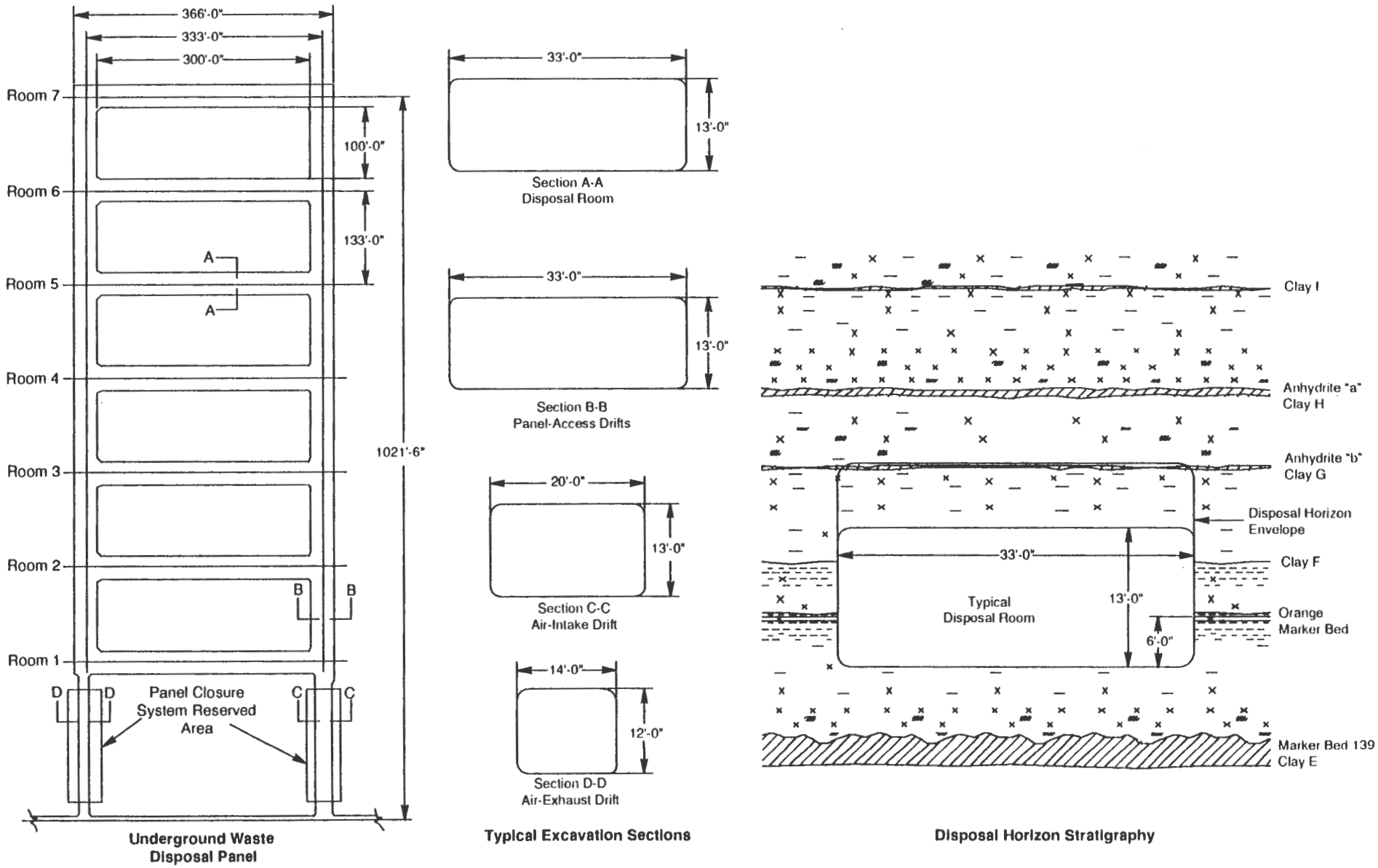
The Waste Isolation Pilot Plant (WIPP), a U.S. Department of Energy (DOE) research facility located near Carlsbad, New Mexico, was established to demonstrate the safe disposal of defense-generated transuranic (TRU) waste. The WIPP repository is approximately 2,150 feet (ft) (655 meters [m]) below the surface, in the Salado Formation. The WIPP facility consists of a northern experimental area, a shaft-pillar area, and a waste-emplacement area.

One important aspect of future repository operations at the WIPP is the activities associated with closure of waste-emplacement panels. Each panel consists of air-intake and air-exhaust drifts, panel-access drifts, and seven rooms (Figure 1-1). After completion of waste-emplacement activities, each panel will be closed, while waste emplacement may be occurring in the other panel(s). The closure of individual panels during the operational period will be conducted in compliance with project-specific health, safety, and environmental performance criteria.

1.1 Scope

This report provides information on the detailed design and material engineering specifications for the construction, installation, and interface grouting associated with a panel-closure system for a minimum operational period of 35 years. The panel-closure system design provides assurance that the limit for the migration of volatile organic compounds (VOC) will be met at the point of compliance, the WIPP site boundary. This assurance is obtained through the inherent flexibility of the panel closure system. The panel-closure system will be located in the air-intake and air-exhaust drifts to each panel (Figure 1-1). The panel-closure system design maintains its intended functional requirements under loads generated from salt creep, internal panel pressure, and a postulated methane explosion. The design complies with regulatory requirements for a panel-closure system promulgated by the Resource Conservation and Recovery Act (RCRA) and Mine Safety and Health Administration (MSHA).

Figure 1-2 illustrates the design process used for preparing the detailed design. The design process commenced with the evaluation of the performance requirements of the panel-closure system through review of the work performed in developing the conceptual design and the "Underground Hazardous Waste Management Unit Closure Criteria for the Waste Isolation Pilot Plant Operation Phase" (Westinghouse, 1995b). The various design evaluations were



Note: Figure is Not to Scale
All Dimensions Shown are Nominal

Figure 1-1
Typical Facilities-Typical Disposal Panel
(After Westinghouse, 1995c)

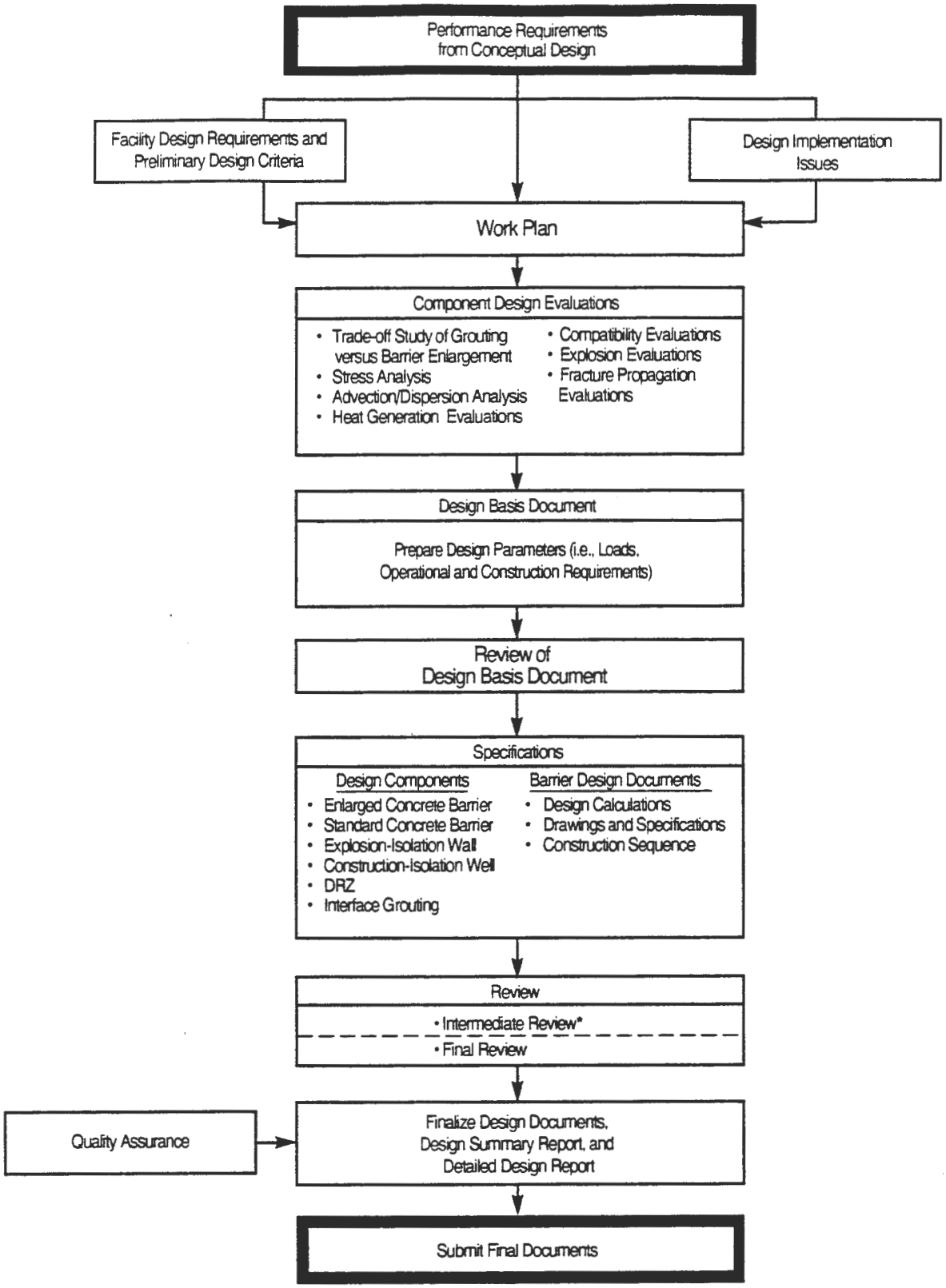


Figure 1-2
Design Process for the Panel-Closure System

performed to address specific design-implementation issues identified by the project. The results of these design evaluations are presented in this report.

1.2 Design Classification

Procedure WP 09-CN3023 (Westinghouse, 1995a) was used to establish a design classification for the panel-closure system. The design classification for the panel-closure system evolved from addressing the short-term operational issues regarding the reduction of VOC migration. Figure 1-3 shows the decision flow logic process used to designate the panel-closure system as a Class IIIB structure.

1.3 Regulatory Requirements

The following subsections discuss the regulatory requirements specified in RCRA and MSHA for the panel-closure system.

1.3.1 Resource Conservation and Recovery Act (40 CFR 264, 268, and 270)

In accordance with Title 40, Code of Federal Regulations (CFR), Part 264, Subpart X (40 CFR 264, Subpart X), "Miscellaneous Units," and 40 CFR 270.23, "Specific Part B Information Requirements for Miscellaneous Units," a RCRA Part B permit application has been submitted for the WIPP facility. According to 40 CFR 268.6, the DOE has opted to pursue a no-migration variance petition (NMVP) instead of treating waste to meet the land disposal restrictions (40 CFR 268) (EPA, 1995).

1.3.2 Protection of the Environment and Human Health

Both the draft NMVP and the WIPP RCRA Part B permit application indicate that VOCs must not exceed health-based standards beyond the WIPP site boundary. Worker exposure to VOCs, and VOC emissions will not pose greater than a 10^{-6} excess cancer risk to the nearest resident in order to meet health-based standards. The panel-closure system design incorporates measures to mitigate VOC migration for compliance with these standards.

1.3.3 Closure Requirements (20 New Mexico Administrative Code 4.1, Subpart V)

The DOE will notify the Secretary of the New Mexico Environment Department in writing at least 60 days prior to the date on which partial and final closure activities are scheduled to begin.

A. Select a system structure or component for classification. (Start with a mitigating item)

B. Is the system, structure, or component required to mitigate the consequences of an accident?

C. Would the system, structure, or component failure result in loss of safety functions of a Design Class I components?

D. Does the system, structure, or component provide any function related to nuclear materials?

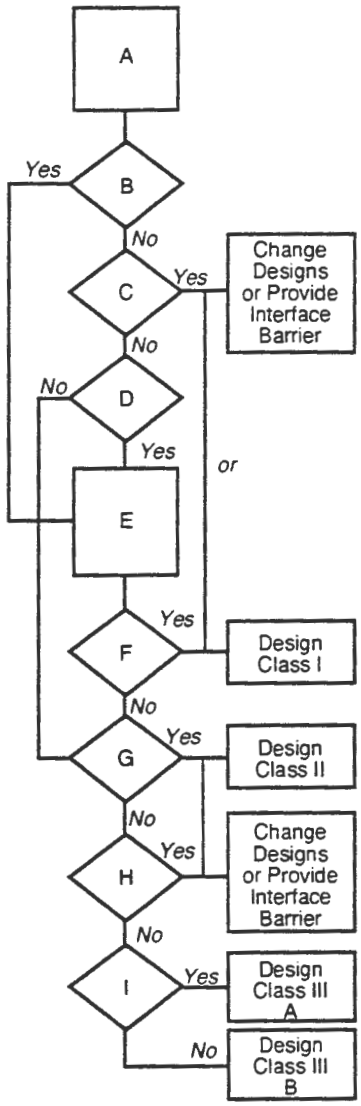
E. Select a conservative accident scenario and perform safety analysis.

F. Does the cumulative radiological consequences following the accident exceed 25 Rem whole body or 75 Rem organ dose commitment to an individual at the Zone I boundary

G. Does the structure, system, operation or component conform to the Class II criteria as defined in Attachment 2?

H. Would the structure, system, operation or component failure result in loss of the required function of a Class II component?

I. Are special design requirements necessary to ensure that failure of the system, structure, or component will NOT result in a significant shutdown of the facility or inhibit accessibility or maintainability of required equipment or have special significance to health and safety of operations personnel?



B. _____YES __X__ NO
Descibe requirement

C. _____YES __X__ NO
Failure mode and affected class I component

D. _____YES __X__ NO
Describe function

E. _____YES __N/A__ NO
Attach safety analysis

F. _____YES _____NO
Calculate dose rates
N/A

(Attach calculations to this form)

G. _____YES __X__ NO
Criteria
N/A

H. _____YES __X__ NO
Failure mode and affected Class II component

I. _____YES __X__ NO
Requirements

Figure 1-3
Design Classification of the Panel-Closure System
(Modified from Westinghouse, 1995a)

1.3.4 Mining Safety and Health Administration

The significance of small natural-gas occurrences within the WIPP repository is within the classification of Category IV for natural gas under the MSHA (30 CFR 57, Subpart T) (MSHA, 1987). These regulations include the hazards of methane gas and volatile dust. Category IV "applies to mines in which non-combustible ore is extracted and which liberate a concentration of methane that is not explosive nor capable of forming explosive mixtures with air based on the history of the mine or the geological area in which the mine is located." For "barriers and stoppings," the regulations provide for noncombustible materials (where appropriate) for the specific mine category and require that "barriers and stoppings" be of "substantial construction." Substantial construction implies construction of such strength, material, and workmanship that the barrier could withstand air blasts, methane detonation or deflagration, blasting shock, and ground movement expected in the mining environment.

1.4 Report Organization

This report presents the engineering package for the detailed design of the panel-closure system. Chapter 2.0 presents the design evaluations. Chapter 3.0 describes the design and Chapter 4.0 presents the Constructability Design Calculations Index. Chapter 5.0 shows the technical specifications. Chapter 6.0 presents the design drawings. The conclusions are presented in Chapter 7.0 and the references presented in Chapter 8.0. Appendices to this report provide detailed information to support the information contained in Chapters 2.0 through 7.0 of this report.

2.0 Design Evaluations

This chapter presents the results of the various design evaluations that support the panel-closure system: (1) analyses addressing the operational requirements, and (2) analyses addressing the structural and material requirements. The first group includes air-flow analyses, an advection/dispersion analysis, and stress analyses using the Fast Lagrangian Analysis of Continua (FLAC) (Itasca, 1995), which support a trade-off study comparing grouting to removal of fracture zones in both the roof and floor. The second group addresses the issue of material compatibility with the host rock and heat-generation that may cause thermal cracking in the main concrete barriers during cement hydration. The second group also includes methane-explosion and fracture-propagation evaluations to address the dynamic pressure and subsequent temperatures generated by a postulated methane explosion.

2.1 Analyses Addressing Operational Requirements

The panel-closure system incorporates design features to address a range of ground conditions, including the most severe ground conditions expected in the air-intake and air-exhaust drifts. The alternatives for dealing with the most severe ground conditions include excavating the fractured disturbed rock zone (DRZ)[2] and installing an enlarged concrete barrier or partially enlarged concrete barrier with interface grouting or emplacing a standard concrete barrier with formation grouting. To evaluate the effectiveness of these alternatives for a panel-closure system, air-flow analyses and structural analyses were performed. The air-flow analyses examined the flow of VOCs through the panel-closure system for these alternatives.

The flow of VOCs is influenced by interface stress development. At the interface, the flow was assumed to be equivalent to a fracture zone. To investigate interface-stress development and the influence of barrier shape, structural analyses were performed for the main concrete barrier. These structural analyses were then used to determine the loads on the main concrete barrier.

The following sections address the air-flow analyses, the advection/dispersion analysis, and the stress analyses that support the trade-off study for designs with or without DRZ removal for overall protection of human health and the environment and compliance at the WIPP site boundary.

[2]DRZ removal is used in the context of the removal of fractured rock in the DRZ.

2.1.1 Air-Flow Analyses

The purpose of the air-flow analysis was to evaluate the trade-offs among a standard concrete barrier with formation grouting, a partially enlarged concrete barrier with partial DRZ removal (roof), and a fully enlarged concrete barrier with complete DRZ removal. Subsequent analyses were performed to evaluate air flow for these alternatives. The air-flow model (DOE, 1995) was used to evaluate the effective intrinsic barrier permeability of the main concrete barrier for these alternatives and to assess VOC flow performance.

In previous studies (DOE, 1995), two air-flow models were evaluated: 1) unrestricted flow, and 2) restricted flow through a panel-closure system. Unrestricted air flow is defined as flow in which the gas pressure develops at or very near atmospheric pressure. No back pressure exists in the waste emplacement areas. Restricted flow is defined as flow in which a back pressure develops due to the restriction of flow through the barrier and the surrounding disturbed rock zone. The analyses were based on an assumed gas generation rate of 8,200 moles per panel per year (0.1 moles per drum per year) due to microbial degradation, an expected volumetric closure rate of 28,000 ft^3 (800 m^3) per year due to salt creep, the expected headspace concentration for nine VOCs, and the expected air dispersion from the exhaust shaft to point of compliance, the WIPP site boundary. The previous analyses indicated that the panel-closure system would limit the concentration (Figures 2-1 and 2-2) of each VOC to a small fraction of the health-based exposure levels during the operational period at the WIPP site boundary.

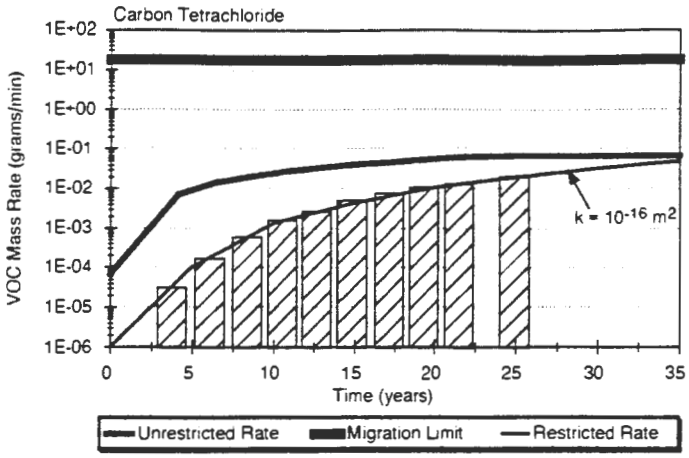
2.1.1.1 Evaluation Procedure

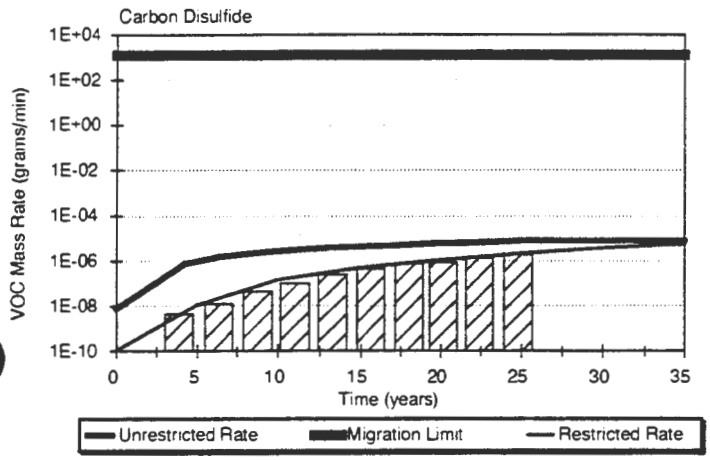
In the following analysis, the gases generated in the waste-emplacement area are in part compressed in the void space within a panel and in part flow into the main return air. The following assumptions were made in this model:

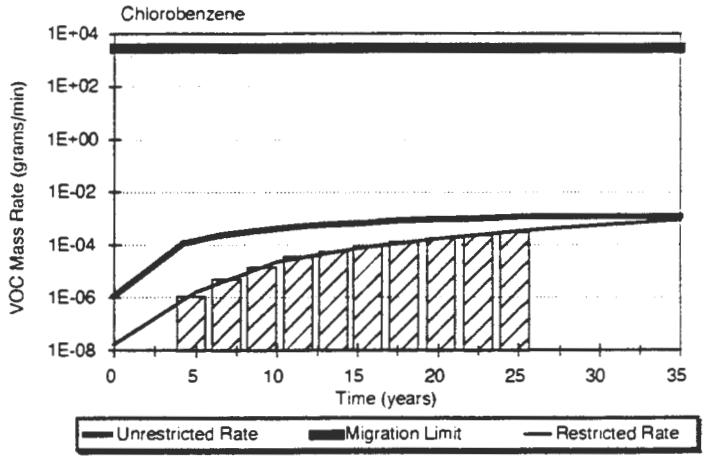
- That the gases (including VOCs) within the void space will obey the ideal gas law. The gases will be generated at a rate of 0.1 moles per drum per year and will be stored by an increase in gas pressure. The rate of pressure buildup will be so gradual that it occurs at constant temperature.

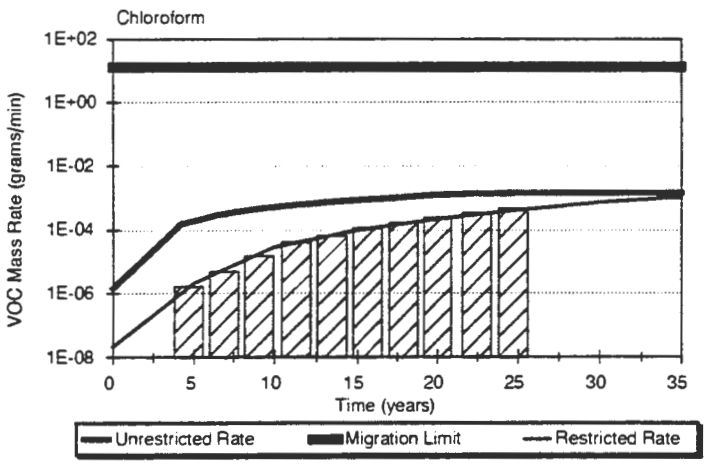
- That volumetric reduction due to creep will reduce the void space at a rate of 28,000 ft^3 (800 m^3) per year and will result in pressurization.

- That the flow of gas out of the panel will obey Darcy's law under quasisteady-state conditions. Under quasisteady-state conditions, the air pressure within the panel-closure system will change so gradually that the compressive storage of the air within the void space of the panel-closure system could be neglected.









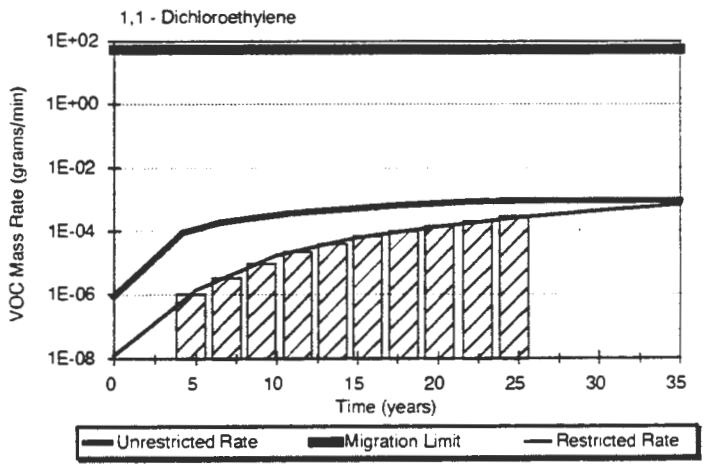


Figure 2-1

Closed-Panel Release Rate Versus Limit Comparison for Carbon Tetrachloride and Other VOCs

(After DOE, 1995)

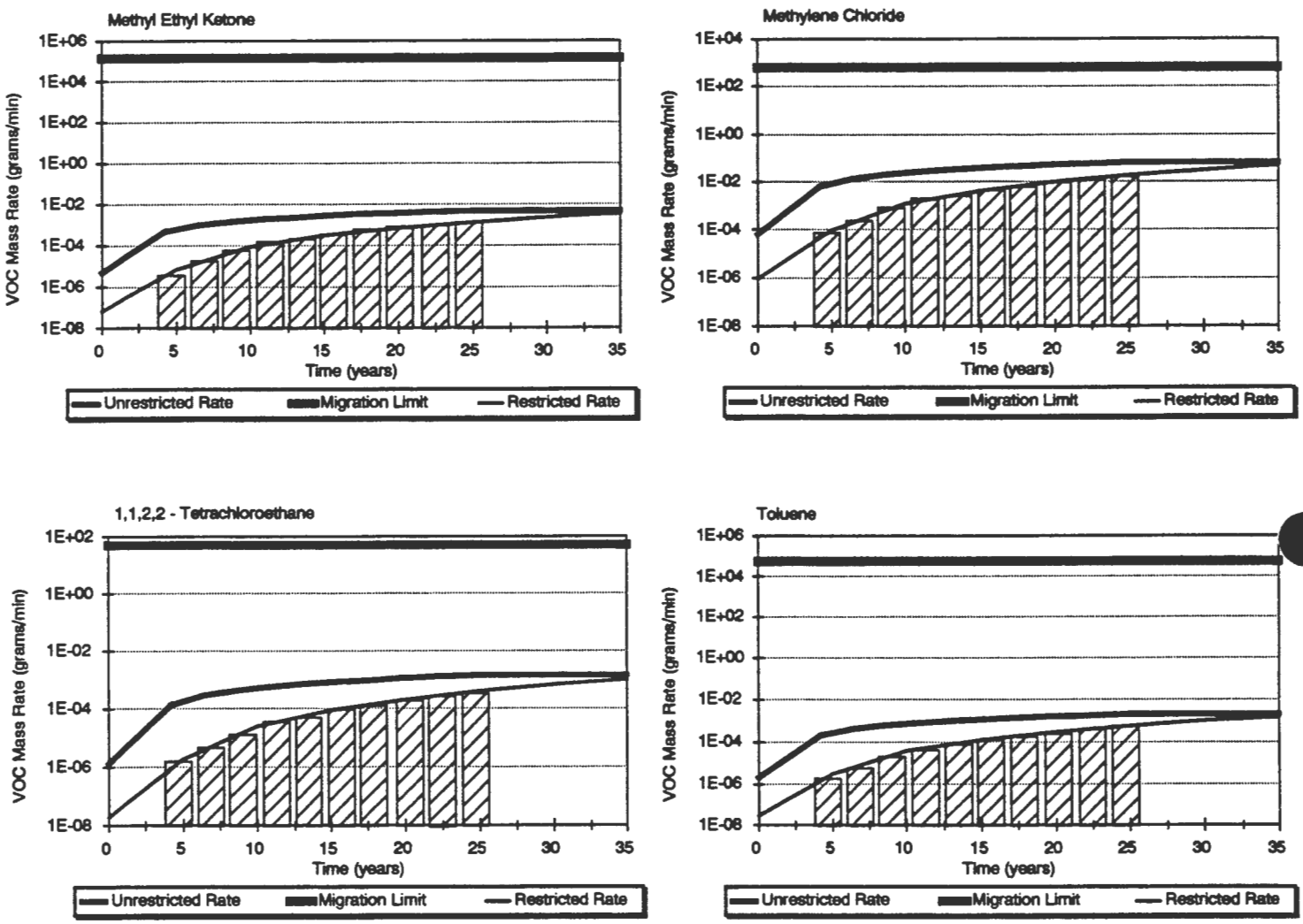


Figure 2-2

Closed-Panel Release Rate Versus Limit Comparison for Other VOCs

(After DOE, 1995)

- That the rates of gas generation, air outflow, and change in compressive storage will balance.
- That hydrodynamic dispersion will be neglected in the analysis.
- That the analysis will consider the superposition of flow rates from individual panels according to the operating schedule for an operational life of at least 35 years.

The air flow under these assumptions follows a nonlinear first-order ordinary differential equation. The model is characterized by molar gas generation and a reduction in void volume that results in an increase in air pressure.

The problem can be stated by solving the system of nonlinear ordinary differential equations as derived in Appendix A:

$$\frac{dP}{dt} = R * T * \frac{\left(g_r - \frac{P}{RT} * C * \frac{P - P_{atm}}{\gamma}\right) * V - n\frac{dV}{dt}}{V^2}$$

$$\frac{dn}{dt} = g_r - \frac{P}{R*T} * C * \frac{P - Patm}{\gamma}$$

where

dt	=	Change in time (years)
R	=	Universal gas constant
T	=	Absolute temperature
n	=	Moles of gas in the panel that is a function of time
P	=	Pressure
P_{atm}	=	Atmospheric pressure
C	=	Conductance of the panel-closure system = $K_s * \frac{A}{L}$
K_s	=	Air conductivity of the panel-closure system
A	=	Cross sectional area of the panel-closure system
L	=	Flow path length of the panel-closure system
γ	=	Air density
g_r	=	Gas generation rate
V	=	Panel volume

$\frac{dV}{dt}$ = Panel volumetric-closure rate

$\frac{dP}{dt}$ = Panel-pressure rate

$\frac{dn}{dt}$ = Panel-molar storage rate.

The above relationships are subject to the following initial conditions: (1) that the pressure in the panel will be atmospheric, and (2) the moles equals the moles of gas occupying the initial panel void volume at the temperature of the repository.

The analysis assumed that the volume of the waste is equal to the total waste capacity of a panel (600,000 ft^3 [16,990 m^3]) (DOE, 1994a) times the assumed average solid volume of the waste drums (23 percent) (IT, 1994). The analysis uses a solid waste volume equal to 138,000 ft^3 (3,910 m^3) for the panel and this volume remains constant during the operational life of the panel. The analysis then evaluates the void volume at panel closure, approximately four years after panel excavation.

The waste-emplacement capacity of a panel includes the seven rooms and the panel-access drifts from Room 1 to Room 7. The analysis uses closure rate and total closure data from the Geotechnical Analysis Report (DOE, 1994b). A combination of field data and empirical analysis is used to determine long-term closure rates for 35 years as presented in Appendix B.

The effective conductivity (K_s) can be further expressed in terms of an effective intrinsic panel-closure system permeability as (Freeze and Cherry, 1979):

$$K_s = \frac{k_s * \rho * g}{\mu}$$

where

K_s = Air conductivity
k_s = Effective concrete barrier permeability (m^2)

ρ = Mass density
g = Acceleration due to gravity
μ = Absolute viscosity.

The calculations assumed that the cross-sectional area for flow through the DRZ and the panel-closure system will equal 9 times the air-intake and air-exhaust area or that the DRZ extends out 3 radii from the center. Case and Kelsall (1986) evaluated permeability measurements performed by Peterson et al. (1985). These data showed a zone of increased permeability (10^{-18} to 10^{-20} ft^2 [10^{-19} m^2 to 10^{-21} m^2]) from (3 to 42 ft [1 to 14 m]). The boundary of the DRZ used in the analysis falls within their range.

The effective intrinsic permeability was calculated by considering the permeabilities over their respective areas of the various media, as presented in Table 2-1. The assumed flow path length equaled 26 ft (7.92 m). The effective permeability was equal to 1×10^{-15} ft^2 (10^{-16} m^2) for the standard concrete barrier with formation grouting. For an enlarged concrete barrier with complete DRZ removal, the effective permeability would equal 1×10^{-16} ft^2 (10^{-17} m^2).

Table 2-1
Intrinsic Permeability of Flow Components

Component	Intrinsic Permeability		Reference
	ft^2	m^2	
Dilated salt	10^{-18}	10^{-19}	Cook and Case, 1991
Fractured salt (grouted)	10^{-15}	10^{-16}	DOE, 1995
Clay seams	10^{-16}	10^{-17}	Freeze and Cherry, 1979
Concrete barrier	10^{-18}	10^{-19}	Gulick and Wakeley, 1989
Marker Bed 139	10^{-15}	10^{-16}	DOE, 1995
Interface zone	10^{-10}	10^{-11}	Fernandez et al., 1994

2.1.1.2 Modeling Results

Figure 2-3 shows that, after closure, the pressure within the panel will build up gradually, due to the large compressibility of the panel void space relative to the air flow rate out of the

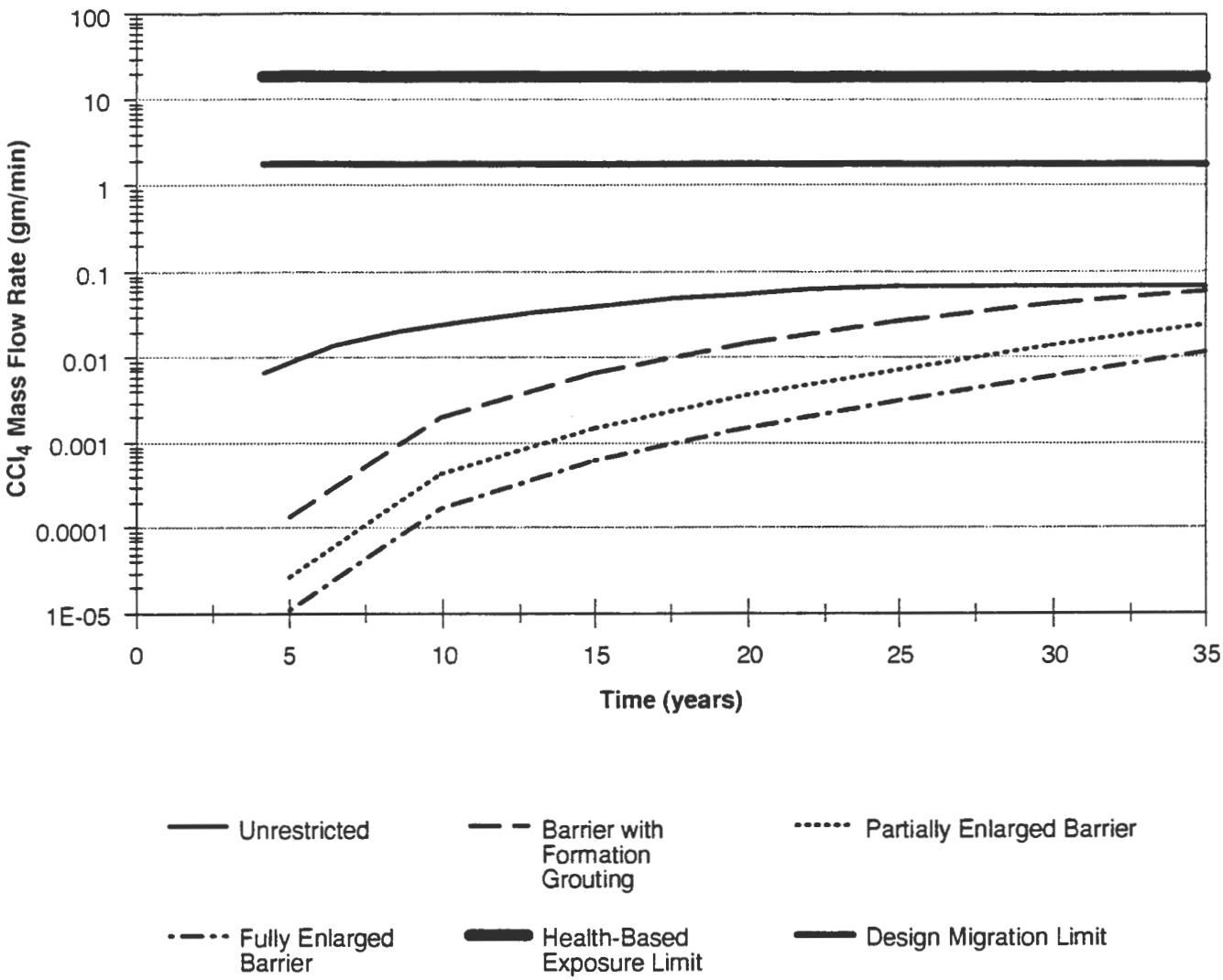


Figure 2-3
Air-Flow Analyses Using Several Alternatives

panel. The panel-closure system will be effective in restricting flow to a value less than the unrestricted flow rate during this period.

2.1.1.3 Conclusions

The air-flow model (DOE, 1995) was used to predict the performance of a grouted standard concrete barrier, a partially enlarged concrete barrier, and a fully enlarged concrete barrier for the mass flow rate of carbon tetrachloride. The analysis suggests that the alternate barrier systems would be effective in restricting air flow over the operational period and that the panel-closure system will restrict flow to at least 1 order of magnitude below the health-based migration limit in preventing the release of VOCs (Figure 2-3).

2.1.2 Advection/Dispersion Evaluation

The purpose of the advection/dispersion evaluation was to assess contaminant transport time through various media. The panel-closure system will be constructed to reduce the air flow-rate by using compressive storage in the panel void space. The model (DOE, 1995) showed that the panel-closure system will restrict transient flow for at least the operational period to an effective gas-generation rate that is substantially less than the steady state flow rate of about 35,000 ft^3 (1,000 m^3) per year.

2.1.2.1 Evaluation Procedure

As panel pressure develops with time, the gases generated from the waste will travel through the panel-closure system to the active underground workings. The model (DOE, 1995) considered that the VOC concentration front will instantaneously develop in the active underground workings and the gases would advect due to velocity variations as panel pressures increased. The more detailed analysis presented below considers the flow distribution and how the concentration of VOCs would be affected by the mechanisms of advection and dispersion. If movement were slow through the panel-closure system, the breakthrough would be delayed.

The relative significance of each of the air-flow zones can be evaluated by studying flow conductance. The flow conductance through the panel-closure system is given by the equation:

$$C = \sum \frac{K_i * A_i}{L_i}$$

where:

C	= Flow conductance
K_i	= Air conductivity of the ith component
A_i	= Cross sectional area of the ith component
L_i	= Length.

The conductance through the panel-closure system will depend on the cross-sectional area and the length. Table 2-2 summarizes the values for each component. The calculations show that flow through fractured salt and MB 139 will dominate the conductance.

Table 2-2
Air Conductance Through System Components

Component	Effective Porosity	Air Conductivity (meters per second)	Approximate Cross-Sectional Area ($meter^2$)	Conductance per Unit Length ($meter^3$ per second)
Dilated salt	0.001	6.2×10^{-14}	170	1.0×10^{-11}
Fractured salt	0.040	6.2×10^{-10}	16	9.9×10^{-9}
Clay seams	0.400	6.2×10^{-12}	0.09	5.6×10^{-13}
Marker Bed 139	0.040	6.2×10^{-11}	11	6.8×10^{-10}
Concrete barrier	0.200	6.2×10^{-14}	27	1.7×10^{-12}

The contaminant breakthrough of VOCs through the panel-closure system under the assumption of advection will occur when the contaminant front traversed the length. The average linear velocity equals the Darcy flux divided by the effective porosity for the various flow components. The average linear velocity that varies with time is given by:

$$V(p(t))_{avg_i} = \frac{K_i * (p(t) - p_{atm})}{n_e * L * \gamma}$$

where:

$V(p(t))_{avg_i}$	=	Average linear velocity for the ith component
K_i	=	Air conductivity
$p(t)$	=	Panel pressure as a function of time
p_{atm}	=	Atmospheric pressure
L	=	Length of the barrier
γ	=	Air density
n_e	=	Effective porosity.

The second evaluation of the air-flow modeling evaluated the effects of hydrodynamic dispersion on contaminant transport, using a one-dimensional dispersion model. This model was chosen to evaluate the effects of dispersion on VOC migration rates through the panel-closure system. To isolate the effects of mechanical dispersion, molecular diffusion was considered insignificant. The advection-dispersion equation is given by Freeze and Cherry (1979):

$$C = \frac{C_0}{2}\left[erfc\left(\frac{L - V_x * t}{2\sqrt{D_L * t}}\right) + exp\left(\frac{V_x}{D_l}\right) erfc\left(\frac{L + V_x * t}{2\sqrt{D_L * t}}\right)\right]$$

where:

$$D_L = a_L V_x + D^*$$

and

erfc	=	Complimentary error function
D_L	=	Longitudinal coefficient of dispersion
a_L	=	Dispersivity
V_x	=	Average linear velocity
C	=	Concentration of contaminant at time t
D^*	=	Molecular diffusion
C_0	=	Initial concentration
t	=	Time
L	=	Length.

- That the air-flow velocity will be constant.

- That the gases (including VOCs) within the void space will obey the ideal gas law.

- That the flow of air out of the panel will obey Darcy's law under quasisteady-state conditions. Under quasisteady-state conditions, the air pressure within the panel-closure system will change so gradually that the compressive storage of air within the void space of the air-intake and air-exhaust drifts will be neglected.

- That two-phase flow and interactions between air and brine will be neglected, although the resaturation of salt would tend to reduce the flow of VOCs through the barrier system.

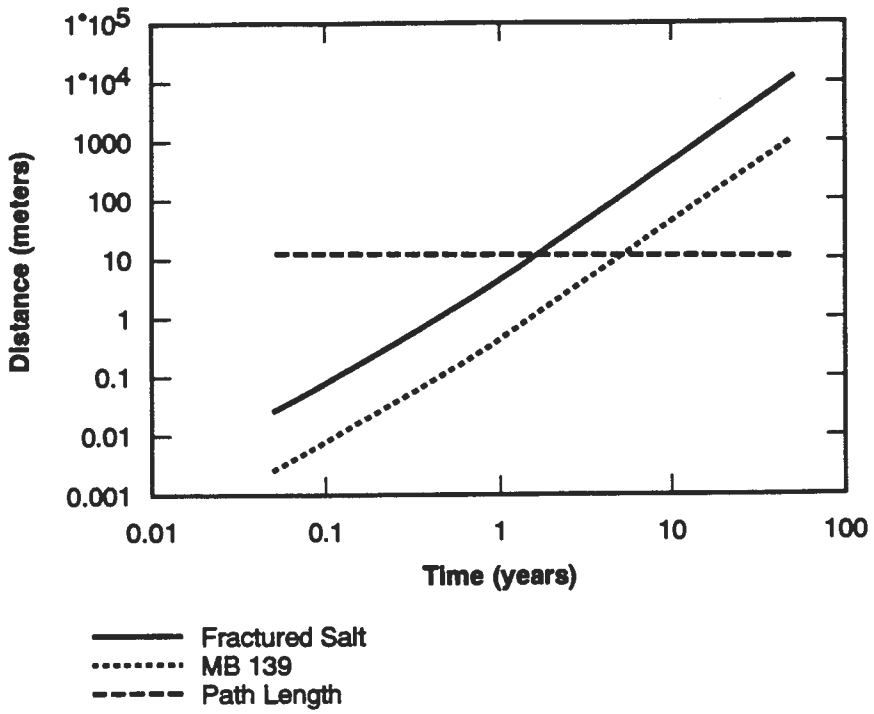
The air-flow velocity was calculated for each component of the panel-closure system using the maximum pressure determined from the air-flow model (DOE, 1995). Once a constant velocity was calculated for each component, the concentration as a function of time was determined for each of the panel-closure system components: fractured salt, fractured anhydrite, clay seams, and the standard concrete barrier.[3] To study the effects of dispersion, a range of different dispersivities was used. Mass flow as a function of time was then determined for carbon tetrachloride and was summed over all components of the panel-closure system.

2.1.2.2 Modeling Results

In the model presented for air flow, the pressure varies as a function of time for flow through the panel-closure system. This will result in a change in the average linear velocity as a function of time that was calculated for each of the various components: fractured salt, MB 139, clay seams, and the panel-closure system. The average linear velocity was then integrated over time.

Breakthrough times for a panel-closure system length of 40 ft (12 m) were computed (Figure 2-4). The analysis suggests that contaminant breakthrough through fracture zones may occur within one to several years, while contaminant breakthrough in the barrier and the dilated salt would not be expected during the WIPP operational period. The analysis shows that for fractured components with high air conductivity and low fracture porosity, large linear velocities result, with breakthrough occurring within months of panel closure. For the

[3]No credit is taken for the explosion isolation or construction isolation wall which is a conservative assumption.



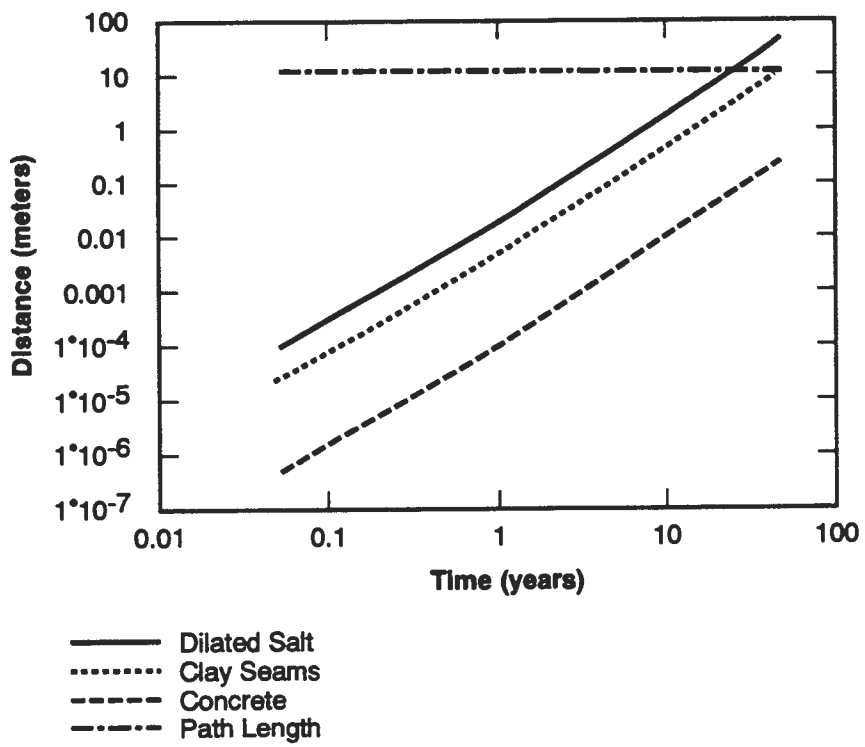


Figure 2-4
Breakthrough Time for VOCs through Several Media

other components, with much lower air conductivity and higher effective porosity the breakthrough would occur many years after panel closure.

In summary, the results of more detailed air-flow modeling suggest the appropriateness of the model for the instantaneous breakthrough of contaminants and the insignificance of dispersion. The results of the air-flow model emphasize the importance of treating fracture zones, either by removal or by grouting for restricting the flow of VOCs.

The results from the second evaluation support the conclusion that breakthrough of VOCs will occur rapidly through the dominant paths of the fractured salt and fractured anhydrite. Because of this, the effects of dispersion will be insignificant on the VOC mass flux.

2.1.2.3 Conclusion

In conclusion, because air-flow modeling results show that breakthrough will occur rapidly and that the effects of hydrodynamic dispersion will be insignificant, the air-flow model (DOE, 1995) is conservative and appropriate.

2.1.3 Stress Analysis

The purpose of the stress analysis was to evaluate the interaction of the main concrete barrier of the panel-closure system with the surrounding salt for different combinations and geometries. The panel-closure system will consist of: (1) a standard concrete barrier or (2) an enlarged concrete barrier. Options (1) and (2) will contain interface grouting and be combined with an explosion-isolation or construction-isolation wall. The walls will isolate the concrete barrier from the waste-emplacement panel and the effects of a postulated methane explosion. Stresses are expected to develop in the concrete-barrier component due to continued primary and secondary creep closure of the air-intake and air-exhaust drifts after installation of the concrete barrier. An estimate of the stress levels expected in the concrete barrier determined the deformability and strength required for the concrete. The development of stresses in the salt around the concrete barrier was also evaluated to estimate the time required for DRZ healing for these options.

2.1.3.1 Evaluation Procedure

The evaluation was performed using the FLAC computer code (Itasca, 1995). Six detailed structural-analysis models were prepared to evaluate the salt/structural interaction of the proposed system. These models included two transverse-plane strain models across the air-intake and air-exhaust drifts associated with a waste-emplacement panel, two long

axisymmetric models, and two short axisymmetric models. The properties used in these models were taken from the Backfill Engineering Analysis Report (IT, 1994) as presented in Appendix C.

2.1.3.2 FLAC Models

Since 1991, FLAC has been used to model underground excavations at the WIPP. FLAC is a two-dimensional, explicit finite difference code that simulates the behavior of rock and soil-like structures. The WIPP Reference Creep Law is built into FLAC and has been verified to U.S. Nuclear Regulatory Commission standards (Itasca, 1995). In addition, FLAC has been verified against the WIPP Second Benchmark Problem (Krieg, 1984). The following subsections describe the geometry and boundary conditions of the model used in the FLAC analysis.

Plane-Strain Model Geometry. Two cross-sectional transverse plane-strain models were run using the air-intake and air exhaust drift geometries. These models used a simplified stratigraphy for approximately 250 ft (75 m) above and below the excavation horizon (Figure 2-5). The models included the interaction of the excavation and the main concrete barrier with MB 139 over time. The cross-sectional dimension of the air-intake drift is 13 by 20 ft (4 by 6 m), while the air-exhaust drift is 12 by 14 ft (3.6 m by 4.3 m). Each model was run with the initial excavation and allowed to creep for a period of 5 years,[4] the time expected for panel excavation and waste emplacement. After 5 years, the drift at the concrete barrier location was excavated just beyond Clay G and Clay E, removing MB 139, and the ribs were excavated to curved segments between these clays. Each model was then run for an additional month simulating the time required to excavate the enlarged area and install the concrete barrier. After the enlarged excavation was open for one month, the model was continued with the installed concrete barrier. The actual construction schedule may be longer for the enlarged barrier; however, the effects on long-term interface stress buildup will be insignificant. As the stresses increased in the concrete barrier and the surrounding salt the model was run for an additional 35 years, representing the required period of performance for a concrete barrier.

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[4]For Panel One, the period between excavation and barrier emplacement would be greater than 5 years. A longer period of time might result in more bed separation. However, since fractured salt is removed to Clay G and the barrier is placed over a short period, the design is considered robust, and the effects of a longer period for Panel One are insignificant.

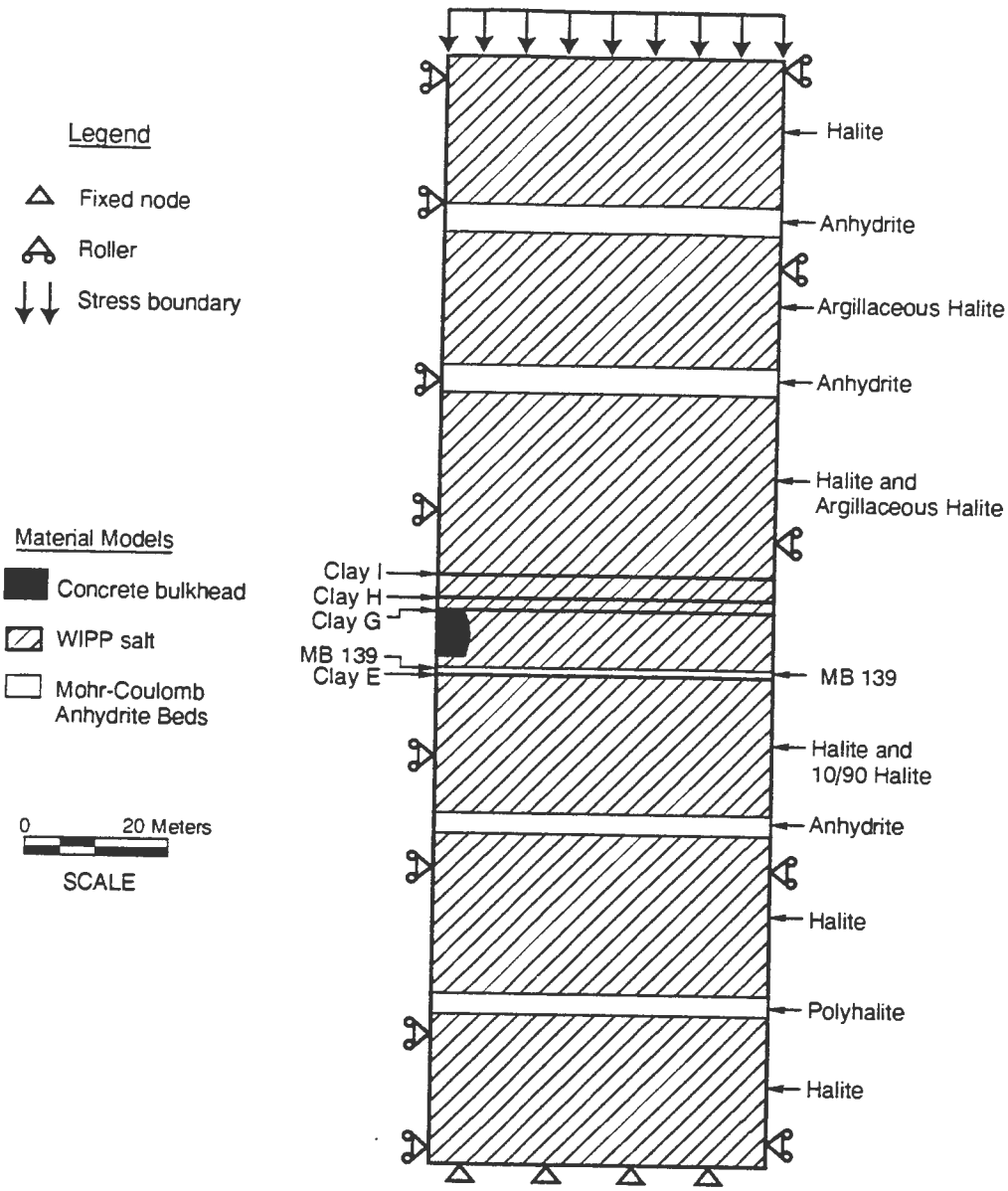


Figure 2-5
Transverse Model for FLAC Analysis

Axisymmetric Models. Four axisymmetric models were run to evaluate the long-term loadings expected on the ends of the concrete barrier. The models (Figure 2-6) were simplified using a homogeneous salt and radial loading. The model for the concrete barrier was symmetrical around the central axis. The cases illustrate that the presence of the barrier ends will result in a longer cylindrical barrier, and that the shorter barrier with the two plug ends will result in a more tapered shape.

Material Properties Used in Modeling. The material properties used for the reference stratigraphy presented in the Backfill Engineering Analysis Report (IT, 1994) were used in the FLAC analysis. These properties (Appendix C) included the elastic, primary creep, and secondary creep constitutive properties of the halite, polyhalitic halite, and argillaceous halite. They also included the elastic properties of the anhydrite and the concrete.

Modeling Results—Transverse Plane-Strain Models. The results of the transverse plane-strain models suggest that higher stresses will form in MB 139 following excavation, but that after barrier emplacement, an increase in barrier-confining stress and a reduction of shear stress will occur in and around the barrier. The results further suggest that substantial uniform confining stresses will develop as the barrier is subjected to the secondary salt creep.

Modeling Results—Axisymmetric Models. The results of the axisymmetric models agree with the results of the transverse models for the prediction of interface stress and suggest the appropriateness of an axisymmetric model to evaluate the long-term stress abutment zone effects. The modeling results for the longer cylindrical barrier suggest that the radial stresses increase by a factor of 2 at the ends of the barrier. The high-stress concentration at the ends of the barrier extends a distance of several meters. Tensile stress develops at the ends of the longer cylindrical barrier. The short axisymmetric barrier, with the design achieving a more tapered configuration, shows that a more uniform state of compression develops all around the barrier. The principal stress results after a period of 30 years for this barrier with DRZ removal are presented in Figure 2-7. These results show that the barrier is in a state of overall compression.

2.1.3.3 Stress Analysis of the Concrete Barrier on an Elastic Foundation

An analysis was performed treating the concrete barrier as a beam on an elastic foundation. After several years it is expected that loads would develop uniformly in the concrete barrier; however, the concrete barrier may be subjected initially to nonuniform loading (Figure 2-8).

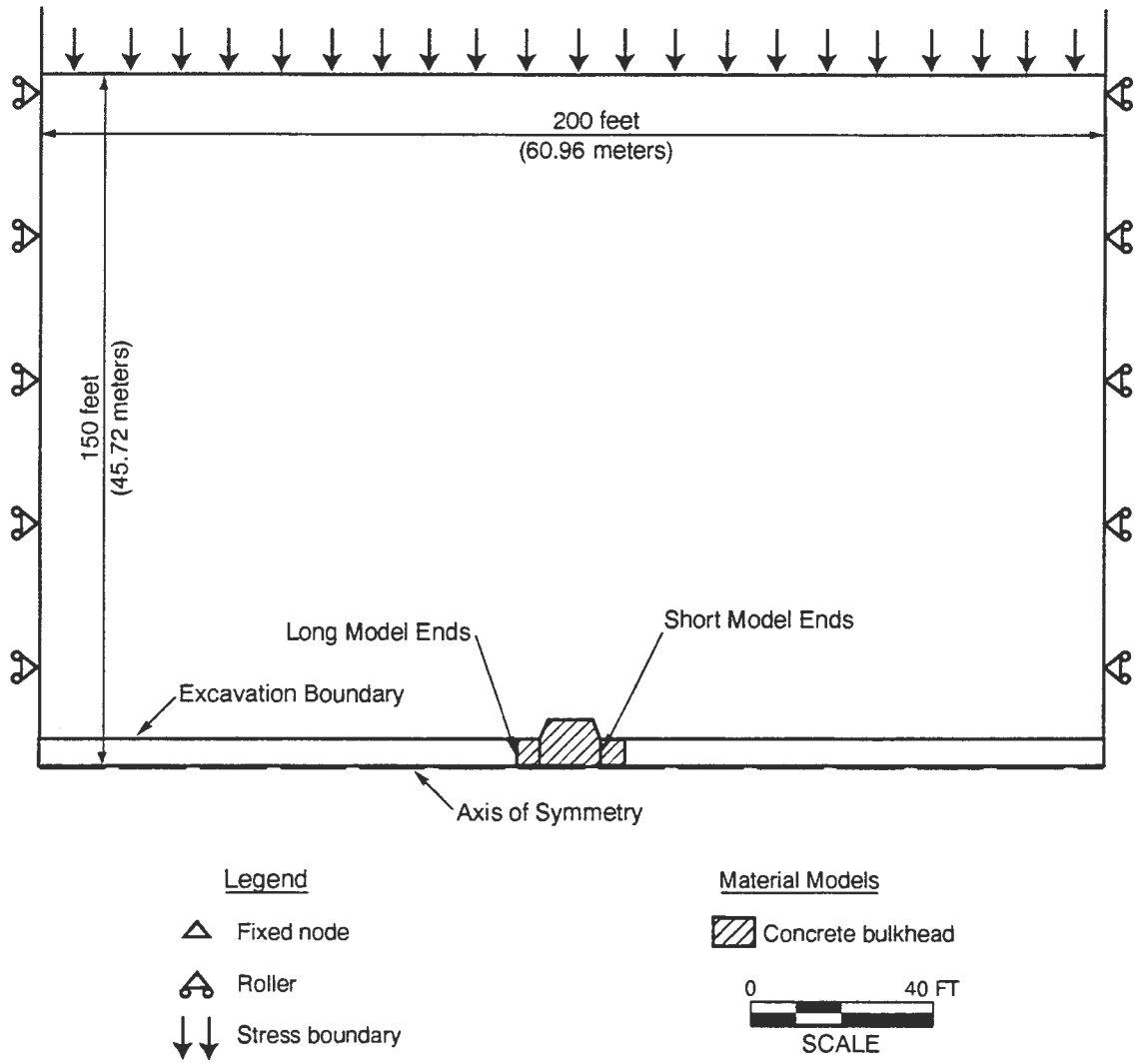


Figure 2-6
Axisymmetric Models for FLAC Analysis

JOB TITLE : Short Axisymmetric Model for Intake Drift - 30 Years After Plug Emplacement

FLAC (Version 3.22)

LEGEND

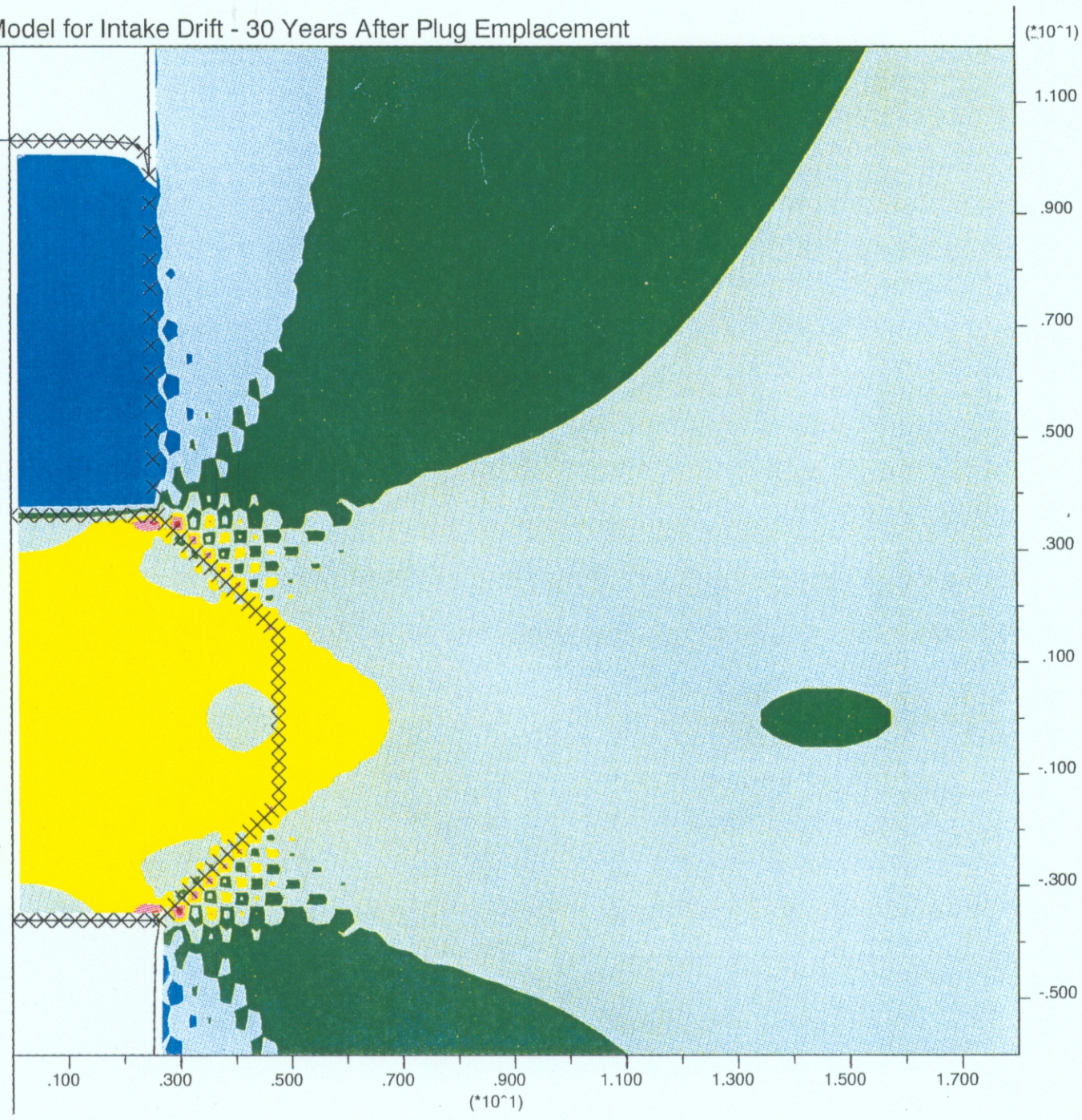
8/21/1995 11:02
step 61637
Creep Time 1.1070E+09
0.000E+00 <x< 1.800E+01
-6.000E+00 <y< 1.200E+01

Maximum principal stress
-3.50E+07
-3.00E+07
-2.50E+07
-2.00E+07
-1.50E+07
-1.00E+07
-5.00E+06
0.00E+00

Contour interval= 5.00E+06
Marked Gridpoints
Boundary plot

0 5E 0

IT Corporation



JOB TITLE : Short Axisymmetric Model for Intake Drift - 30 Years After Plug Emplacement

FLAC (Version 3.22)

LEGEND

8/21/1995 11:02
step 61637
Creep Time 1.1070E+09
0.000E+00 <x< 1.800E+01
-6.000E+00 <y< 1.200E+01

Minimum principal stress
-2.50E+07
-2.00E+07
-1.50E+07
-1.00E+07
-5.00E+06
0.00E+00
5.00E+06
1.00E+07

Contour interval= 5.00E+06
Marked Gridpoints
Boundary plot

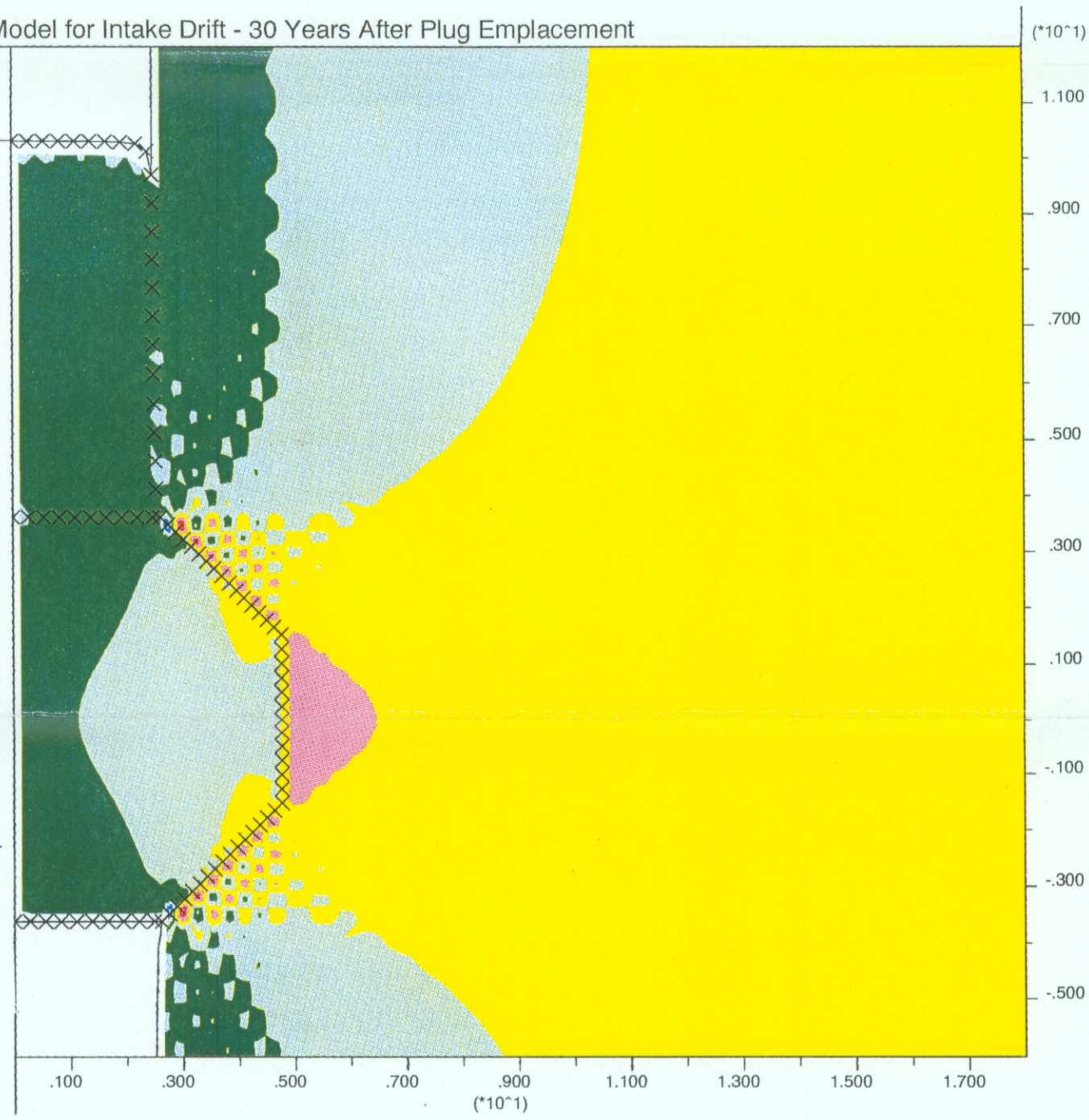


Figure 2-7
Stress Analysis of a Barrier
with DRZ Removal

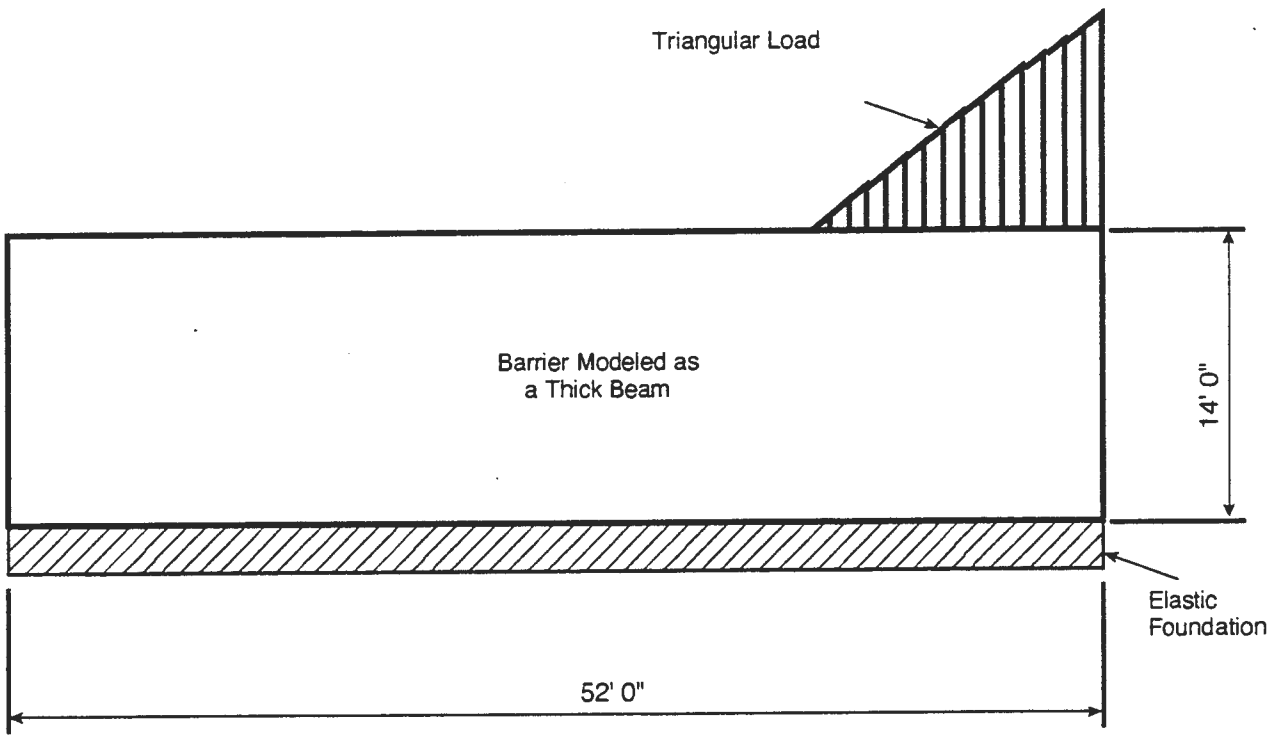


Figure 2-8
Stress Analysis of a Barrier on Elastic Foundation

The analysis of the concrete barrier on an elastic foundation shows that, for various assumed loadings that will develop, the amount of flexure and transverse shear was minimal and would result in insignificant nonuniform load reactions and failure of plain concrete in flexural tension or shear (Figure 2-9). The only manner in which flexure will develop would be through nonuniform loading. The assumed approximate stress gradient for the first room for the Chabannes solution (DOE, 1995) at a distance of 80 ft (24 m) equals 300 pounds per square inch (psi) (2.1 megapascals [MPa]) over 50 ft (15 m). The analysis evaluated the effects of varying the modulus of subgrade reaction for the barrier (equal to 500,000 psi [3,500 MPa]). The results suggest that the potential for flexural tension and shear will be greater when loads were resisted by fractured salt. The removal of fractured salt from the central portion of the excavation should result in a more uniform loading on the barrier and stiffer resistance in reaction that reduces short-term flexural tension and shear.

2.1.3.4 Interface Stress Buildup

Previous small-scale sealing studies (Case and Kelsall, 1986) showed that stress in seals in contact with salt develop rapidly (Figure 2-10). As an example, in the 3 ft- (91- centimeter [cm])-diameter plug for the Small Scale Seal Performance Test, interface stress developed to about 1,000 psi (7 MPa) within 1,000 hours. An analysis was conducted to evaluate the effects of concrete barrier stiffness on the recovery of the DRZ for the alternatives. The technical approach to the standard analysis considered an infinitely long cylindrical concrete barrier[5] in an infinite medium (DOE, 1995). Figure 2-11 illustrates that interface stresses for the standard concrete barrier with formation grouting would develop more slowly than the enlarged concrete barrier, resulting in less healing of the surrounding DRZ for at least the 35-year operational period.

2.1.4 Tradeoff Study of Formation Grouting versus DRZ Removal

The purpose of this study was to evaluate the tradeoffs of formation grouting versus DRZ removal for the alternatives for overall protection of human health and the environment. The tradeoff study considered compliance with the design migration limit, barrier effectiveness, and implementability of the design at the WIPP. This evaluation was performed qualitatively through examination of the results of air-flow and stress analyses as presented in previous sections. The alternatives included a standard concrete barrier with formation grouting, a

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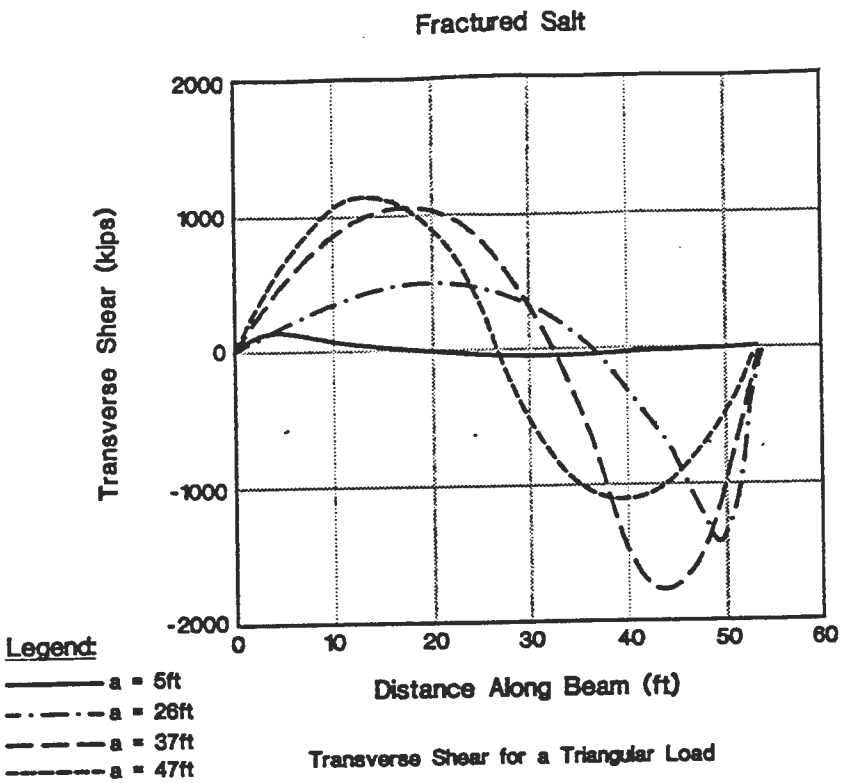
[5]A cylindrical concrete barrier develops interface stress less rapidly than a spherical concrete barrier. However, the analysis of a cylindrical barrier provides a relative comparison of the effects of fractured salt on the development of interface stress for a long cylindrical barrier.



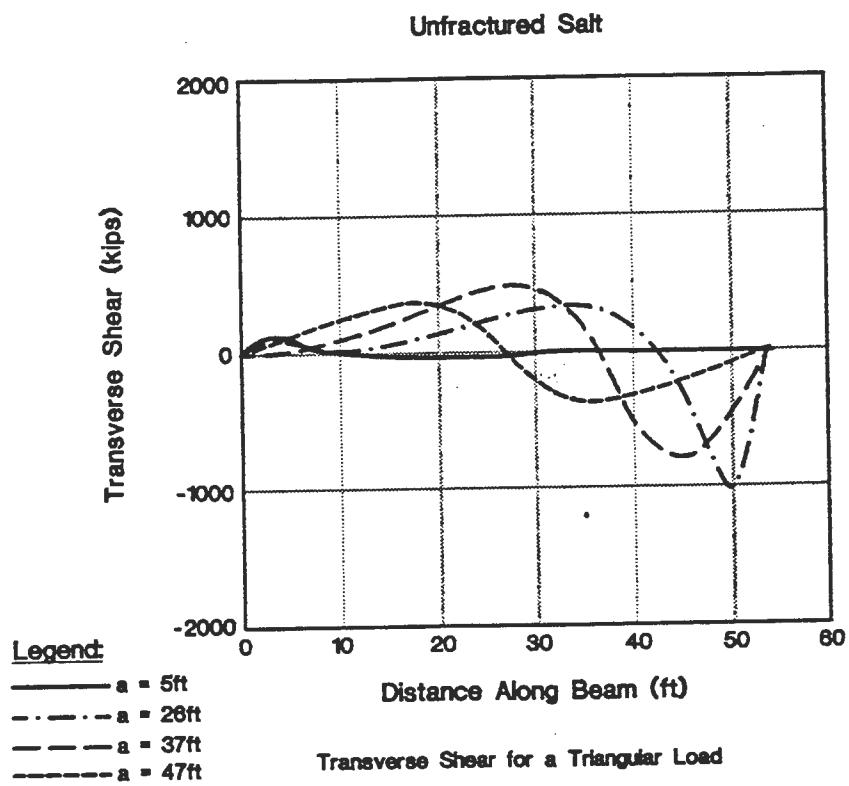


Figure 2-9
Reactive Barrier Loads

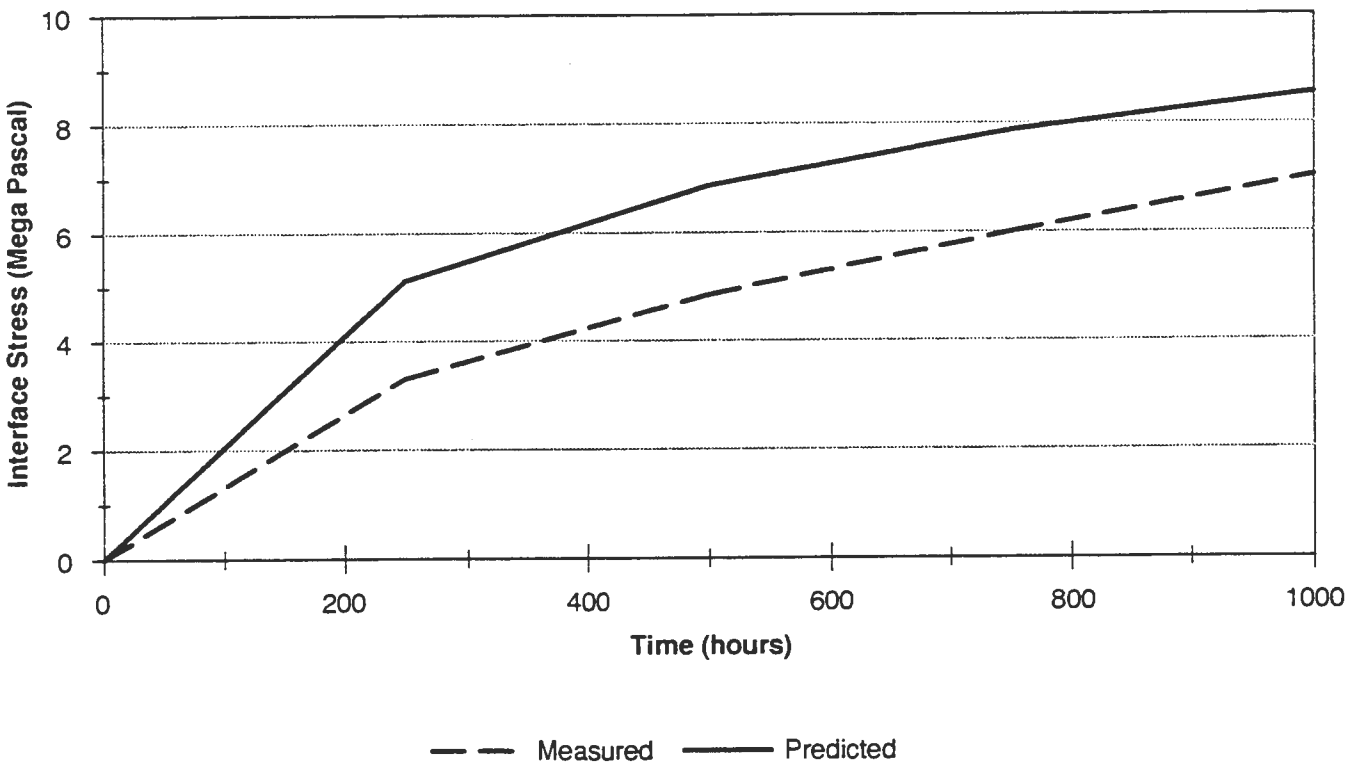


Figure 2-10
Development of Interface Stress in the Large 91-cm-Diameter Plug
(After Case and Kelsall, 1986)

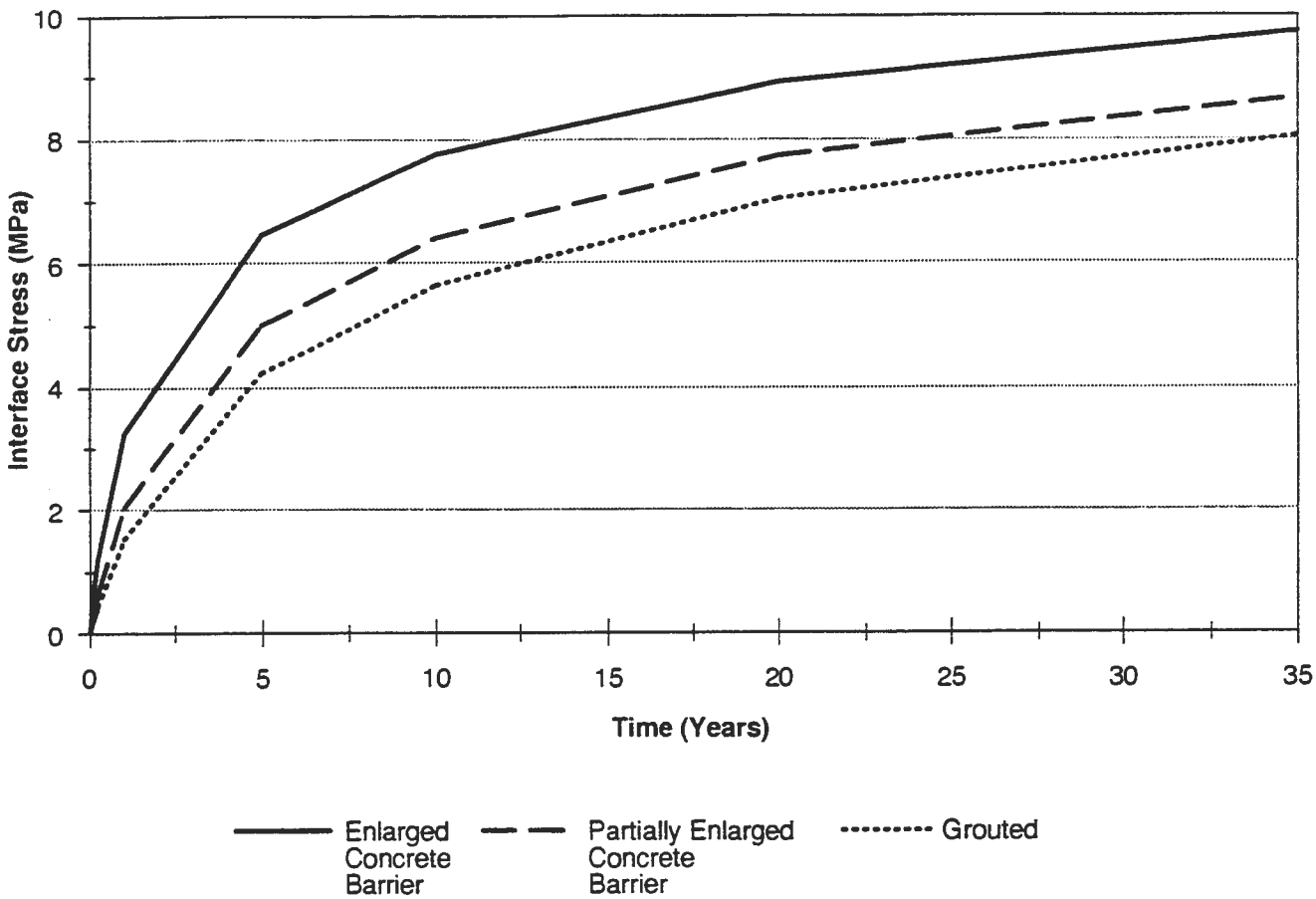


Figure 2-11
Effect of Enlarging Barrier on Interface Stress

partially enlarged concrete barrier with DRZ removal in the roof, and a fully enlarged barrier with complete DRZ removal. In all cases, the most severe ground conditions were considered. Existing information and the previous modeling efforts were combined to provide insight to the performance of the alternatives.

Bench-scale tests done by Terra-Tek showed the importance of interface zone permeability (Fernandez, et al., 1994). For sealed boreholes, flow occurs either through the seal matrix or through the interface zone. These tests showed that the "effective barrier permeability" for flow through the interface zone to be 1 to 2 orders of magnitude greater than the permeability of the plug material. This result supports the theory that the interface zone behaves like a fracture, in that at low effective stress levels, the interface opens and exhibits high conductivity. At higher stress levels, the interface closes and exhibits a much lower conductivity that is independent of effective stress. These studies suggest that the excavation of a more circular shape that reduces stress concentrations and the emplacement of a sufficiently strong barrier that would reduce shear stresses, and increase confining stresses at the interface zone is preferable.

The discussion presented above allows an evaluation of the compliance of the alternatives with the design migration limit and a qualitative evaluation of the effectiveness of the alternatives in light of the previous stress analyses performed. The stress analyses performed suggested that for the barrier with formation grouting, there is a greater potential for barrier flexure when fractures in the surrounding rock are present, and that the interface stress would develop more slowly because of the compliance of these fractures. This will then result in potentially higher VOCs flow through the interface zone, and reduced effectiveness. The development of lower interface stresses would result in lower confining stresses in the surrounding DRZ, and a slower rate of DRZ healing.

In evaluating the tradeoffs among the alternatives, it was noted that all three alternatives could be implemented. Technologies exist for the placement of a barrier with formation grouting (DOE, 1995). Further, methods are available for the excavation of an enlarged barrier with DRZ removal. Fernandez et al., 1989 evaluated various techniques for enlargement of barriers. These included the use of expansive agents, and hydraulic splitters in addition to the methods for continuous mining. The use of expansive agents could be used in the floor to excavate to below MB 139. While the use of these more labor intensive methods would take longer and make barrier emplacement more difficult, the techniques are

nevertheless available. The alternatives involving rock removal can be implemented in the underground WIPP repository.

In conclusion, the evaluations addressing the operational requirements of the panel-closure system show that, for the most severe ground conditions to be encountered, the maximum protection is provided when an enlarged concrete barrier is used. The severity of the ground conditions relate to the size and age of the air-intake and air-exhaust drifts, and the distance to the room intersections. The longer the time period between excavation, and panel closure, the greater the degree of fracturing that could occur. For example, the period of time for Panel 1 has been much longer than the four year period currently planned for other panels. Where the time between excavation and panel is short, fracturing may be absent or inconsequential, and the design can be simplified to a standard barrier with no DRZ removal.

2.2 Structural and Material Requirements

This section presents evaluations relating to the structural and material requirements for the panel-closure system.

2.2.1 Material-Compatibility Evaluations

The purpose of the material-compatibility evaluations is to select the most suitable concrete and grout materials for a panel-closure system. This section evaluates the concrete and grout compositions and their geochemical compatibility with the host rock and brine. This section also evaluates the geotechnical properties and permeabilities of a concrete/grout to liquid phase and gaseous phase contaminants (brine and VOCs, respectively).

2.2.1.1 Evaluation Procedure

Project information was reviewed for appropriate concrete-barrier materials that would minimize VOC migration and cement hydration for candidate materials.

2.2.1.2 Concrete-Barrier Material Candidates

The selection of candidate materials for use as concrete and grout in a panel-closure system requires that numerous criteria be satisfied in terms of the 35-year period of performance. The materials must be chemically compatible with the host rock and brine (Salado Formation) without chemical degradation. Concrete used in the main concrete barrier must be sufficiently strong enough to support lithostatic loads and resist the compressive stress of the creeping salt. The concrete must cure at a low heat of hydration. If the concrete evolves heat too rapidly (i.e., greater than 14 degrees celsius (°C) (25 degrees Fahrenheit [°F]), it may

experience rapid slump loss before hardening and excessive thermal stress after hardening. Slump loss directly affects the workability and pumpability of the concrete. The workability of the concrete must allow ample time and the pumpability must be adequate for installation. The most desirable characteristics for achieving adequate pumpability were a 4-hour working time (Wakeley et al., 1994). The concrete must perform under large-scale installation conditions. Grout must form a tight seal between the concrete barrier and the host rock.

Wakeley et al. (1993) studied and developed (Gulick and Wakeley, 1989) salt-saturated concrete and grout in the floor of the WIPP repository for six years (Appendix D). Then the concrete and grout plugs along with some host rock were overcored. The study concluded that little or no deterioration occurred to the concrete or grout. Overall the compressive strengths increased with time with the lowest values from samples taken in the DRZ. Reaction rims with increased permeability were noted on anhydrite surrounding the plugs, suggesting interaction between the grout or concrete and host rock. There was also evidence of halite dissolution in the anhydrite zone near the plugs; however, the presence of halite facilitated better bonding between the grout or concrete and the host rock. Crystallization of new phases was also noted on free surfaces, indicating that strongly ionic, magnesium-bearing fluids were present and moving. The movement of the fluid improved the bonding with the host rock.

Gulick and Wakeley (1989) proposed expansive salt-saturated concrete (ESC) (Appendix E) and grout mixtures that yielded favorable results for suitability in a panel-closure system. The formulation for their grout mixture is indicated in Table 2-3.

Table 2-3
Salt-Saturated Grout (BCT-1F)

Component	Percent of Total Mass
Class H cement	48.3
Class C fly ash	16.2
Cal seal® (plaster)	5.7
Sodium chloride	7.9
Dispersant	0.78
Defoamer	0.02
Water	21.1

Class H cement is a standard oil-well cement that has been used extensively in grouts and concretes in underground applications. Class C fly ash contributes expansive properties to concrete. Cal Seal® (a plaster of paris, manufactured by Halliburton) also develops expansive properties in mixtures containing Class H cement. Expansive components that are added to the concrete or grout mixtures enhance bonding with the host rock.

Wakeley et al. (1993) later researched concrete mixtures that would behave optimally under the type of large-scale installation conditions associated with the panel-closure system. The concrete mixture was also designed to keep the temperature due to heat of hydration less than 14°C (25°F). The concrete mixture that resulted from this study was termed the Salado Mass Concrete (SMC), and it superseded ESC as the performance mixture (Wakeley et al., 1993). Table 2-4 summarizes the SMC composition.

Table 2-4
Salado Mass Concrete

Component	Percent of Total Mass
Class H cement	4.93
Chem Comp III	2.85
Class F fly ash	6.82
Fine aggregate	33.58
Coarse aggregate	43.02
Sodium chloride	2.18
Defoaming agent	0.15
Sodium citrate	0.09
Water	6.38

Class F fly ash increases the aluminum content of the concrete mixture, which decreases the heat of hydration and increases the setting speed. A mixture of fine and coarse aggregate decreases the porosity of the concrete, and the fine aggregate contributes more silica over time.

For Class M cement and Class F fly ash addition of sodium chloride to the mixture ensures that the water content of the concrete is in equilibrium with the host rock to minimize dissolution, and inhibit deterioration of the concrete. The use of defoaming agents inhibit air entrainment in the concrete mixture.

Wakeley et al. (1994) studied under laboratory conditions the effects of various compositions of brines and concretes, including the SMC formulation. The study evaluated the susceptibility of concretes to chemical degradation by brines. Both pastes containing no aggregate, and mortars containing fine aggregate were formulated and tested in simulated brines containing magnesium and sulfate concentrations representing the brines at the repository horizon. The study concluded that high-magnesium brines exacerbated the deterioration of pastes and mortars; mortars deteriorated more rapidly than pastes. This study concluded that loss of calcium was the primary cause of weakened concrete materials. The use of salt in mortars with an expansive component slowed the rate of deterioration. These experiments were carried out under extreme experimental conditions unrepresentative of the trace amount of brine that will be encountered during large-scale installation of the concrete barriers.

2.2.1.3 VOC Interaction

Theoretically, if the pH of the VOCs is too low, it could negatively impact the structural integrity of the concrete barrier. The higher the VOC pH, the less likelihood for physical degradation of the concrete barrier. Using a portland cement with a pH greater than 12 should ensure the integrity of the concrete barrier.

2.2.1.4 Cement Hydration

Mathewson (1981) reported that the aggregate mineralogy significantly affects the curing/hydrating process by generating heat and alkali fluids, which can have deleterious effects on the strength of the concrete. Minerals susceptible to an alkali-aggregate reaction are hydrated silicates, opaline shale, chert, siliceous limestones, rhyolite, and dacite. Nonreactive minerals include quartz, feldspar, calcite, and the ferromagnesium minerals.

2.2.1.5 Conclusions

Previous studies suggest the application of the SMC to the design of the panel-closure system. This concrete possesses characteristics of low heat of hydration and workability. Because of the trace amounts of brine and the impermeable nature of the concrete, a standard concrete with a low heat of hydration and similar workability was considered acceptable. Therefore,

the design specifies a plain cement concrete mix that must be verified with testing. The cement will be Portland cement, type II modified, with pozzalan or type IV, to limit the heat of hydration of the resultant mix.

2.2.2 Heat-Generation Evaluations

Heat-generation studies evaluated the effects of the heat of hydration for the installation of the concrete barrier. The curing of concrete is facilitated by hydration in that the water present in the mixture reacts with calcium and silica to incorporate water into the resulting mineral phase. This process is an exothermic reaction, resulting in a temperature increase in the concrete barrier and host rock. This temperature increase causes a thermal expansion of the concrete barrier and increases the interface stress. As the concrete cools, the interface stress decreases, and tensile strain may occur at the interface.

2.2.2.1 Evaluation Procedure

The one-dimensional radial numerical and analytical model SHAFT.SEAL (Case et al., 1992) solves for temperature and stress as a function of radial position, in either the barrier or the surrounding host rock. The model uses the implicit finite-difference method (Carnahan et al., 1990) to analyze the temperature rise and fall following completion of the hydration. The model assumes radial conductive heat transfer to the surrounding host rock.

The analysis used thermal and thermomechanical properties from previous modeling efforts (Case and Kelsall, 1986; Van Sambeek and Stormont, 1987). The proposed concrete mixture exhibits a double-humped hydration curve (Figure 2-12) (Van Sambeek and Stormont, 1987). The first "hump" results from a reaction that occurs shortly after the mixing of the concrete. The double-hump manifestation in the temperature-versus-time data of the expansive salt-based concrete reduces the maximum temperature by increasing the time over which the hydration takes place. This is beneficial in large volumes of concrete where the dissipation of heat in the interior of the concrete barrier is slow. The analyses used input properties for the candidate material as determined from laboratory studies (Van Sambeek and Stormont, 1987), with modifications made to account for a reduced heat of hydration for the SMC. Table 2-5 summarizes the properties used in the analysis. The placement temperature was selected at ambient temperature.

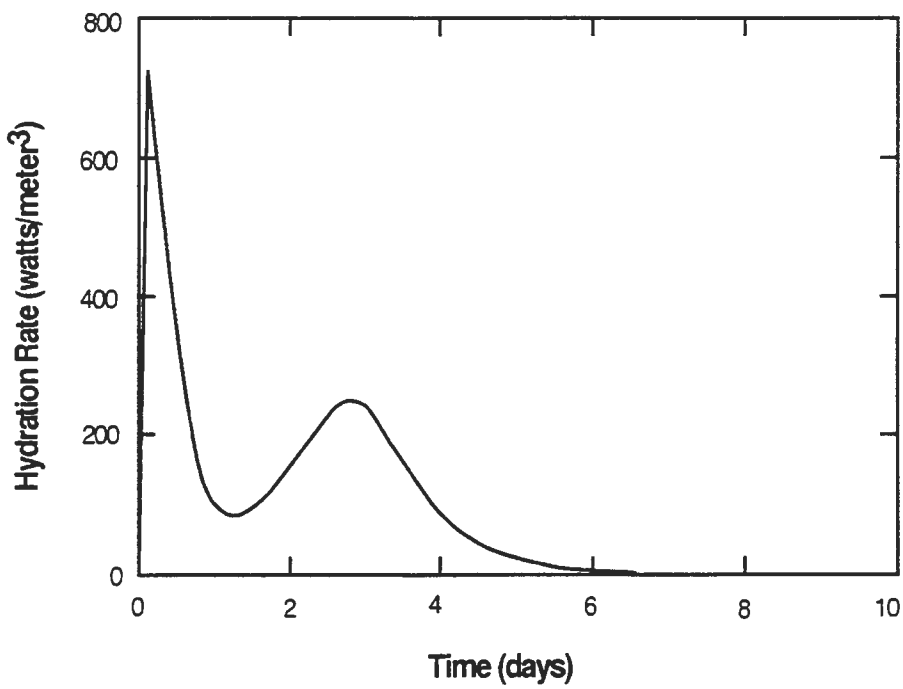


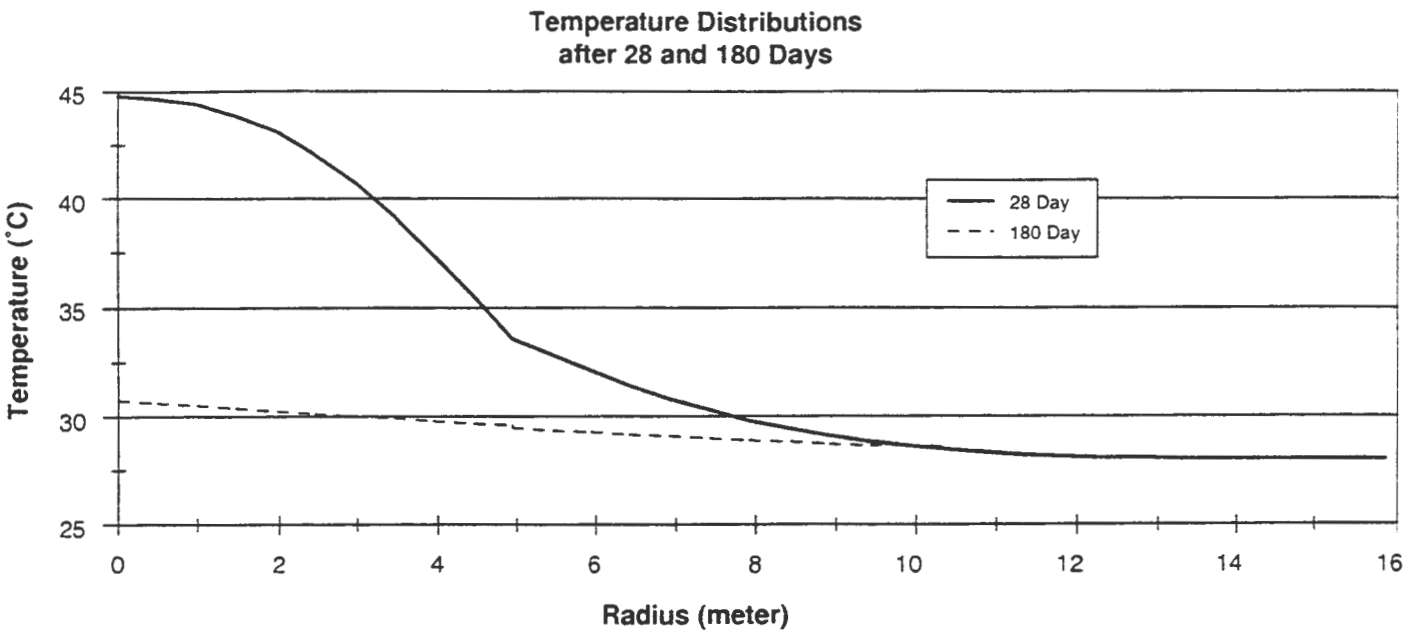
Figure 2-12
Heat of Hydration for Expansive Salt Concrete
(After Van Sambeek and Stormont, 1987)

Table 2-5
Thermal and Thermomechanical Properties for SHAFT.SEAL Analysis

Property	Value
Barrier properties:	
Plug diameter	10 meters
Concrete placement temperature	28°C
Concrete Properties:	
Specific heat	980 joules/(kilogram-Celsius)
Thermal conductivity	2.1 watts/(meters-Celsius)
Density	2,280 kilograms/cubic meter
Young's Modulus	28,000 MPa
Poisson's ratio	0.20
Thermal expansion coefficient	12.6×10^{-6} 1/°C
Rock properties:	
Specific heat	860 joules/(kilogram-Celsius)
Thermal conductivity	4.94 watts/(meters-Celsius)
Density	2,300 kilograms/cubic meter
Rock temperature	28°C
Young's Modulus	31,000 MPa
Poisson's ratio	0.25
Thermal expansion coefficient	45.0×10^{-6} 1/°C

2.2.2.2 Modeling Results

The modeling results include the temperature and stress distributions in the concrete barrier and the surrounding host rock at various times (Figure 2-13). The thermal analysis shows that temperatures initially rise uniformly due to cement hydration, maintaining a high radial thermal gradient within the interface zone. Thermal gradients decreased with time as hydration nears completion, and the heat thermally diffuses to the surrounding rock. After 28 days, temperatures rose to about 45°C (102°F), inducing a thermal gradient and thermal stress at the interface zone. After this time, the temperatures fell and approached the in situ rock temperature after an additional 28 days. The temperatures suggest that the heat pulse will be short and that the placement of the concrete, combined with the high thermal diffusivity of the salt, will control hydration temperatures to an acceptable level. The stress analysis suggests that tensile stress in the concrete will be offset by the rapid buildup of compressive stress, due to salt creep of the host rock.



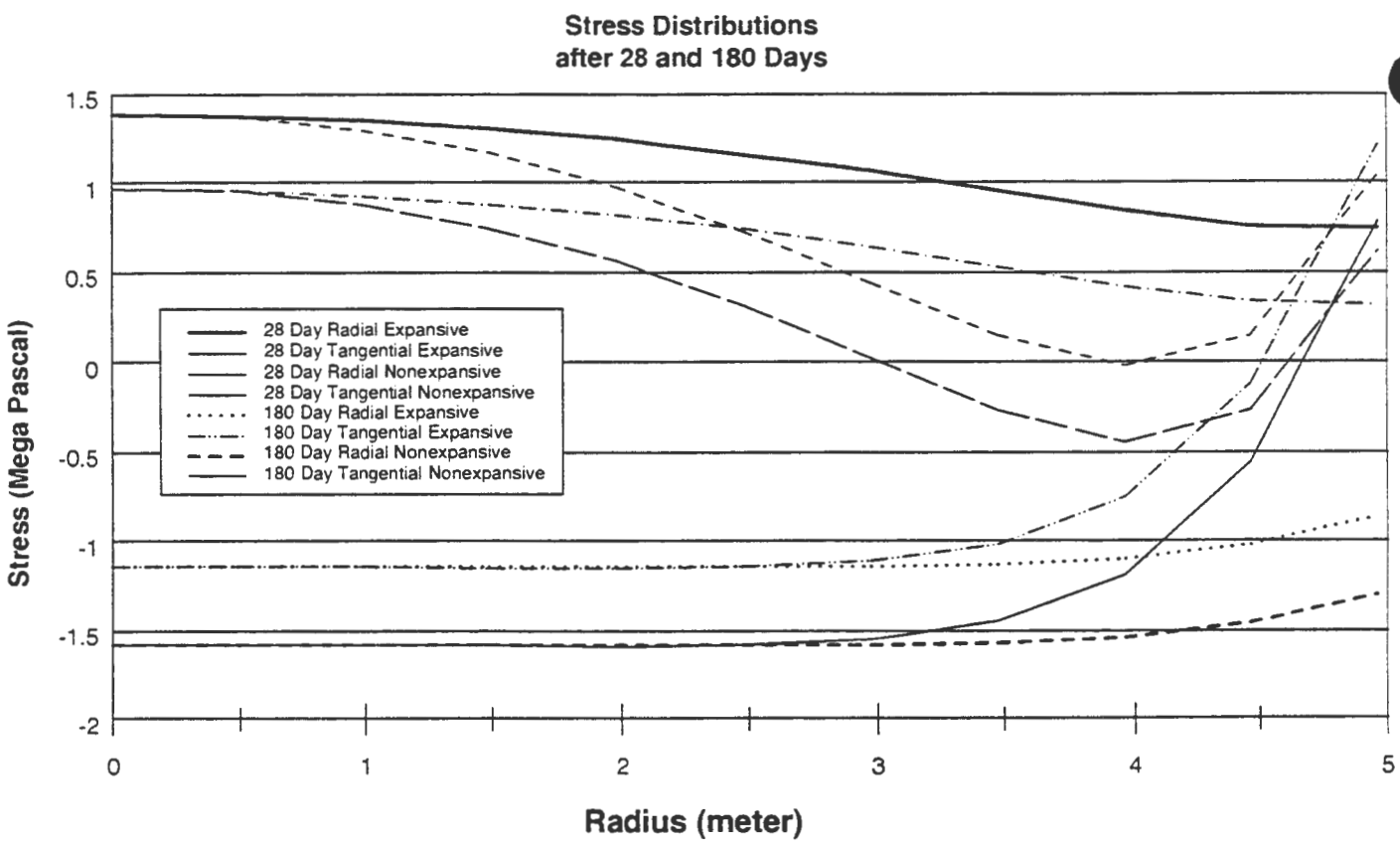


Figure 2-13

Temperature and Stress Distributions for Concrete Barrier

2.2.2.3 Conclusions

Hydration temperatures will be controlled through the selection of an appropriate concrete to reduce the potential for tensile cracking and separation at the interface zone. A thermal analysis using information on the heat of hydration of the concrete coupled with a salt-creep analysis suggests that, for the size of pour, placing the concrete at ambient temperature will control hydration temperatures. Finally, because steel formwork will be used during installation, such formwork will conduct heat away from the face of the concrete and thereby cool the concrete.

2.2.3 Explosion Evaluations

The methane-explosion evaluation focused on the pressure and thermal effects of such an explosion on the explosion-isolation wall. The DOE (1995) suggests that gas-generation rates, due to microbial degradation, might range from 0.01 to 0.1 moles per drum per year, with methane comprising 70 percent of the gas. It is estimated that the potential for a methane explosion would not occur prior to closure of the first waste-emplacement panel for a gas generation rate of 0.1 moles per drum per year. Such an explosion could occur approximately 20 years after closure of the first panel. This time is determined by comparing the percent volume concentration to the explosive limits for methane as shown in Figure 2-14.

If the composition of the air in the closed panel were 18 percent oxygen, the explosive range will be from about 5 to 15 percent methane by volume. Above 15 percent methane, the atmosphere in an abandoned waste-emplacement panel would be "fuel rich" and would not be capable of sustaining an explosion. With a reduction in the amount of oxygen available, the explosive range narrows, and the potential will be nonexistent below a 12 percent oxygen composition.

A methane explosion would generate an initial pressure transient that would impinge on the explosion-isolation wall. Subsequently, temperatures would rise in the panel, as well as raise the temperature in the explosion-isolation wall.

2.2.3.1 Evaluation Procedure

Two analyses were conducted to evaluate methane-explosion effects: 1) a dynamic analysis, and 2) a thermal heat-transfer analysis of the explosion-isolation wall. After an explosion, the explosion-isolation wall would be subjected to short-term dynamic loading. The design pressure can be calculated as the maximum pressure times the dynamic load factor (Biggs, 1964). The dynamic load factor will depend on the shape of the pressure-time transient. An

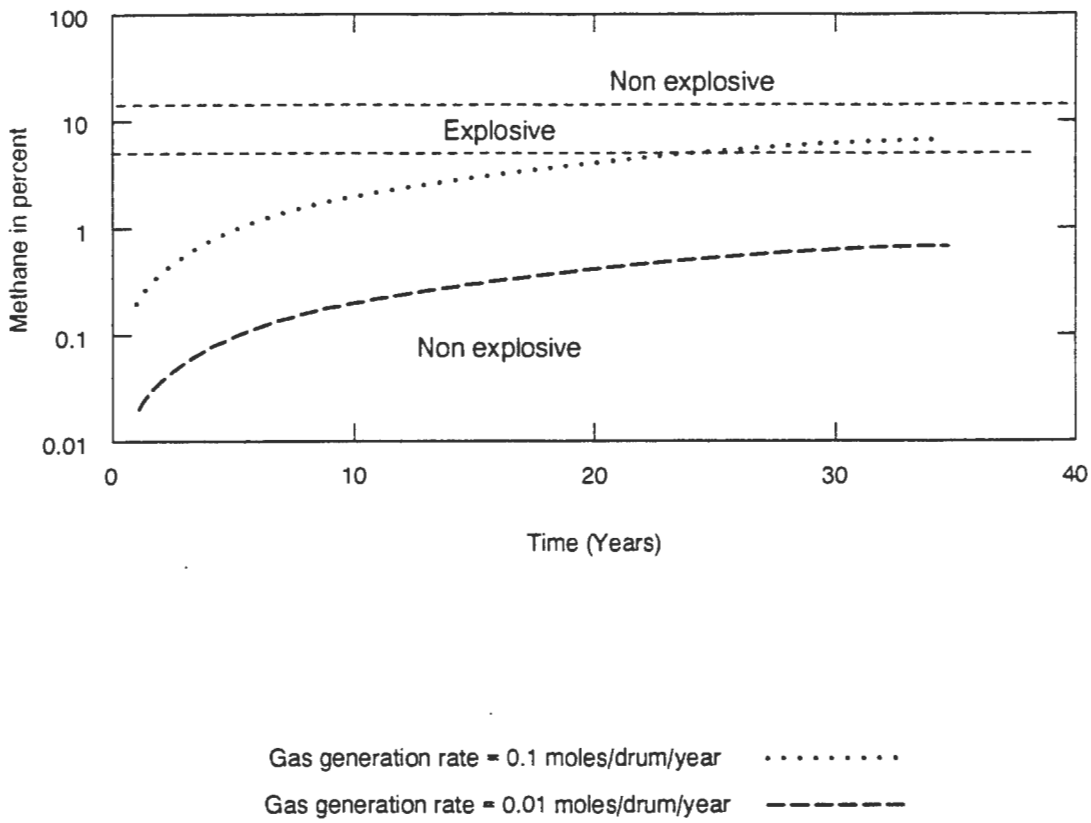


Figure 2-14

Methane Concentrations in the Waste Panel Over Time (After DOE, 1995)

explosion will result in a wave front that will rise instantaneously and then drop gradually. In this study, the transient pressure pulse is idealized as having an instantaneous rise and an exponential decay (Figure 2-15).

In the event of a hydrocarbon explosion: either (1) deflagration will result in a rapid rise of pressure, with no transition to a detonation, or (2) a detonation wave front will propagate as a supersonic shockwave. The transition to a detonation is a function of two parameters: (1) the methane concentration at the time of the explosion, and (2) the ability for a wave front to form. In underground excavations, the latter condition typically requires a reasonably long passage through which the combustion wave travels and transforms to a detonation. After 20 years, the open passage above the waste stack will be reduced in size, and it is unlikely that a long passage with an open geometry will exist. Further, individual rooms will be isolated by bulkheads at each end. Therefore, the dynamic analysis considers a deflagration.

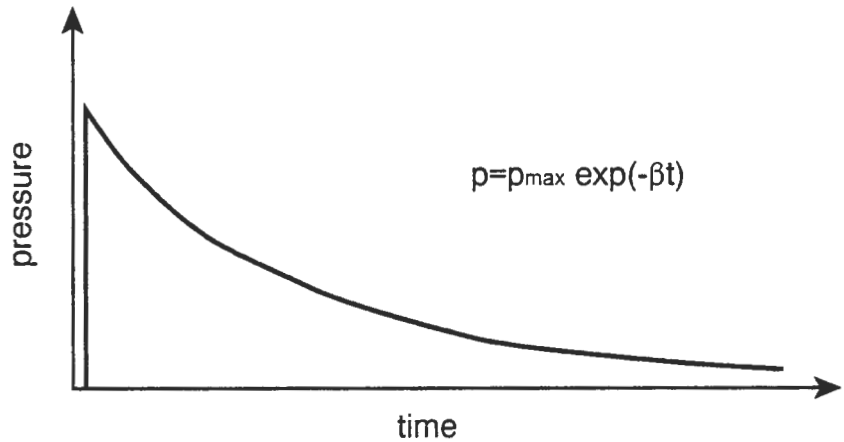
The second analysis involves a thermal analysis with a heat-transfer model (Appendix F). The heat-transfer model under the postulated explosion within the panel considers the heat balance between the gas and the walls of the panel for a stoichiometric mixture of methane. The rate at which the gas temperature will rise within the panel depends on (1) the number of moles of methane, (2) the specific heat capacity of the gas and the heat transfer to the salt and the walls through radiation, (3) convection along the vertical and horizontal surfaces, and (4) conduction within the salt and walls. Because the properties involved in the heat transfer analysis are temperature-dependent, a numerical model was run using the explicit finite difference method. The model provided the necessary information for evaluating thermal effects in selecting the size of the explosion-isolation wall.

2.2.3.2 Analysis Results

The peak explosive pressure was taken from the pressure rising from a deflagration that is about 8 times the ambient pressure (2 atmospheres) at the time of the explosion. This results in a peak pressure of 240 psi (1.7 MPa).[6]

The dynamic load factor will depend on the natural frequency of the explosion-isolation wall. The value for the dynamic load factor approaches a value of 2, with increased natural

[6]The analysis is conservative in that the presence of the waste drums would result in dampening of the explosion.



LEGEND

p = Pressure

p_{max} = Maximum pressure

t = Time

β = Shape factor for experimental curve

Figure 2-15
Pressure Pulse Versus Time

frequency for a variety of exponential curves (Figure 2-16). Based upon this loading, an explosion-isolation wall was designed to adsorb the energy from such an explosion.

The thermal-analysis results are presented in Figures 2-17 through 2-19. Figure 2-17 shows the gas temperature, the salt-wall temperature, and concrete wall temperature following the explosion. In the analysis, the gas reached a temperature of 2,500 Kelvin after about 20 seconds and then declined with time. The gas approached ambient temperatures after about 1.5 hours. Figures 2-18 and 2-19 show the temperature distribution as a function of distance into the walls. The results show that, at the initial time, the heat transfer from combustion gas to the salt and walls will result in a large temperature gradient at the wall. At later times, heat will be conducted through the wall, and the salt and the thermal gradient will be reduced. After 2 hours, the elevated temperature in the wall will propagate a maximum of 6 inches (15 cm) into the wall. Because the explosion-isolation wall is designed to resist creep deformation, temperature gradients will not significantly affect the stability of the wall.

2.2.3.3 Conclusions

The explosion-isolation wall was designed for a peak deflagration pressure of 240 psi (1.7 MPa) under pseudostatic conditions, with a dynamic load factor of 2.0. Because the explosion-isolation wall is designed to resist creep deformation, temperature gradients will not significantly affect the stability at the wall.

2.2.4 Fracture-Propagation Studies

The fracture-propagation studies evaluated the potential for fracture propagation, using the results of previous analyses. These analyses included a stress analysis and explosion evaluations.

2.2.4.1 Evaluation Procedure

The results of the thermal analysis suggest that elevated temperatures within an explosion-isolation wall and salt will be a localized phenomenon. During an explosion, which may potentially occur 20 years after closure of the first panel, two phenomena could affect the potential fracturing of the salt: (1) the expansion of the explosion products into existing fractures and (2) the potential reflection of sonic waves off free surfaces around the barrier. These effects were evaluated.

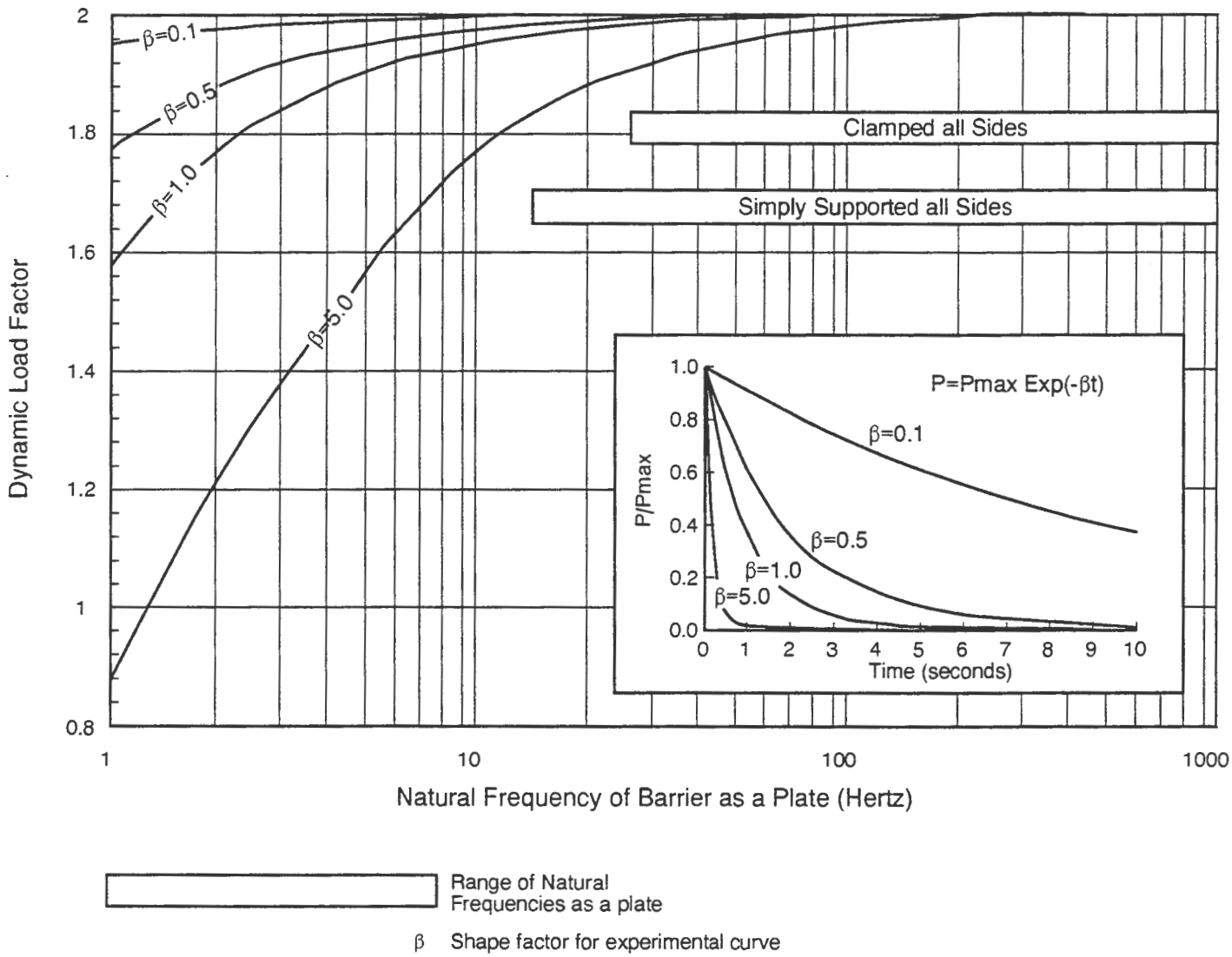


Figure 2-16
Dynamic Load Factor Versus Frequency of the Concrete Wall as a Plate

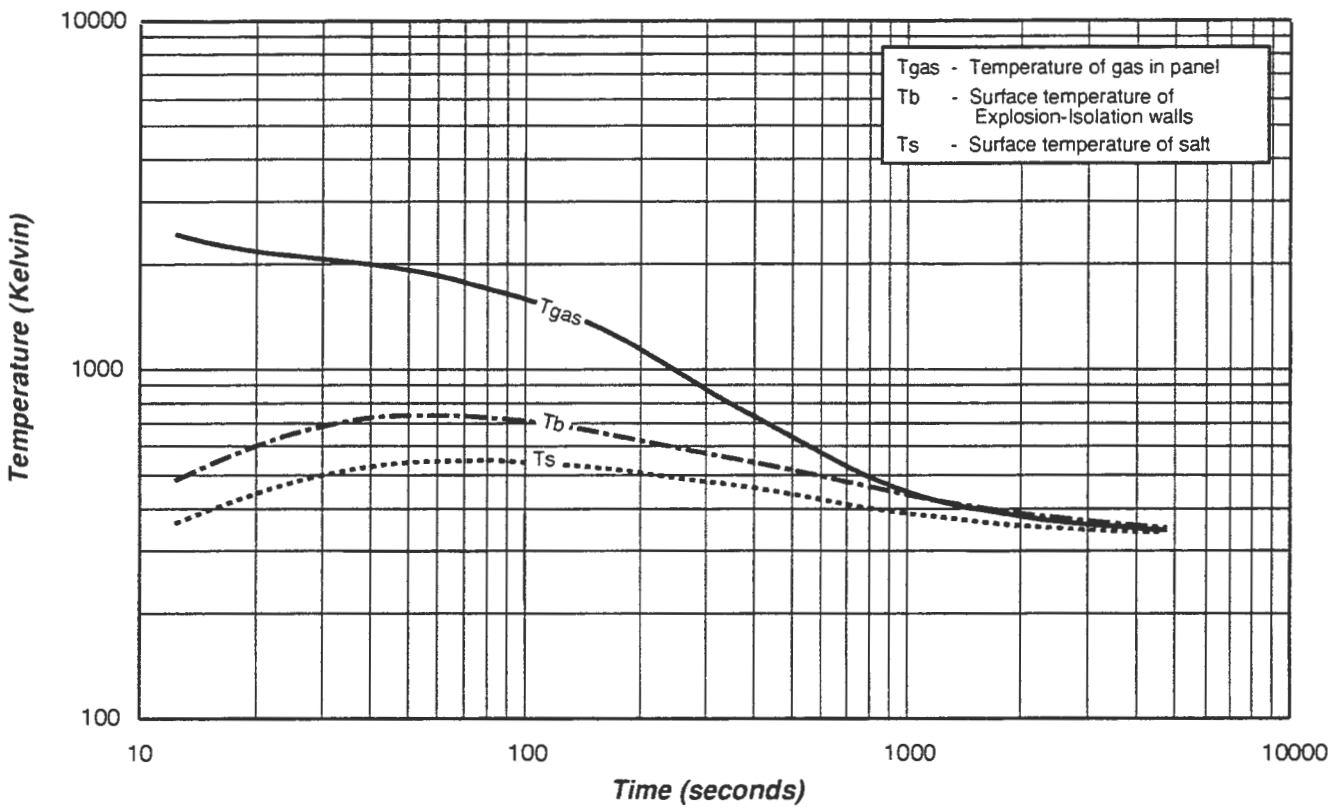


Figure 2-17
Temperature Variation with Time for Gas, Salt, and Explosion-Isolation Walls

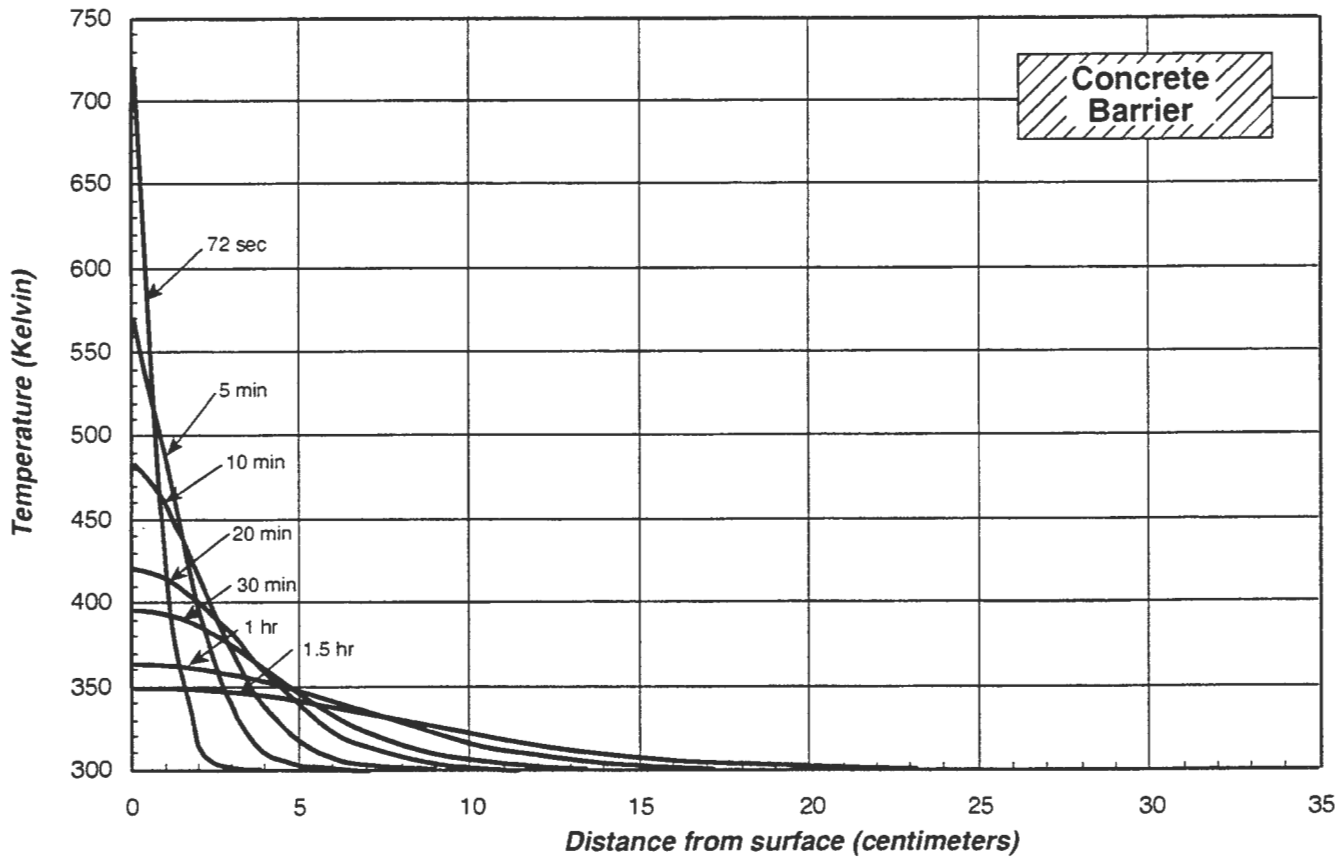


Figure 2-18
Temperature Distribution with Time for Concrete Barrier

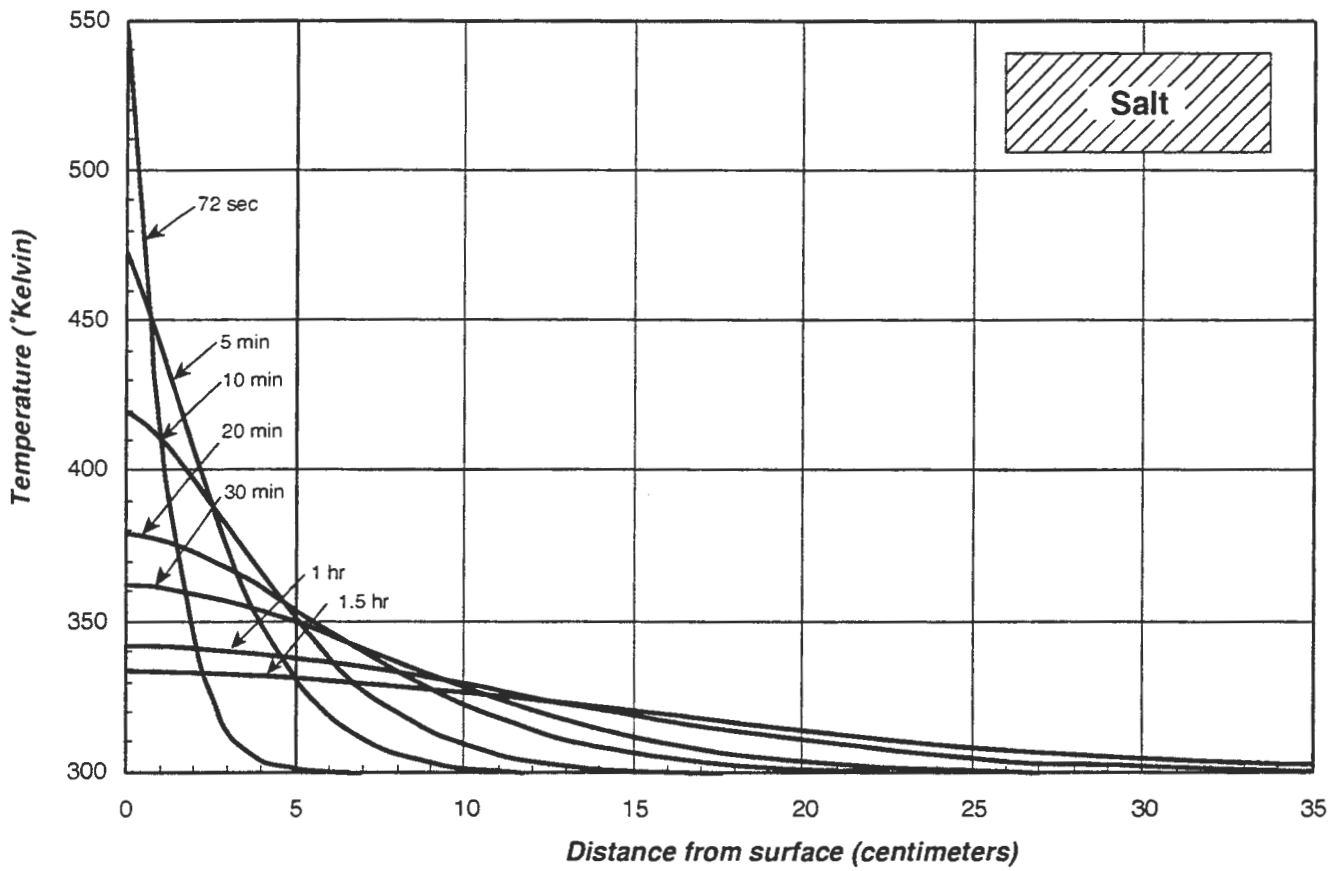


Figure 2-19
Temperature Distribution with Time for Salt

2.2.4.2 Evaluation Results

The fractures in the roof and floor could be affected by the expansion of the gas products on the order of 240 psi (1.7 MPa), which decay rapidly with time and attenuate with distance. Around the wall, the confining stress on the order of 1,450 psi (10 MPa) could develop after 20 years, as presented in Section 2.1.3. Horizontal fracture propagation could occur around the concrete barrier only if the internal gas pressure exceeded the confining pressure. Because the peak internal pressure from the deflagration is only about one-fifth of the confining pressure, fractures would not propagate through or around the main wall.

Following an explosion, the wall would be subject to sonic waves that would impinge on the wall. As the sonic wave encountered a contrast in wall stiffness, a portion of the sonic wave would be refracted, and a portion would be reflected (Jaeger and Cook, 1972). This would result in minor tensile spalling of the isolation wall.

2.2.4.3 Conclusions

At the time of a potential explosion, the development of confining stress relative to the explosion pressure would prevent fracturing around the main concrete barrier. With the selection of a thick enough wall, the effects of a postulated methane explosion can be isolated from the main concrete barrier.

3.0 Design Description

This chapter presents the final design selected from the evaluations performed in the previous chapter. It presents design modifications to cover a range of conditions that may be encountered in the underground and describes the design components for the panel-closure system. Finally, information is presented on the proposed construction for the panel-closure system.

3.1 Design Concept

The composite panel-closure system selected is (1) a standard concrete barrier, rectangular in shape, or (2) an enlarged tapered concrete barrier. Options (1) and (2) will be grouted along the interface and may contain explosion- or construction-isolation walls. Figure 3-1 illustrates these design components. The construction methods and materials to be used to implement the design have been proven in previous mining and construction projects. The standard concrete barrier without DRZ removal will most likely apply to future panel air-intake and air-exhaust drifts where the time duration between excavation and barrier emplacement is short. The enlarged concrete barrier with DRZ removal would apply to Panel 1 where a significant time lapse will occur between excavation and barrier emplacement. The design concept for the enlarged concrete barrier incorporates:

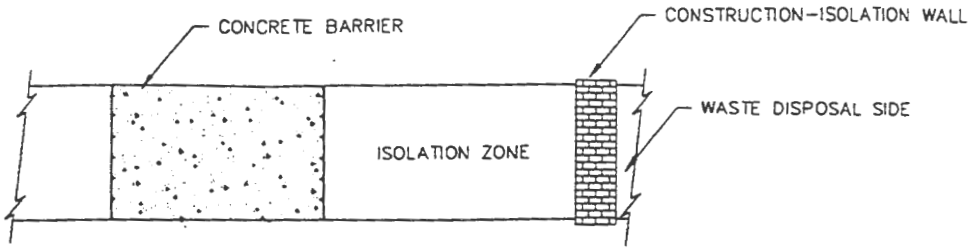
- A concrete barrier that is tapered to promote the rapid stress buildup on the host rock. The stiffness was selected to provide rapid buildup of compressive stress and reduction in shear stress in the host rock.

- The enlarged barrier requires DRZ removal just beyond Clay G and MB 139, and to a corresponding distance in the ribs to keep the tapered shape approximately spherical. The design includes DRZ removal and thereby limits VOC flow through the panel-closure system.

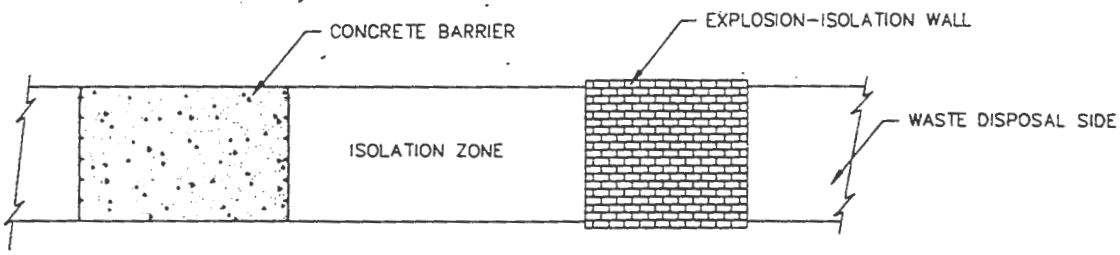
- The design of the panel-closure system includes either a construction- or an explosion-isolation wall designed to provide strength and deformational serviceability during the operational period. The length was selected to assure that uniform compression develops over a substantial portion of the structure and that end-shear loading that might result in fracturing of salt into the back is reduced.

3.2 Design Options

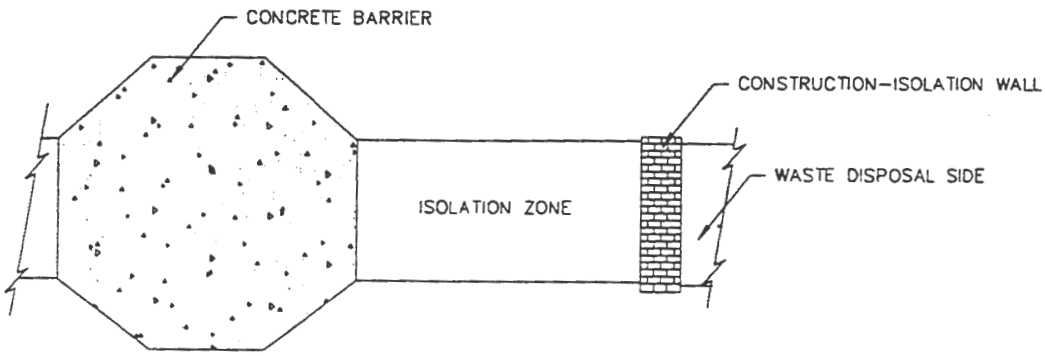
The design options consist of the following:



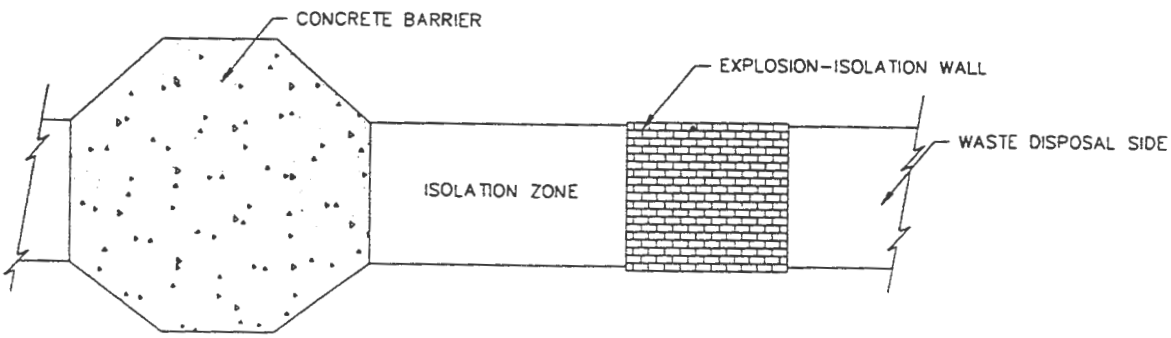
A. CONCRETE BARRIER WITHOUT DRZ REMOVED AND CONSTRUCTION ISOLATION WALL



B. CONCRETE BARRIER WITHOUT DRZ REMOVED AND EXPLOSION ISOLATION WALL



C. CONCRETE BARRIER WITH DRZ REMOVED AND CONSTRUCTION ISOLATION WALL



D. CONCRETE BARRIER WITH DRZ REMOVED AND EXPLOSION ISOLATION WALL

Figure 3-1
Main Concrete Barrier with Wall Combinations

- An enlarged concrete barrier with the DRZ removed and a construction-isolation wall
- An enlarged concrete barrier with the DRZ removed and an explosion-isolation wall
- A rectangular concrete barrier without the DRZ removed and a construction-isolation wall
- A rectangular concrete barrier without the DRZ removed and an explosion-isolation wall.

In each case, interface grouting will be used for the upper barrier/salt interface. The process for selecting these options would depend on the subsurface conditions at the panel-closure system locations described in the following subsections.

3.2.1 Selection of the Concrete Barrier

The design provides flexibility to satisfy the design migration limit for the flow of VOCs out of the panel. An enlarged concrete barrier will be selected where air-intake and air-exhaust drifts have fractured with age resulting in significant flow of VOCs. These conditions apply to the most severe ground conditions in the air-intake and air-exhaust drifts of Panel 1. If ground conditions are more favorable such as might be the case for future panel entries, then the panel-closure system can be simplified to a standard concrete barrier, rectangular in shape, with a construction-isolation wall.

Several methods are available for detecting the location and extent of fractures in the DRZ (DOE, 1995). These methods include ground-penetrating radar and observation boreholes, which have already been used for underground fracture detection at the WIPP (DOE, 1995). These methods will be used to determine when conditions are favorable, and the standard concrete barrier can be used to limit/restrict VOC flow.

The GPR methods and other exploratory methods show where fractures are minimal in order to select an optimum location for the panel-closure system. In such areas, the design can be simplified to a standard concrete barrier without DRZ removal. The area with the least number of fractures as determined by these exploratory methods would mean that compressive stresses increase on the standard concrete barrier. The effective concrete barrier permeability will be reduced with time as stresses increase on the standard concrete barrier.

GPR is a nondestructive electromagnetic reflection technique that is sensitive to variations in the dielectrical constant of rock salt. The use of GPR is a proven technology for detecting shallow fracture zones in the underground and will have practical value in determining the location of a panel-closure system (IT, 1993). GPR surveys perpendicular to the long axis and axial surveys of the drift would provide data to determine the optimum location for the main concrete barrier. Fractured rock will be removed as necessary for installation of the concrete barrier.

For future waste-emplacement panels, GPR will be used to monitor fracture development. Radar surveys could be conducted shortly after excavation to provide a baseline with which to compare future radar surveys. GPR will be used periodically to monitor the development of brittle deformation occurring in the new air-intake and air-exhaust drifts.

Observation boreholes will be drilled into the roof or floor of the new air-intake and air-exhaust drifts and will be used for observation of fractures and bed separation. Observations can be made in the boreholes using a small video camera, or a scratch rod. A scratch rod survey will be performed in accordance with the current Excavation Effects Program (EEP) procedure.

The EEP was initiated in 1986 with the occurrence of fractures in Site and Preliminary Design Validation Room 3. The purpose of the EEP is to study fractures that develop as a result of underground excavation at the WIPP and to monitor those fractures. Borehole inspections have been successful for determining the fracturing and bed separation in the host rock. These inspections have been performed since 1983 (Francke and Terrill, 1993). This technique in addition to the above will be used to determine the optimum location for the panel-closure system.

3.2.2 Selection of an Explosion- or Construction-Isolation Wall

While no requirements for barricading waste areas exist under the MSHA, the intent of the regulations is to safely isolate abandoned areas from active workings using barricades of "substantial construction." The previous analysis (DOE, 1995) examined the issue of methane gas generation from TRU waste and its potential consequence in closed areas. The principal concern is the occurrence of an explosive mixture of methane and an ignition source, which would result in deflagration. If a methane explosion is considered possible, an explosion-isolation wall of sufficient thickness will be used to resist dynamic and creep loads. In the absence of explosive conditions, a construction-isolation wall will be used.

3.3 Design Components

The following subsections present system and components design features.

3.3.1 Concrete Barrier

The enlarged concrete barrier consists of plain concrete, with sufficient unconfined compressive strength and with an approximately circular cross-section excavated into the salt over the central portion of the barrier (Figure 3-2). The enlarged concrete barrier will be located at the optimum locations in the air-intake and air-exhaust drifts with the central portion extending just beyond Clay G and MB 139.

The enlarged concrete barrier will be placed in four cells, with construction joints perpendicular to the direction of potential air flow. The concrete strength will be selected according to the standards specified by the latest edition of the ACI code for plain concrete. The concrete will be placed through 6-inch- (15-cm)-diameter steel pipes and vibrated from outside the formwork. The formwork is designed to withstand the hydrostatic loads during construction, with minimal bracing onto exposed salt surfaces. This will be accomplished by placing a series of steel plates that are stiffened by angle iron, with load reactions carried by spacer rods. The spacer rods will be staggered to reduce potential flow along the rod surfaces through the barrier. Some exterior bracing will be required when the first cell is poured. All structural steel will be ASTM A36, with detailing, fabrication, and erection of structural steel in conformance with the latest edition of the AISC steel manual (AISC, 1989). After concrete placement, the formwork will be left in place.

The above design is for the most severe conditions expected to be encountered at the WIPP. If actual conditions are found to be more favorable (i.e., if the age of the entries at the time of emplacement is less, and if the fractured DRZ does not develop, or there is adequate design margin for the flow of VOCs), the design can be simplified to a rectangular barrier without DRZ removal (Figure 3-3).

3.3.2 Explosion- and Construction-Isolation Walls

An explosion-isolation wall, consisting of concrete-blocks, will mitigate the effects of a postulated methane explosion. The explosion-isolation wall consists of 3,500-psi (24-MPa) concrete blocks mortared together with cement (Figure 3-4).

The concrete block wall design complies with MSHA requirements (MSHA, 1987) because it uses incombustible materials of substantial construction. The explosion-isolation wall will be

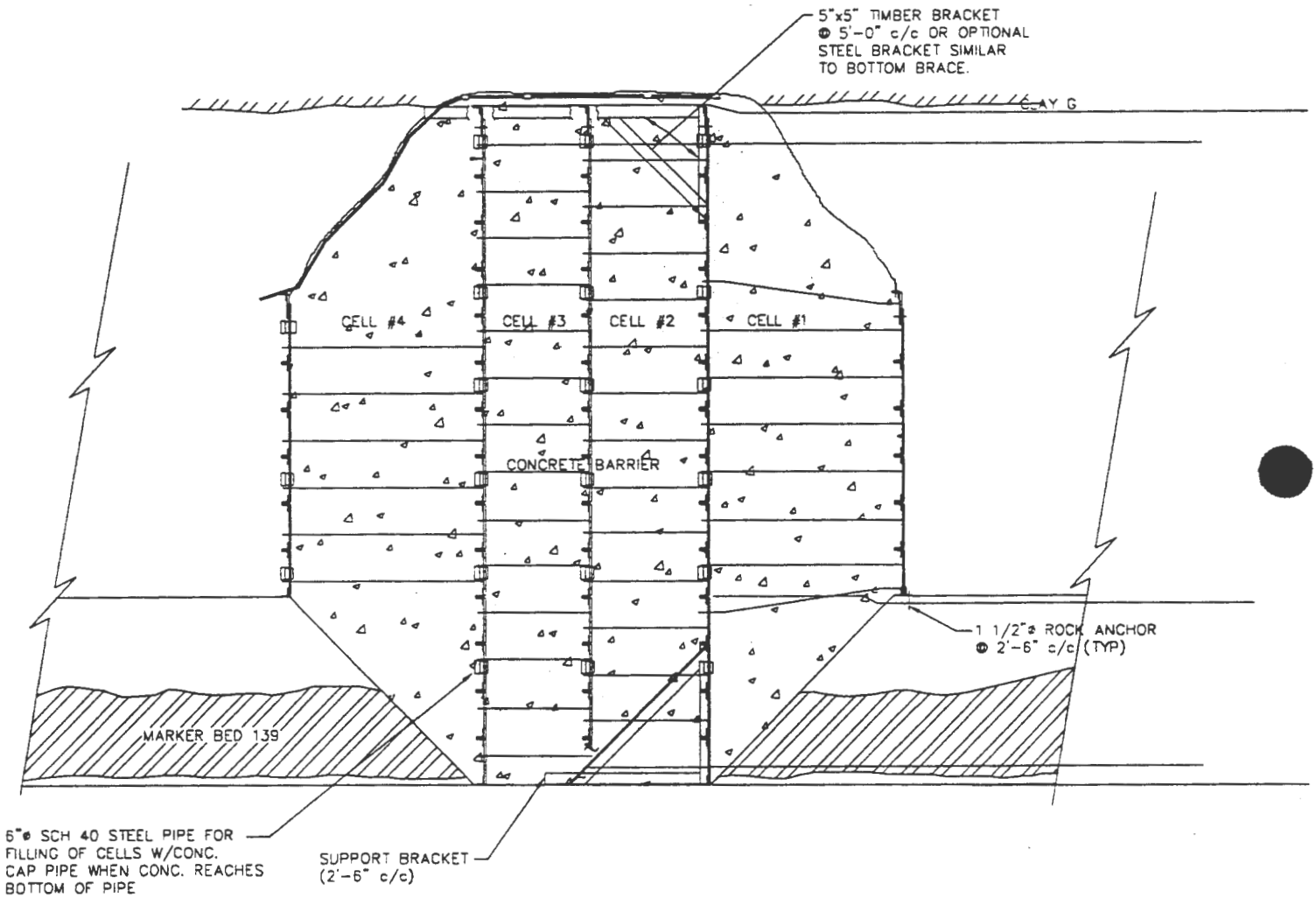


Figure 3-2
Concrete Barrier with DRZ Removal

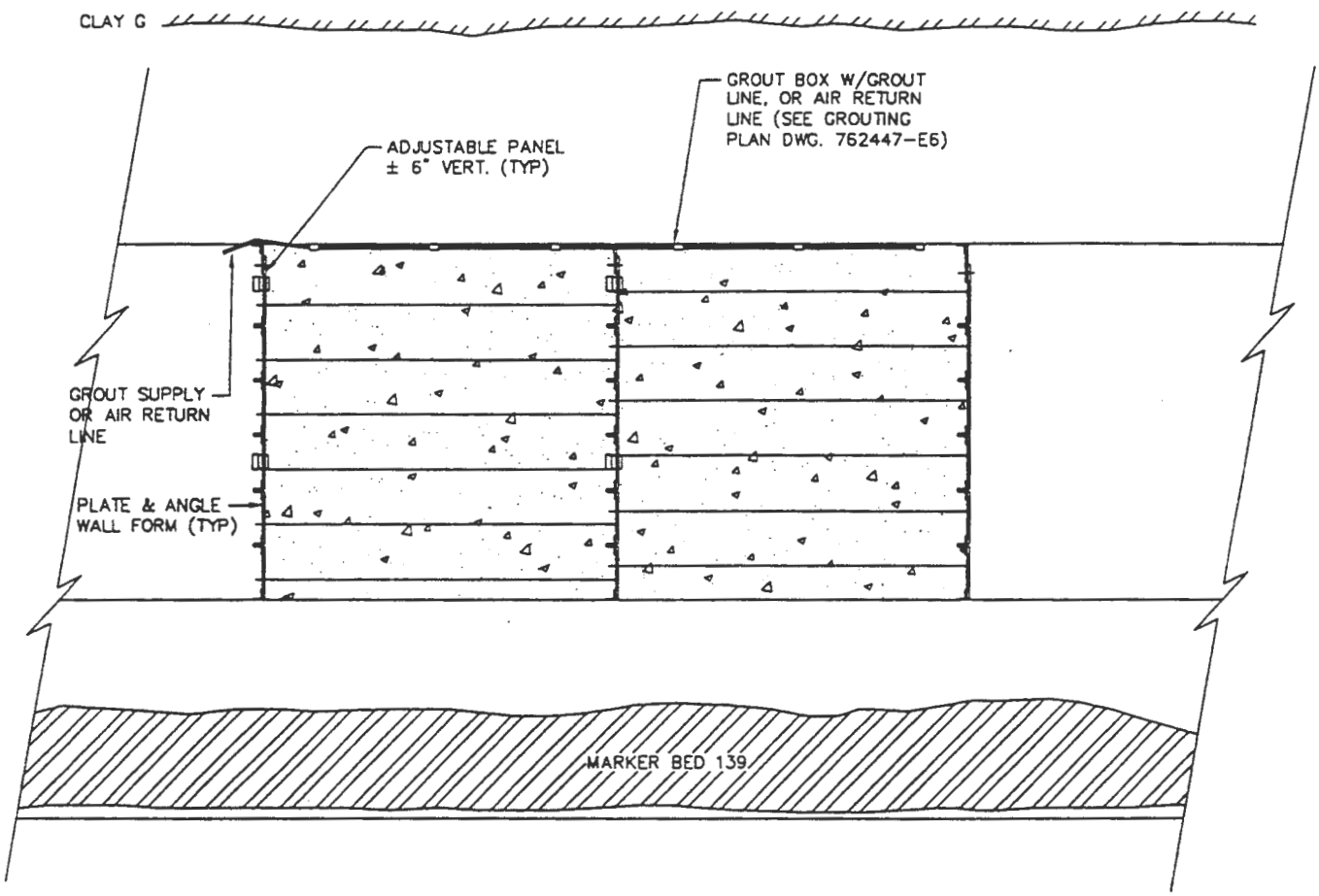


Figure 3-3
Concrete Barrier Without DRZ Removal

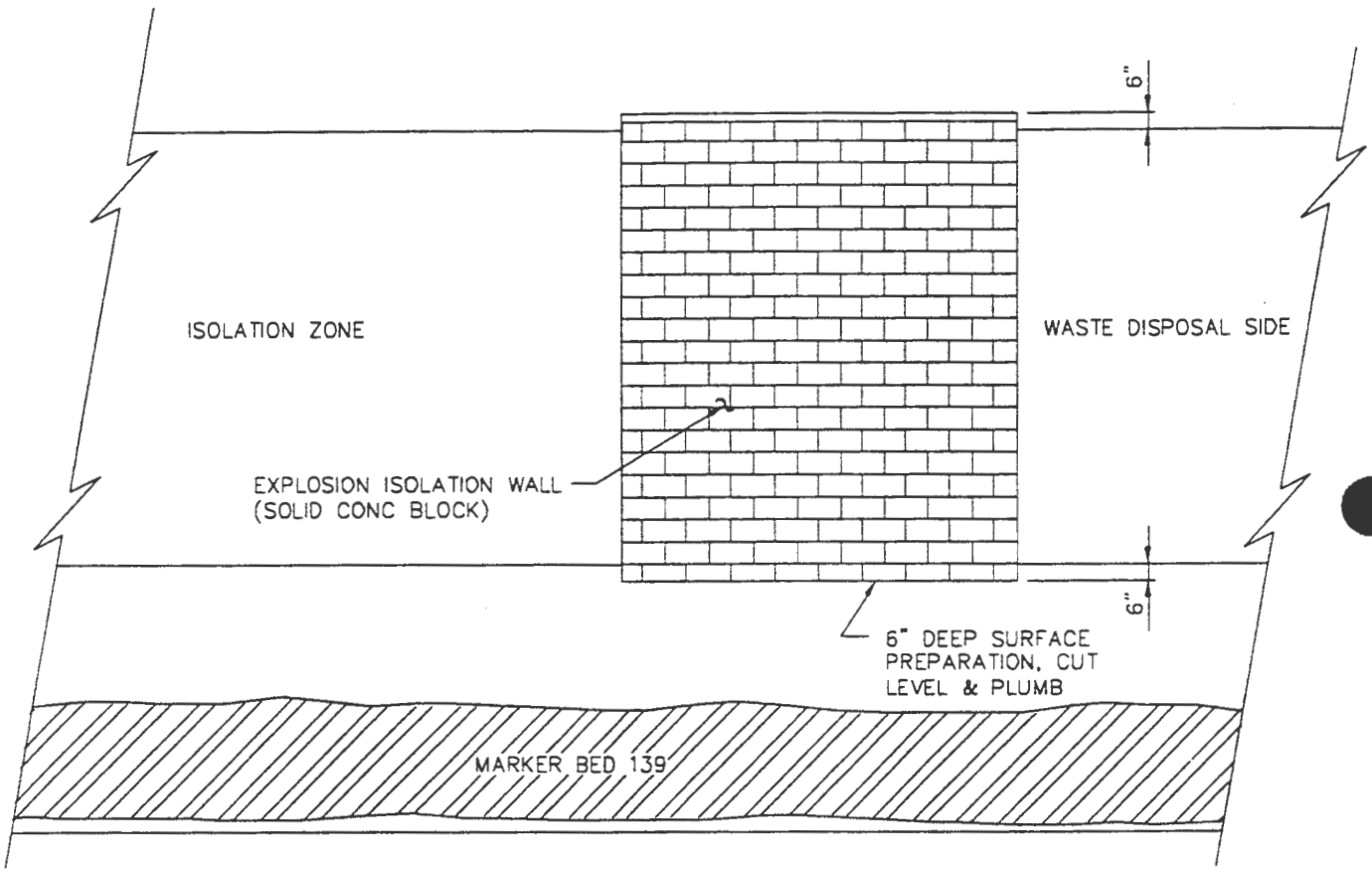


Figure 3-4
Explosion-Isolation Wall

placed into the salt for support. The explosion-isolation walls are designed to resist creep loading from salt deformation. In the absence of the postulated methane explosion, the design will be simplified to a construction-isolation wall. The construction-isolation wall design provides temporary isolation during the time the main concrete barrier is being constructed.

3.3.3 Interface Grouting

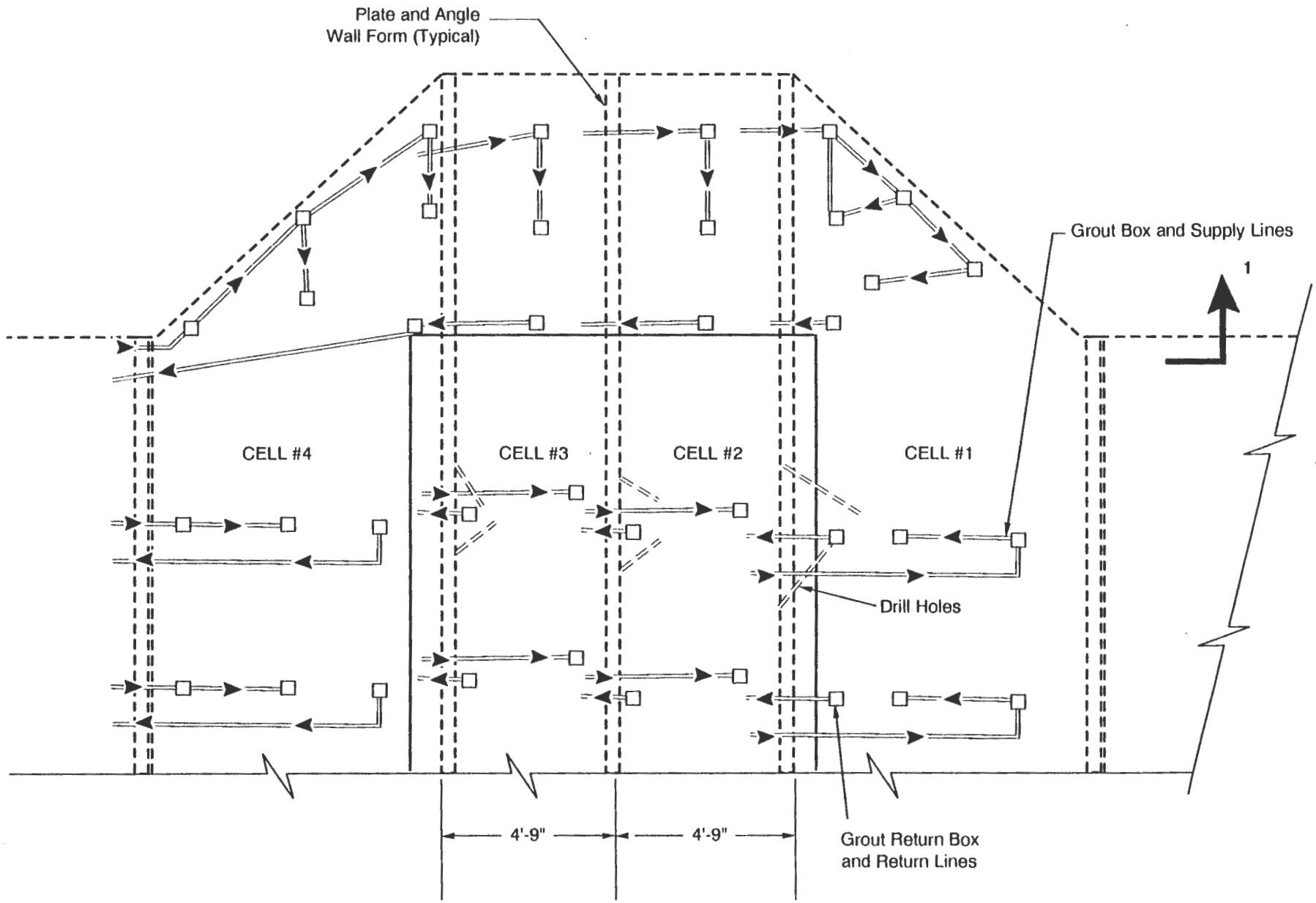
After construction of the main concrete barrier, the interface between the main concrete barrier and the salt will be grouted through a series of grout-supply and air-return lines that will terminate in grout distribution collection boxes. The openings in these boxes will be protected during concrete placement (Figure 3-5). The grout boxes will be mounted near the top of the barrier. The grout will be injected through one distribution system, with air and return grout flowing through a second distribution system.

3.4 Panel-Closure System Construction

The construction methods and materials to be used to implement the design have been proven in previous mining and construction projects. The design uses common construction practices according to existing standards. The proposed construction sequence follows completion of the waste-emplacement activities in each panel: (1) Perform subsurface exploration to determine the optimum location for the panel closure system, (2) select the appropriate design option for the location, (3) prepare surfaces for the construction- or explosion-isolation walls (if required), (4) install these walls, (5) excavate for the enlarged concrete barrier (if required), (6) install concrete formwork, (7) emplace concrete for the first cell, (8) grout the completed cell, and (9) install subsequent formwork, concrete and grout until completion of the enlarged concrete barrier.

The explosion-isolation or construction-isolation walls will be located at some distance from the main concrete barrier. The host rock will be excavated 6 inches (15 cms) around the entire perimeter prior to installing the explosion-isolation wall. The surface preparation will produce a level surface for placing the first layer of concrete blocks. Excavation may be performed by either mechanical or manual means.

Excavation for the enlarged concrete barrier will be performed using mechanical means, such as a cutting head on a suitable boom. The existing roadheader at the main barrier location in each drift is capable of excavating the back and the portions of the ribs above the floor level. Some manual excavation may be required in this situation as well. If mechanical means are not available, drilling boreholes and an expansive agent can be used to fragment the rock



Plan View of an Enlarged Bulkhead

Figure 3-5
Grouting Details

(Fernandez et al., 1989). Excavation will follow the lines and grades established for the design. The roof will be excavated to just above Clay G and then the floor to just below MB 139 to remove the DRZ. The tolerances for the enlarged concrete-barrier excavation are +6 to 0 inches (+15 to 0 cm). In addition, loose or spalling rock from the excavation surface will be removed to provide an appropriate surface abutting the enlarged concrete barrier. The excavations will be performed according to approved ground control plans.

Following completion of the roof excavation for the enlarged barrier, the floor will be excavated. If mechanical means are not available, drilling boreholes and using an expansive agent to fragment the rock (Fernandez et al., 1989) is a method that can be used. Expansive agents would load the rock salt and anhydrite, producing localized tensile fracturing in a controlled manner, to produce a sound surface.

A batch plant at the surface or underground will be prepared for batching, mixing, and delivering the concrete to the underground in sufficient quantity to complete placement of the concrete within one form cell. The placement of concrete will be continuous until completion, with a target time for completing one section of 8 to 10 hours, allowing an additional 2 hours for cleanup of equipment.

Pumping equipment suitable for placing the concrete into the forms will be provided at the main concrete barrier location. After transporting, and prior to pumping, the concrete will be remixed to compensate for segregation of aggregate during transport. Batch concrete will be checked at the surface at the time of mixing and again at the point of transfer to the pump for slump and temperature. Admixtures may be added at the remix stage in accordance with the batch design.

4.0 Design Calculations

Table 4-1 summarizes calculations to support the construction details for an explosion-isolation wall, construction-isolation wall, and structural steel formwork for concrete barriers up to a 29-ft high. The codes for the explosion-isolation and construction-isolation wall are specified by the Uniform Building Code (International Conference of Building Officials, 1994), with related seismic design requirements. The external loads for the solid block wall are as developed in the methane-explosion and fracture propagation design evaluations.

Table 4-1
Constructability Design Calculations Index

Section	Design Area	Category
1.0	Explosion-isolation wall	W
2.0	Explosion-isolation wall seismic check	S
3.0	Formwork design	F

The structural formwork for all cells is designed in accordance with the AISC guidelines on allowable stress (AISC, 1989). Lateral pressures are developed using ACI 347R-88, using a standard concrete weighing 150 pounds per cubic foot (2,410 kg/m^3) with a slump of 8 inches (20 cm) or less. Design loadings reflect full hydrostatic head of concrete, with lifts spaced at 4 ft (1.2 m) intervals from bottom to top through portals, with no external vibration. All forms will remain in place.

5.0 Technical Specifications

The specifications are in the engineering file room at the WIPP and are the property of Westinghouse WID. These specifications are included as an attachment in Appendix G and summarized in Table 5-1.

Table 5-1
Technical Specifications for the WIPP Panel-Closure System

Division 1 - General Requirements	
Section 01010	Summary of Work
Section 01090	Reference Standards
Section 01400	Contractor Quality Control
Section 01600	Material and Equipment
Division 2 - Site Work	
Section 02010	Mobilization and Demobilization
Section 02222	Excavation
Section 02722	Grouting
Division 3 - Concrete	
Section 03100	Concrete Formwork
Section 03300	Cast-in-Place Concrete
Division 4 - Masonry	
Section 04100	Mortar
Section 04300	Unit Masonry System

6.0 Drawings

The drawings (Appendix H) are in the engineering file room at the WIPP and are the property of the Westinghouse WID and summarized in Table 6-1.

Table 6-1
Panel-Closure System Drawings

Drawing Number	Title
762447-E1	Title Sheet
762447-E2	Underground Waste Disposal Plan
762447-E3	Air Intake Drift Construction Details
762447-E4	Air Exhaust Drift Construction Details
762447-E5	Construction and Explosion Barrier Construction Details
762447-E6	Grouting and Miscellaneous Details

7.0 Conclusions

This chapter presents the conclusions for the detailed design activities of the panel-closure system. A design basis, including the operational requirements, the structural and material requirements, and the construction requirements, was developed that addresses the governing regulations for the panel-closure system. Table 7-1 summarizes the design basis for the panel-closure system and the compliance with the design basis. The panel-closure system design incorporates mitigative measures to address the treatment of fractures and therefore counter the potential migration of VOCs. Several alternatives were evaluated for the treatment of fractures. These included excavation and emplacement of a fully enlarged barrier with removal of the DRZ, excavation of the roof and emplacement of a partially enlarged barrier, and emplacement of a standard barrier with formation grouting.

To investigate several key design issues and to implement the design, design evaluations were performed. These design evaluations can be divided into evaluations satisfying the operational requirements of the system and evaluations satisfying the structural and materials requirements of the system. The conclusions reached from the evaluations addressing the operational requirements are as follows:

- Based on an air-flow model used to predict the mass flow rate of carbon tetrachloride through the panel-closure system for the alternatives, the air-flow analysis suggests that the fully enlarged barrier is the most protective for restricting VOCs during the operational period of 35 years.

- Results of the FLAC analyses show that the recommended enlarged configuration is a circular rib-segment excavated to Clay G and under MB 139. Interface grouting would be performed at the upper boundary of the concrete barrier.

- The results of the transverse plane-strain models show that high stresses would form in MB 139 following excavation, but that after installation of the panel-closure system, an increase in barrier-confining stress and a reduction in shear stress would result. The concrete barrier would provide substantial uniform confining stresses as the barrier is subjected to secondary salt creep.

- The removal of the fractured salt prior to installation of the main concrete barrier would reduce the potential for flexure. With the removal of MB 139, the fractured salt stiffens the surrounding rock and results in the development of more uniform compression.

Table 7-1
Compliance of the Design with the Design Requirements

Type of Requirement	Requirement	Section	Compliance with Requirement	Notes on Compliance
Operational	Individual panels shall be closed in accordance with the schedule of actual waste emplacement.	2.1.1	Complies	Gas-flow models used for design are based on the waste-emplacement operational schedule.
	The panel-closure system shall provide assurance that the limit for the migration of volatile organic compounds (VOC) of concern will be met at the point of compliance. To achieve this assurance, the design shall consider the potential flow of VOCs through the several components of the disturbed rock zone and the panel-closure system.	2.1.1, 2.1.2	Complies	Gas-flow modeling shows that the VOC flow is less than the design migration limit.
	The panel-closure system shall comply with its intended functional requirements under loads generated from creep closure and any internal pressure that might develop in the disposal panel under reasonably anticipated conditions.	2.1.2, 4.0	Complies	Stress analyses and design calculations show that the panel-closure system performs as intended.
	The panel-closure system shall comply with its intended functional requirements under a postulated methane explosion.	2.2.3, 2.2.4, 4.0	Complies	The methane explosion studies, fracture propagation studies, and supporting design calculations show that the panel-closure system performs as intended.
	The operational life of the panel-closure system shall be at least 35 years.	2.1.1	Complies	Gas-flow modeling and analyses shows satisfactory performance for at least 35 years.
	The panel-closure system for each individual panel shall not require routine maintenance during its operational life.	3.2	Complies	Passive design components require no routine maintenance.
	The panel-closure system shall address the most severe ground conditions expected in the panel entries. If actual conditions are found to be more favorable, this design can be simplified and still satisfy the operational requirements of the system.	2.1.1 2.1.3 3.2	Complies	Design is based upon flow and structural analyses for the most severe expected ground conditions. If conditions are less severe, simpler design options are used. The various design options accommodate all expected conditions.

Table 7-1 *(Continued)*
Compliance of Design with the Design Requirements

Type of Requirement	Requirement	Section	Compliance with Requirement	Notes on Compliance
Design configuration and essential features	The panel-closure system shall be emplaced in the air-intake and air-exhaust drifts identified by Westinghouse (1995c)	3.2	Complies	The design shows placement in the designated areas for panel closure.
	The panel-closure system shall consist of a concrete barrier and construction-isolation and explosion-isolation walls with dimensions to satisfy the operational requirements of the system.	3.2, 3.3	Complies	The panel-closure system design uses the identified components with dimensions to satisfy the operational requirements of the system.
Safety	The design class for the panel-closure system shall be IIIb. Design and construction shall follow conventional mining and construction practices.	3.4	Complies	Components are designed according to Class IIIb. The construction sequence for the design followed conventional mining practices.
	The structural analysis for the underground shall use the empirical data acquired from the WIPP Excavation Effects Program.	2.1.2	Complies	The structural analysis uses properties that model creep closure for stress analyses from data acquired in the WIPP Excavation Effects Program.
Structural and material	The panel-closure system materials shall be compatible with their emplacement environment and function. Surface treatment between the host rock and the panel-closure system shall be considered in the design.	2.2.1	Complies	The material compatibility studies showed no degradation of materials and no need for surface treatment.
	The selection and placement of concrete in the concrete barrier shall address potential thermal cracking due to the heat of hydration.	2.2.2	Complies	The heat generation studies show that hydration temperatures are controlled by appropriate selection of cement type and placement temperature.
	The panel-closure system shall sustain the dynamic pressure and subsequent temperature generated by a postulated methane explosion.	2.2.3, 2.2.4, 4.0	Complies	The methane explosion study shows that the explosion-isolation wall protects the concrete barrier from pressure loading and thermal loading. The fracture propagation study shows that the system performs as intended.

Table 7-1 *(Continued)*
Compliance of Design with the Design Requirements

Type of Requirement	Requirement	Section	Compliance with Requirement	Notes on Compliance
Construction	The panel-closure system shall use to the extent possible normal construction practices according to existing standards.	3.4	Complies	The specifications include normal construction practices used in the underground at WIPP and according to the most current steel and concrete specifications.
	During construction of the panel-closure system, a quality assurance/quality control program shall be established to verify material properties and construction practices.	3.4	Complies	The specifications include materials testing to verify material properties and construction practices.
	The construction specification shall take into account the shaft and underground access capacities and services for materials handling.	3.4	Complies	The specifications allow construction within the capacities of underground access.

- The trade-off study also showed that a panel-closure system with an enlarged concrete barrier with the removal of the fractured salt roof and anhydrite in the floor was found to be the most protective.

The conclusions reached from the design evaluations addressing the structural and material requirements of the panel-closure system are as follows:

- Existing information on the heat of hydration of the concrete supports placing concrete with a low cement content to reduce the temperature rise associated with hydration. The slump at the required strength would be achieved through the use of plasticizers. A thermal analysis coupled with a salt creep analysis suggest installation of the enlarged barrier at or below ambient temperatures to adequately control hydration temperatures.

- In addition to installation at or below ambient temperatures, the concrete used in the main concrete barrier would exhibit the following:

  - An 8 inch (0.2 meter) slump after 3 hours of intermittent mixing
  - A less-than-25-degree Fahrenheit heat rise prior to installation
  - An unconfined compressive strength of 4,000 psi (28 MPa) after 28 days
  - Volume stability
  - Minimal entrained air.

- The trace amounts of brine from the salt at the repository horizon should not degrade the main concrete barrier for at least 35 years.

- In 20 years, the open passage above the waste stack would be reduced in size. Further, rooms with bulkheads at each end would be isolated in the panel. It is unlikely that a long passage with an open geometry would exist; therefore, the dynamic analysis considered a deflagration with a peak explosive pressure of 240 psi (1.7 MPa).

- The heat-transfer analysis shows that elevated temperatures would occur within the salt and the explosion-isolation wall; however, the elevated temperatures will be isolated by the panel-closure system. Temperature gradients will not significantly affect the stability of the wall.

- The fractures in the roof and floor could be affected by expanding gas products reaching pressures of the order of 240 psi (1.7 MPa). Because the peak internal pressure from the deflagration is only one fifth of the pressure, fractures could not propagate beyond the wall.

The design options to satisfy the design requirements for the panel-closure system include (1) a standard barrier, rectangular in shape, or (2) an enlarged concrete barrier, approximately

spherical in shape. Options (1) and (2) will be grouted at the interface and may contain explosion- or construction-isolation walls.

The design provides flexibility to satisfy the design migration limit for the flow of VOCs out of the panels. An enlarged concrete barrier would be selected where the air-intake and air-exhaust drifts have aged and where there is fracturing resulting in significant flow of VOCs. These conditions apply to the most severe ground conditions in the air-intake and air-exhaust drifts of Panel 1. If ground conditions are more favorable, such as might be the case for future panel entries, the design can be simplified to a standard concrete barrier rectangular in shape, with a construction isolation wall. GPR and observation boreholes are available for detecting the location and extent of fractures in the DRZ. These methods will be used to select the optimum location and appropriate panel-closure system.

The design is presented in this report as a series of calculations, engineering drawings, and technical performance specifications. The drawings illustrate the construction details for the system. The technical performance specifications cover the general requirements of the system, site work, concrete, and masonry. Information on the proposed construction method is also presented.

The design complies with all aspects of the design basis established for the WIPP panel-closure system. The design can be constructed in the underground environment with no special requirements at the WIPP.

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APPENDIX A
DERIVATION OF RELATIONSHIPS FOR THE AIR-FLOW MODELS

APPENDIX A
DERIVATION OF RELATIONSHIPS FOR THE AIR-FLOW MODELS

A1.0 Introduction

This appendix shows the unrestricted and restricted air-flow models used to determine the performance of the panel closure system alternatives. These analyses are order-of-magnitude estimates of the volume of gas that might flow through the panel seal systems at the Waste Isolation Pilot Plant (WIPP).

A2.0 Model for Unrestricted Flow of VOCs

A model for the unrestricted flow of volatile organic compounds (VOC) was developed to predict the mass flow rates of VOCs and to compare this mass flow rate to the design migration limit for VOCs. As gas generation and panel volumetric creep closure proceed, a mixture of gases containing the VOC concentrations flows from each waste container. It is assumed for the unrestricted flow model that the headspace concentrations serve as a constant source of VOCs. This assumption is highly conservative, because most containers only have trace quantities of VOCs either trapped in the headspace or adsorbed on the surfaces of the various waste forms. It is believed that only a small number of waste containers have significantly greater sources of VOCs, such as a solvent-soaked rag or a can containing residual partially dried paint. Only these waste containers have a likelihood of maintaining a constant headspace VOC concentration as gas generation proceeds. However, the exact proportion of waste containers with higher VOC concentrations versus those with trace quantities is currently unknown. These data are based on results of the characterization of approximately 500 transuranic (TRU) mixed waste drums at the Idaho National Engineering Laboratory (INEL) and Rocky Flats.

The VOCs migrate due to advection from volumetric closure of the panel void space at a rate of about 28,250 ft^3 (800 m^3) per year. Gas generation for the waste inventory at a rate of 0.1 mole per drum per year (8,200 moles per panel per year) results in a volumetric flow rate of 7,060 ft^3 (200 m^3) per year. Because flow is unrestricted, the VOCs migrate under a pressure of one atmosphere. Other assumptions in the unrestricted model are as follows:

- Any gases released into the mine atmosphere would be reduced in concentration by 460,000[1] cfm of uncontaminated air. The mass flow rate of individual VOCs from individual panels following their closure is summed to determine the mass flow rate of VOCs through the exhaust shaft.

- This calculation considers the schedule for closure of individual panels as illustrated in Figure A-1 during the operational life of the WIPP. The VOC mass flow rate changes with time, with the maximum mass flow release occurring after 10 panel equivalents have been closed, about 25 years.

- Each VOC is analyzed in the calculations. Carbon tetrachloride is the most restrictive VOC in terms of satisfying the health-based levels for individual VOCs.

- Open panels of waste will not be considered as a source contributing to the emissions for a no-migration demonstration.

Considering only advection to result in the migration of VOCs, the mass-balance relationship is:

$$C_p * Q_p = C_{es} * Q_{es}$$

where

C_p = Head space concentration for an individual VOC
Q_p = Flow rate of VOCs from the panel that may vary with time
C_{es} = Concentration of VOCs at the exhaust shaft.
Q_{es} = Underground ventilation flow rate for the exhaust shaft

Air dispersion modeling is used for evaluating the receptor concentrations at the WIPP site boundary based upon the exhaust shaft source term. The air dispersion modeling considers such factors as meteorological data, release velocity, release temperature, and proximity of the WIPP site boundary to the exhaust shaft. The results of the modeling are expressed as a ratio R of the concentration at the exhaust shaft to the concentration at at the WIPP site boundary:

$$C_{es} \leq RC_{hbl}$$

This inequality can be expressed in terms of mass flow rate:

---

[1]The design ventilation rate for the WIPP underground is 425,000 standard cfm (12,000 standard m^3 per minute) under standard temperature and pressure conditions of 25 degrees Celsius and 1 atmosphere. The ventilation flow rate of 460,000 cfm (13,025 m^3 per minute) is the observed ventilation rate at the repository horizon under actual temperature and pressure conditions.

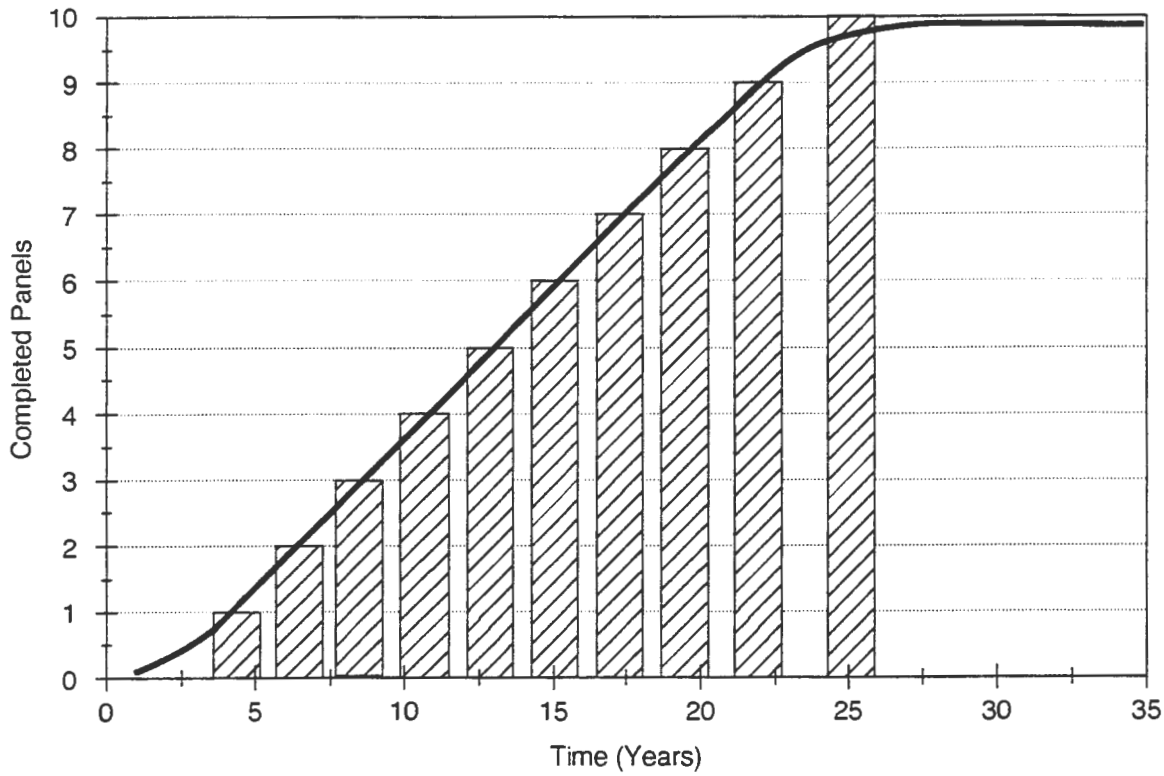

Figure A-1
Schedule for Panel Completion

$$\frac{C_p * Q_p}{Q_{es}} * \frac{1}{R} \leq C_{hbl}$$

where

R = Ratio of the concentrations at the exhaust shaft to the concentrations at the WIPP site boundary

C_{hbl} = Concentration to satisfy the health-based level for the individual VOC.

The ratio of the concentrations at the WIPP site boundary, R equals 10,753, reflecting the substantial atmospheric dispersion in reducing the concentration of VOCs.

The flow rates of VOCs from the panels are calculated for two mechanisms, gas generation and volumetric closure, using the following:

$$Q_p = Q_{gr} + Q_c$$

where

Q_{gr} = Volumetric flow rate due to gas generation[2] (200 m^3 per year per panel)

Q_c = Volumetric flow rate due to panel volumetric closure (800 m^3 per year per panel).

Table A-1 presents the closed panel release limits (migration limits) for VOCs based upon the health-based concentrations of individual VOCs. This inequality can be rewritten as:

$$C_p \cdot Q_p \leq C_{hbl} \cdot Q_{es} \cdot R$$

Table A-2 presents for a single closed panel and ten equivalent closed panels, the release rate for individual VOCs at the end of the 35-year operating period.

For the WIPP site boundary, the VOC concentrations are reduced substantially in the atmosphere. The above analysis shows that the concentration at the WIPP site boundary would be approximately 4 orders of magnitude lower than the concentration at the exhaust shaft. The predicted VOC mass flow rates due to unrestricted flow suffice to comply with the

[2]The volumetric flow due to gas generation is calculated as the gas generation rate (0.1 moles per drum per year) times the number of drums within a panel times the specific volume under atmospheric pressure.

Table A-1
Closed Panel Release Limits for VOCs

Compound	WIPP Site Boundary Health-Based Exposure Level[a] (micrograms per cubic meter)	Exhaust Shaft Concentration Migration Limit (micrograms per cubic meter)	Closed Ten Panel Migration Limit (grams per minute)
Carbon disulfide	10.00	107,530	1,400
Carbon tetrachloride	0.13	1,398	18
Chlorobenzene	20.00	215,060	2,801
Chloroform	0.09	968	13
1,1-dichloroethylene	0.40	4,301	56
Methyl ethyl ketone	1000.00	10,753,000	140,045
Methylene chloride	4.26	45,808	597
1,1,2,2-tetrachoroethane	0.35	3,764	49
Toluene	400.00	4,301,200	56,018

Table A-2
Closed Panel Release Rates for VOCs

Compound	Average Headspace Concentration (milligrams per cubic meter)[a]	Single-Panel Volumetric-Release Rate (cubic meters per minute)	Ten-Panel Volumetric-Release Rate (cubic meters per minute)	Single-Panel Mass-Release Rate (grams per minute)	Ten-Panel Mass-Release Rate (grams per minute)
Carbon disulfide	0.41	0.0019	0.019	7.80×10^{-7}	7.80×10^{-6}
Carbon tetrachloride	3625.77	0.0019	0.019	6.90×10^{-3}	6.90×10^{-2}
Chlorobenzene	63.99	0.0019	0.019	1.22×10^{-4}	1.22×10^{-3}
Chloroform	76.79	0.0019	0.019	1.46×10^{-4}	1.46×10^{-3}
1,1-dichloroethylene	48.68	0.0019	0.019	9.26×10^{-5}	9.26×10^{-4}
Methyl ethyl ketone	241.73	0.0019	0.019	4.60×10^{-4}	4.60×10^{-3}
Methylene chloride	3387.03	0.0019	0.019	6.45×10^{-3}	6.45×10^{-2}
1,1,2,2-tetrachloroethane	69.65	0.0019	0.019	1.33×10^{-4}	1.33×10^{-3}
Toluene	105.51	0.0019	0.019	2.01×10^{-4}	2.01×10^{-3}

[a]Westinghouse Electric Corporation, 1995, "Underground Hazardous Waste Management Unit Closure Criteria for the Waste Isolation Pilot Plant Operational Phase," *WID/WIPP-2038*, Westinghouse Electric Corporation, Waste Isolation Division, Carlsbad, New Mexico.

closed ten-panel migration limit based upon the health-based levels at the WIPP site boundary over the operational life of the repository.

A3.0 Air Model

The modeling assumptions for the restricted air-flow model are as follows:

- The gases are generated at a specified rate (0.10 moles per drum per year).
- The gases flow out of the panel entries according to Darcy's law under quasi-steady state conditions.
- The gases within the pore space obey the ideal gas law
- The rates of gas generation, gas outflow, and change in compressive storage must balance.
- Hydrodynamic dispersion is neglected in the analysis.

After panel closure, the volume, moles of gas, and pressure are changing as functions of time. The ideal gas law (Hiller and Herber, 1960) is written as:

$$p = \frac{n * R * T}{V}$$

where

p = Pressure
n = Moles of gas in the panel
R = Universal gas constant
T = Absolute temperature
V = Volume

Differentiating with respect to t and using the chain rule, we obtain the following relationship:

$$\frac{dp}{dt} = R * T * \frac{\frac{dn}{dt} * V - n * \frac{dV}{dt}}{V^2}$$

The volumetric closure rate is negative and constant as discussed below. The rate at which gas enters the panel minus the rate that gas leaves the panel must equal the change in moles stored. We obtain the mass-balance relationship:

$$\frac{dn}{dt} = g_r - \frac{p}{R*T} * K_s * \frac{A}{L} * \frac{p - p_{atm}}{\gamma}$$

where

g_r	=	Panel gas generation rate
p_{atm}	=	Atmospheric pressure
γ	=	Air density
K_s	=	Effective panel closure system conductivity
A	=	Cross-sectional area
L	=	Length of flow path

We define the conductance (C) as:

$$C = K_s * \frac{A}{L}$$

and substituting into the ordinary differential equations (ODE), we obtain

$$\frac{dp}{dt} = R*T*\frac{g_r - \frac{p}{R*T} * C * \frac{p - p_{atm}}{\gamma} * V - n * \frac{dV}{dt}}{V^2}$$

$$\frac{dn}{dt} = g_r - \frac{p}{R*T} * C * \frac{p - p_{atm}}{\gamma}$$

These two first-order coupled ODEs can be solved by a simple explicit finite difference technique:

$$p_j = p_{j-1} + R * T * \frac{g_r - \frac{p_{j-1}}{R*T} * C * \frac{p_{j-1} - p_{atm}}{\gamma} * V - n_{j-1} * \frac{dV}{dt}}{V^2} * \Delta t$$

$$n_j = n_{j-1} + g_r - \frac{p_{j-1}}{R*T} * C*\frac{p_{j-1} - p_{atm}}{\gamma}\Delta t$$

where

p_j, n_j	= the pressure and moles of gas at the current time step
P_{j-1}, n_{j-1}	= the pressure and moles of gas at the previous time step

subject to the boundary condition that the initial pressure equals atmospheric pressure, and the initial moles of gas can be determined by the ideal gas law at initial volume and pressure. Further note that the volume can be expressed as the linear function:

$$V(t) = \alpha * t + \beta$$

where

α	= slope of the volume-time relationship
β	= intercept of volume-time relationship
t	= time

These expressions can be substituted into the above explicit finite difference relationships, and the pressure and molar air flow rates determined as functions of time.

$$\frac{dV}{dt} = \alpha$$

APPENDIX B

CALCULATIONS IN SUPPORT OF PANEL GAS PRESSURIZATION DUE TO CREEP CLOSURE

APPENDIX B
CALCULATIONS IN SUPPORT OF PANEL GAS PRESSURIZATION DUE TO CREEP CLOSURE

B.1.0 Introduction

This appendix presents the closure mechanisms and supporting calculations for panel volumetric closure for the analysis of gas pressurization within a closed panel at the Waste Isolation Pilot Plant (WIPP). The volume reduction is due to the panel volume change from viscoplastic creep closure of the walls, roof, and floor. As the walls, roof, and floor of the excavations converge, the total volume of the panel decreases. The volumetric closure of a panel is the result of several different mechanisms working in tandem. These mechanisms include:

- Viscoplastic creep of the salt toward the excavation
- Fracturing in the roof and floor caused by the deviatoric stresses around the excavation
- Bed separation at the clay seams in the roof and the floor.

The combination of these three mechanisms causes the observed convergence rates in Panel 1. Of these mechanisms, only creep of the salt reduces the total volume of the panel and pore space in the surrounding disturbed rock zone (DRZ). Fracturing in the roof and floor and bed separation transfer the void volume within the excavation to the DRZ. This void volume within the DRZ is assumed to be interconnected with the open excavation. Therefore the total reduction in volume within the panel, based simply on room closure, overestimates the effective reduction in void volume. However, quantifying the amount of interconnected void space within the DRZ would require a much more detailed analysis. The total volume change calculated from the room closure measurements is therefore considered conservative.

Other assumptions made in this calculation are:

- The volumetric closure rates are constant after panel closure.
- The waste in the panel provides no significant resistance to creep closure during the initial 35 years.

- The air volume is the total volume of the excavations minus the solid volume of the waste in drums or other waste packages. This is estimated to equal 138,000 ft^3 (3,908 m^3).

- The closure rate of each room in the panel equals the closure rate at the midpoint of the room.

- The length of each room or drift is constant; to simplify the calculations, only the width and height change with creep closure.

- The panel is comprised of seven rooms and two panel access drifts.

B.2.0 Panel Volume Change Calculation

The panel volume change calculation is performed by first calculating the initial panel volume, then calculating the room and drift closure rates, and finally calculating the panel volumetric closure rate. Following is a detailed description of each part of the calculation.

B.2.1 Initial Panel Volume

The initial panel volume is determined immediately after completion of excavation. The total volume is calculated by summing the individual room and drift volumes within the panel. These volumes are based on the as-built dimensions of the excavated rooms and drifts in Panel 1 (DOE, 1993). Table B-1 presents the room and drift dimensions and the calculated volume of each room and drift. The volume of the air-intake and air-exhaust drifts is not included. The total initial volume of Panel 1 is 1,669,434 ft^3 (47,273 m^3).

The total solid volume of the waste in a filled panel is 138,000 ft^3 (3,908 m^3) (DOE, 1994; Butcher, et al., 1991). Subtracting the waste volume from the total panel volume gives the total initial air volume (1,531,434 ft^3 [43,365 m^3]) in the panel.

B.2.2 Closure Rates

Using convergence data from Panel 1 the average closure rates of the rooms and drifts are determined (DOE, 1993). Closure rates within the rooms and drifts are higher in the first five years after excavation. The roof-to-floor and wall-to-wall closure rates for each of the rooms and drifts are presented in Table B-2.

Because all of the excavations in Panel 1 are approximately 13 x 33 ft (4 x 10 m), the closure rates for each room or drift are the same.

Table B-1
Initial Room and Drift Dimensions and Volume of Panel 1

Room or Drift	Initial Width (ft)	Initial Height (ft)	Initial Length (ft)	Initial Volume (ft^3)
Room 1	33	13	300	128,700
Room 2	33	13	300	128,700
Room 3	33	13	300	128,700
Room 4	33	13	300	128,700
Room 5	33	13	300	128,700
Room 6	33	13	300	128,700
Room 7	33	14	300	138,600
South 1950 panel access drift	33	14	848	391,776
South 1600 from Room 1 to Room 5	33	13	573	245,817
South 1600 from Room 5 to Room 7	33	14	262	121,044
Total Initial Panel Volume				1,669,437

B.2.3 Volumetric Panel Closure Rate

Using the closure rates from Table B-2, the dimensions of the rooms and drifts in Panel 1 can be calculated at the end of each progressive year or for subsequent years using the following equations.

For 0 to 5 years after excavation:

$$V_t = (w_i - R_H t) \times (h_i - R_{Vo} t) \times l_i$$

Table B-2
Room and Drift Closure Rates
(DOE, 1993)

Room or Drift	Vertical Closure Rate		Horizontal Closure Rate	
	0 to 5 Years (ft/yr)	> 5 Years (ft/yr)	0 to 5 Years (ft/yr)	> 5 Years (ft/yr)
Room 1	0.3194	0.2109	0.2234	0.1160
Room 2	0.3194	0.2109	0.2234	0.1160
Room 3	0.3194	0.2109	0.2234	0.1160
Room 4	0.3194	0.2109	0.2234	0.1160
Room 5	0.3194	0.2109	0.2234	0.1160
Room 6	0.3194	0.2109	0.2234	0.1160
Room 7	0.3194	0.2109	0.2234	0.1160
South 1950 panel access drift	0.3194	0.2109	0.2234	0.1160
South 1600 from Room 1 to Room 5	0.3194	0.2109	0.2234	0.1160
South 1600 from Room 5 to Room 7	0.3194	0.2109	0.2234	0.1160

For greater than 5 years after excavation:

$$V_t = (w_i - R_H t) \times (h_i - R_{V5}(t-5) - R_{V0}5) \times l_i$$

where

V_t = Volume of the room at time t
t = Time (in years)
w_i = Initial room width
h_i = Initial room height
l_i = Initial room length
R_H = Horizontal closure rate (ft/year)
R_{V0} = Vertical closure rate for first 5 years (ft/year)
R_{V5} = Vertical closure rate after 5 years (ft/year).

We obtain the incremental change in volume:

$$\Delta V = V_1 - V_2$$

where

V_1 = Volume of room at time t_1 (ft^3)
V_2 = Volume of room at time t_2 (ft^3)
ΔV = Change in volume of room between time t_1 and t_2 (ft^3)
t_1, t_2 = Years after excavation

The volume of all the rooms within the panel is calculated at the time of four years after excavation, when the waste is assumed to have been emplaced the amount of time required for waste emplacement (Table B-3). The total volume of the panel after four years is 1,469,112 ft^3 (41,601 m^3). The volume of the panel is then calculated at five years after excavation or one year after panel closure (Table B-3). This volume is 1,420,312 ft^3 (40,219 m^3), and the volume reduction in that year is 48,800 ft^3 (1,382 m^3).

The initial volume in a closed panel after approximately four years is obtained from the total volume at four years (1,469,112 ft^3 [41,601 m^3]) minus the solids volume (138,000 ft^3 [3,908 m^3]), or 1,331,112 ft^3 (37,693 m^3). This volume is used as the initial volume for the restricted air-flow model calculations.

The rate of change for panel volume is assumed to be constant for the first five years after excavation, because the vertical and horizontal closure rates are constant during this period. (Actually, rate of volume change over time decreases slightly with each year due to "corner effects," but this error is less than 2 percent and is considered insignificant.) Table B-3 also shows the panel volumes at 15 and 16 years after excavation and the change in volume between those years. The volumetric panel closure rate is 28,673 ft^3 per year (812 m^3 per year). This is the rate in volume change per year in the panel from five to approximately 35 years after excavation.

At approximately 16 years after excavation, the roof comes in contact with the waste stack. Only 35 years after excavation does the waste stack begin to provide significant resistance to creep (approximately 2 MPa). This resistance is expected to slow the vertical convergence rate by some amount.

Table B-3
Panel Volume at Various Times

Room or Drift	Volume of Room (ft^3)			
	At 4 Years	At 5 Years	At 15 Years	At 16 Years
Room 1	112,914	109,069	85,662	83,401
Room 2	112,914	109,069	85,662	83,401
Room 3	112,914	109,069	85,662	83,401
Room 4	112,914	109,069	85,662	83,401
Room 5	112,914	109,069	85,662	83,401
Room 6	112,914	109,069	85,662	83,401
Room 7	122,545	118,633	94,879	92,583
South 1950 panel access drift	346,395	335,337	268,191	261,702
South 1600 from Room 1 to Room 5	215,665	208,321	163,614	159,296
South 1600 from Room 5 to Room 7	107,023	103,607	82,861	80,856
Total Volume of Panel 1	1,469,112	1,420,312	1,123,529	1,094,856
Change in Volume		48,800		28,673

B.3.0 References

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APPENDIX C
FLAC MODELING OF THE PANEL CLOSURE SYSTEM

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FLAC MODELING OF THE PANEL CLOSURE SYSTEM

Numerical modeling is considered one of the better methods available for quantifying the interaction of concrete barriers with the surrounding media. Therefore, a series of models have been developed for this report to evaluate the interaction of the main concrete barrier of the panel closure system with the surrounding salt for different alternatives and concrete barrier geometries. This appendix discusses the code used and describes the material constitutive models used in the stress analysis.

C.1.0 The FLAC Code

FLAC software has been used for numerical modeling of the underground excavations at the WIPP since 1991. FLAC is a two-dimensional explicit finite difference code that simulates the behavior of rock and soil-like structures. The WIPP Reference Creep Law is built into FLAC and has been verified to Nuclear Regulatory Commission standards (Itasca, 1995). In addition, all versions of FLAC used by the Westinghouse Waste Isolation Division have been verified against the WIPP Second Benchmark Problem (Krieg, 1984).

C.2.0 Material Constitutive Models

The material properties associated with the material constitutive models are given in Tables C-1 through C-3. These properties are the standard properties which have been used in previous WIPP geotechnical FLAC modeling such as the Backfill Engineering Analysis Report (BEAR) (IT, 1994). Note that the stress analysis of the concrete barrier also uses the same stress-strain relationship for the uncompacted crushed salt as was used in the BEAR. The stress analysis in Figure 4-4 used uncompacted crushed salt on one side of the enlarged concrete barrier and open void space on the other side. The crushed salt has subsequently been eliminated from the panel closure system final design. The symmetry in the principal stress plots for the enlarged concrete barrier analysis indicated that the presence or absence of the crushed salt does not significantly affect the stresses within the enlarged concrete barrier. Therefore, the FLAC analysis results presented in Figure 4-4 apply to the panel closure system final design.

Table C-1[a]
FLAC[b] Model Time-Dependent Material Properties

Property	Halite	Argillaceous Halite	Halite, 10% Polyhalite
Bulk modulus (GPa)	20.7	20.7	22.1
Shear modulus (GPa)	12.4	12.4	13.2
Density (kg/m^3)	2,300	2,300	2,300
Activation energy (cal/mol)	12,000	12,000	12,000
A	4.56	4.56	4.56
B	127	127	127
D (Pa$^{-4.9}$/s)	5.79×10^{-36}	1.74×10^{-35}	5.21×10^{-36}
n	4.9	4.9	4.9
Gas constant (cal/mol K)	1.987	1.987	1.987
Critical strain rate	5.39×10^{-8}	5.39×10^{-8}	5.39×10^{-8}

Table C-2[a]
FLAC[b] Elastic Material Properties

Property	Anhydrite	Polyhalite	Concrete
Bulk modulus (GPa)	83.4	65.8	11.6
Shear modulus (GPa)	27.8	20.3	9.0
Density (kg/m^3)	2,300	2,300	2320
Cohesion (MPa)	27	17.2	–
Friction (degrees)	29	46.5	–

Table C-3[a]
FLAC[b] Clay Seam Material Properties

Property	Value
Normal stiffness (Pa/m)	1.0×10^{12}
Shear stiffness (Pa/m)	5.0×10^{10}
Cohesion (Pa)	0.0
Friction (degrees)	5

[a]IT, 1994

[b]FLAC = Fast Lagrangian Analysis of Continua
GPa = Gigapascal(s)
kg/m^3 = Kilogram(s) per cubic meter
cal/mol = Calorie(s) per mole
Pa$^{-4.9}$/s = Pascal(s) to the negative 4.9 per second
cal/mol K = Calorie(s) per mole Kelvin
A,B,n = unitless model factors
D = model factor
Pa/m = Pascal(s) per meter
MPa = Megapascal(s)

C.3.0 References

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APPENDIX D
BRINE/CEMENT INTERACTIONS

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BRINE/CEMENT INTERACTIONS

Concern about potentially deleterious constituents in the Waste Isolation Pilot Plant (WIPP) brines were initially raised when evidence of some minor concrete deterioration in the waste shaft key was noted. The cause is geochemical alteration of the concrete shaft liner and shaft grout by the brine present at the Rustler-Salado contact. Chemical constituents detected in brine samples included both organic and inorganic compounds that probably originated from dissolution of the concrete liner and grout materials used in the shaft construction. The presence of large amounts of organics that likely originated from the chemical grout appeared to have complexed the calcium present in the brine, interfering with the inorganic chemistry of the naturally occurring brine. The brines in contact with the waste shaft key were also found to be significantly higher in both chlorides and magnesium than the Salado Formation brine. These factors probably resulted in a Rustler/Salado brine chemistry more aggressive than that of the naturally occurring Salado brines that may contact the panel barrier.

Lankard Materials Laboratory (LML) (1992) concluded that there has been both a "physical attack" component and a "chemical attack" component acting upon the waste shaft key by brines. A "worst-case" scenario proposed by LML indicated that deterioration from both chemical and physical factors could result in a loss of material on the shaft side of the concrete liner at a rate of approximately 12 centimeters (5 inches) over a 50-year period.

The very local deterioration of the waste shaft key concrete resulted in some reduction in its load-bearing capacity and some increase in its permeability to brine infiltration. In addition, exposure of chemical residue deposits to the air within the shaft may have created a spalling effect that also facilitated local concrete deterioration on the interior (shaft opening) side of the liner.

Sandia National Laboratories/New Mexico (SNL/NM) studied the effect of high-magnesium brine interactions on various candidate barrier materials (SNL/NM, 1994). High-magnesium brines are characteristic of the Rustler-Salado contact, which is the location of the waste shaft key. The study was intended to evaluate chemical impacts to mass-concrete barriers in the WIPP panels and to the Salado Formation. However, the results of the study were also used to evaluate the cause of the deterioration of the waste shaft key. IT Corporation (IT) (1994),

in a separate study, also evaluated the geochemistry of brines associated with the waste shaft key near the Rustler-Salado Formation contact.

Both studies concluded that the brines have chemically reacted with the constituents in the concrete and grouts used in the waste shaft key liner. The SNL/NM (SNL/NM, 1994) study theorized that the loss of the liner's strength was facilitated by the loss of calcium from the concrete liner. SNL/NM noted that the magnesium present in the brine replaced calcium in the concrete, but the replacement process occurred as a delayed reaction. Magnesium replacement did not occur until after the structural integrity of the waste shaft key liner was already impacted negatively by the loss of calcium, which increased the porosity of the liner. This resulted in a more open and permeable microstructure not attributable solely to a weakening effect from magnesium replacement. Both the IT and SNL/NM studies supported the conclusion that the waste shaft key liner deterioration occurred only locally and in the outermost reaction zone of the liner, so that the structural integrity of the liner as a whole was not significantly impacted. SNL/NM proposed that further deterioration of the liner may be limited only to areas of the concrete liner that develop stress fractures.

Wakeley et al. (1993) studied salt-saturated concrete and grout emplaced in the floor of the WIPP repository six years before its retrieval. The concrete and grout used in the study were cementitious, rather than organic. In retrieving the concrete and grout plugs, the plugs were overcored to also retrieve some host rock.

The study concluded that little to no deterioration occurred to the concrete or grout and that general compressive strengths of the concrete and grout increased over time. The lowest compressive strength values were observed in samples taken from the disturbed rock zone. Reaction rims with increased permeability were noted on anhydrite surrounding the plugs, suggesting interaction between the grout or concrete and host rock. However, comparable evidence of a reaction with the concrete or grout was not seen. There was also evidence of dissolution of halite in the anhydrite zone near the plugs; however, the evidence also indicates that the presence of the halite facilitated better bonding between the grout or concrete and the host rock. Crystallization of new phases was also noted on free surfaces, indicating that strongly ionic magnesium-bearing fluids were present and moving. The fluid movement appeared to have no effect on the host rock other than to improve bonding.

The differences in the appearances, strengths, and phase assemblages between the grout/concrete plugs in the study discussed above and the waste shaft key liner concrete are

different enough that two extremely different service environments can be inferred. The magnesium level and fluid transport are apparently much greater in the waste shaft key location, facilitating a greater degree of deterioration of the waste shaft key concrete than was noted in the plugs studied by Wakeley et al. (1993). The waste shaft key concrete liner was also composed of organic constituents, which appeared to be more reactive with the brine chemistry. The main concrete barrier will be located in a service environment similar to that studied by Wakeley et al. (1993), where very minor amounts of brine would contact the main concrete barrier.

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APPENDIX E

PREVIOUS STUDIES OF PANEL-CLOSURE SYSTEM MATERIALS

APPENDIX E
PREVIOUS STUDIES OF PANEL-CLOSURE SYSTEM MATERIALS

In researching the available literature relating to panel-closure system designs and materials, studies on both long-term and short-term barrier performance were evaluated. The intended function of the main concrete barrier described in this report is to provide short-term (35 years) barrier capability until the repository host rock reconsolidates around the barrier. However, studies on long-term barrier performance were found useful for the panel-closure system material compatibility evaluation performed for this document. The results of these studies provided insight into the complex issues to be considered for selecting an appropriate concrete and grout for the panel-closure system.

Stormont (1987) studied small-scale seal performance tests (SSSPT). The SSSPTs were designed as in situ experiments to evaluate the performance of candidate seal materials. Barrier systems consisted of the barrier itself, the barrier-rock interface, and the surrounding rock. The system performance was evaluated using thermal/mechanical and fluid flow (both gas and brine) data generated by testing under expected repository conditions. Thermal, mechanical, and hydrologic performance of the barriers was evaluated. Test Series A consisted of a bulkhead constructed of salt-based concrete. Regarding hydration of the concrete, stresses and strains induced in the rock and the barrier were a result of hydration. Stresses and strains also resulted from the salt creep and from the panel-closure system material. Evaluation of these stresses and strains yielded information about the stability of the barrier system and the structural/fluid flow relationship. The permeabilities of the barrier material with respect to gas and brine were important for evaluating the potential for a repository breach scenario. Test Series A was conducted in geologic horizons that included bedded halite and interbeds of clay and anhydrite.

Three types of concrete were evaluated for the Test Series A study: salt-free concrete, salt concrete, and expansive salt-based concrete. The latter proved to yield the most favorable results due to its significant expansive properties, which create a tight interface; its workability (about 4 hours); and for its ability to inhibit dissolution of surrounding salt during cement hydration.

Stormont (1988) also studied the performance of grout and concretes as constituents of main concrete barriers for the panel-closure system. The use of cementitious grouts within the disturbed rock zone adjacent to the main barrier was determined to be detrimental at times, as it could facilitate fracture propagation. To prevent the load reaction causing the fracture propagation, Stormont proposed the emplacement of rigid concrete at the main barrier location. Stormont's investigations of concrete to form the actual main barrier indicated that concrete is impermeable, and any associated leakage across the barrier would occur at the concrete/rock interface zone. Leakage could be attributed to concrete shrinkage and the integrity of the rock itself. However, Stormont noted that the presence of halite in the host rock would result in compressional forces exerted on the concrete barrier over time, with little or no leakage occurring.

SSSPT performed by Stormont (1988) and Finley and Tillerson (1992) evaluated salt-based concrete, bentonite, and salt blocks for barrier performance. In the salt-based concrete barriers, both brine and gas migration across the barrier-rock interface were retarded by salt creep adjacent to the barrier and the expansive properties of the salt-based concrete. The salt-based concrete barriers also withstood significant back-pressure forces. Bentonite and salt blocks did not perform as satisfactorily with respect to their load-bearing capacities or fluid permeabilities.

Hansen et al. (1994) discussed barrier materials for vertical shaft environments in terms of the barriers' long- and short-term components. The single long-term component envisaged in their studies was reconsolidated salt, especially engineered to achieve a barrier function in approximately 100 years. However, short-term materials included concrete, bentonite, grout, chemical seal rings, and potential alternatives, although the alternatives were not included in a reference barrier design. Each barrier component had a functional requirement to prevent the passageways from becoming the preferred passageways for transport of brines or gases to or from the repository. Short-term components provided barriers to brine and groundwater inflow to the consolidating and long-term members and to the repository. The composition of each selected barrier was based on experience in the mining industry, assurance of function through test results, and compatibility with the stratigraphy in which the barrier was placed. The authors looked at specific geologic horizons with respect to their ability to prevent brine and gas flow.

Test Series B (Peterson et al., 1987) more likely approximated the configuration of the proposed panel barrier, which will be emplaced in a horizontal drift leading to the waste-

emplacement panels. The type of material used in the testing was a salt-saturated expansive concrete, as was used in Test Series A.

In both the A and B test series, the parameter of primary interest was the barrier permeability. For calculational purposes, it was assumed that all flow goes through the barrier. However, some flow may enter the surrounding formation as well, although it is difficult to determine and quantify. Factors affecting measured flow rates through the barrier would include the pressure under which the brine was flowing. If a brine was saturated with respect to its liquid phase at ambient conditions, added pressures may decrease its saturation and encourage dissolution of the surrounding halite.

In one test, barrier brine flow rate decreased slowly with time; this is an important consideration when modeling long-term response. Possible mechanisms causing this decrease include precipitation, healing, or creep closure of open pore spaces. Estimates of brine and gas permeabilities depend strongly on the degree of pore saturation.

Only gas-flow tests were performed in the B Series. All of the barriers leaked (though at slow rates) in the B Series tests. No leakage occurred at the barrier/formation interface. Leaks were associated with a small formation fracture and with an instrumentation bundle. Gas-flow tests performed approximately one year later indicated no leakage associated with the barriers.

Test Series C (Stormont et al., 1987) consisted of salt and salt-bentonite block barrier material emplaced in a horizontal drift within almost pure halite. Four barriers were composed of salt blocks, and four barriers consisted of salt-bentonite blocks. Four of the barriers, two representing each type of material described above, were evaluated without instrumentation, for fluid flow and permeability testing. Instrumentation and cabling are often leak paths for such testing. The instrumentation used in the other barriers measured deformations and pressures and provided other important data. The data suggest that crushed salt provides very little resistance to closure until the crushed salt is very dense. Deformation experiments were designed to verify or refute this evidence.

Principal advantages to salt-block emplacements as opposed to mechanical or pneumatic backfilling were that initial porosity of the crushed or granular salt was minimized, reducing the time required for effective or complete salt consolidation. This in turn reduced the likelihood of brine influx from the surrounding strata that could impede the consolidation

process. Block emplacements also allowed considerable control over production and emplacement. Blocks could be tailored to achieve certain properties, such as addition of bentonite or moisture.

Experiments with different types of blocks indicated that the relative density of the blocks increased with the maximum particle size used. Further, blocks cured in humid environments became extremely friable and unviable. Within the Waste Isolation Pilot Plant (WIPP) facility, the humidity of the ventilation air is below the critical humidity of 75 percent (the air will take moisture from the salt).

Blocks cured at ambient conditions were the most resilient in that they resisted chipping and shattering. Their "toughness" was a result of the development of an indurated "skin" from particle caking. Caking occurs when moisture at particle contacts is evaporated, resulting in bridging and microcrystalline growth that essentially cements the particles together. However, an indurated skin may also hinder consolidation at the interfaces between blocks from a lack of available water believed necessary for rapid consolidation.

The purpose of adding bentonite to salt blocks was to reduce the permeability without requiring extensive consolidation. Data collected indicated that permeabilities to brines and water fell off to microdarcy values somewhere between 25 and 50 percent bentonite by weight. For this experiment, a 1:1 ratio of salt to bentonite was used. Over 90 percent of the bentonite was composed of the clay mineral montmorillonite. Water was also introduced into the mixture.

Salt/bentonite blocks cured in the humid environment took sufficient moisture from the air to become extremely friable, and therefore, unviable. Under covered conditions, less moisture was lost. Salt/bentonite blocks were also tougher than salt-only blocks. Also, greater amounts of moisture contributed to a tougher block than the addition of less moisture.

The use of mortars was necessary to fill the voids between the blocks and the borehole wall. Mortar was generally only emplaced into the interface and not between blocks. The mortars were composed of the same materials as the blocks.

In summary, both types of blocks were found to lose excessive moisture to the dry mine atmosphere unless they were covered between the time of production and the time of emplacement. Initial fluid flow testing of the salt/bentonite barriers revealed that erosion

along the block/rock interface occurred when the brine was introduced too rapidly to allow the bentonite to take up the water and swell to shut down flow paths. Subsequent testing with slower introduction of brine confirmed this result, that is, salt/bentonite blocks could be effective barriers to brine flow. Structural measurements provided data to test laboratory models of salt consolidation. To date, the measurements do not contradict model predictions of the barriers providing little resistance to hole closure until they become very dense.

The concrete and grout used in the above-referenced study were developed by Gulick and Wakeley (1989). They proposed expansive salt-saturated concrete (ESC) and grout mixtures that yielded favorable results for suitability as panel barrier and grout materials during the in-place testing at the WIPP repository. The grout composition was summarized in the text of this report in Section 2.2.1. The formulation for the ESC is shown in Table E-1.

Table E-1
Expansive Salt-Saturated Concrete

Component	Percent of Total Mass
Class H cement	9.03
Chem comp III	6.03
Cal seal (plaster)	1.80
Class C fly ash	5.10
Fine aggregate	34.11
Coarse aggregate	34.58
Sodium chloride	2.50
Defoaming agent	0.21
Sodium citrate	0.11
Water (iced)	6.60

Class H cement is a standard oil-well cement. It has been used extensively in grouts and concretes in underground applications. Class C fly ash contributes expansive properties to the concrete. Cal Seal (a plaster of paris manufactured by Haliburton) also develops expansive properties in mixtures containing Class H cement. Expansive components that are added to the concrete or grout mixtures enhance bonding between the concrete or grout and the host rock. The addition of sodium chloride to the mixture is necessary to assure that the water

content of the concrete or grout is in equilibrium with the host rock. This prevents dissolutioning, and also inhibits or reduces deterioration of the concrete or grout. Defoaming agents inhibit air entrainment in the concrete or grout mixture.

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APPENDIX F

HEAT TRANSFER MODEL DERIVATION
METHANE EXPLOSION

APPENDIX F
HEAT TRANSFER MODEL DERIVATION
METHANE EXPLOSION

Under the conditions of a postulated methane explosion within the panel, the temperature of the gas is raised by the combustion process to an initial value $T_{g\ init}$ with time t = 0 corresponding to initial conditions in the panel. Subsequently, the gas temperature in the panel decreases as heat is transferred to the surrounding salt and to the two explosion-isolation walls in the air-intake and air-exhaust drifts of each panel.

At time t = 0 the pressure in the panel is P_{init} based on panel closure due to creep and the elevation in pressure resulting from the explosion. Thus, the rise time of the temperature is not considered in the model.

At time t = 0, the volume of the panel is V_{init} and is assumed to remain constant throughout the cooling of the gas in the panel because of the short duration of the explosion. This means that the effect of creep on the panel volume is assumed negligible during the postulated explosion. The initial volume is given by:

$$V_{init} = V_{panel} - V_{waste} - V_{creep}$$

where

V_{init} = Initial volume
V_{panel} = Volume of the panel
V_{waste} = Volume of the waste
V_{creep} = Volume reduction due to creep

and is taken as given at the start of the heat transfer analysis and assumed to remain constant during the transfer of heat to the panel walls, roof, and floor.

F.1.0 Heat Balance

Assuming a constant volume is equivalent to stating that any creep closure of the panel volume during the explosion and subsequent cooling can be neglected.

$$\frac{dQ_{volume\ of\ gas}}{dt} = qA_{walls,\ floor,\ roof}$$

where $Q_{volume\ of\ gas}$ represents the heat contained in the hot gases subsequent to an explosion, q is the heat flux rate at the boundaries of the panel volume, and $A_{walls,\ floor,\ roof}$ is the surface area of the panel volume.

Following D'Appolonia (1978) it is conservatively assumed that the heat transfer to the surrounding walls, floor, roof, is related to the rate of change of enthalpy of the reaction products gas. Thus, the heat content of the room is given by:

$$\frac{dQ_{volume\ of\ gas}}{dt} = nC_p\frac{dT_g}{dt}$$

where n is the number of moles of gas in the room subsequent to the explosion, T_g is the gas temperature, and C_p is the heat content of the gas at constant pressure.[1] Thus,

$$nC_p\frac{dT_g}{dt} = qA_{walls,\ floor,\ roof} \qquad (1)$$

F.2.0 Moles of Gas

The gas in the panel subsequent to the explosion is a mixture of the combustion products of the explosive gas which is taken to be a mixture of methane, CH_4 and air. Because methane can explode with other than a stoichiometric air/methane mixture (i.e., the methane concentration in air for an explosion to occur is a range as opposed to a single value), it is impossible to determine the number of moles of combustion product gas precisely. Thus, it is assumed that the explosion occurs with a stoichiometric air/methane mixture.

[1]The specific heat at constant volume is used even though the explosion or rapid combustion of the methane-air mixture occurs at constant volume because the rate of change of enthalpy as opposed to internal energy has been used.

F.2.1 Mixture

The stoichiometric reaction for methane is (Bodartha, 1980):

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$

with the moles of air given by:

$$n_{air} = 4.77(2) = 9.54 \ mole\ air/mole\ methane$$

or 9.54 moles of air are required to provide 2 moles of oxygen. Using a ratio of 9.54 moles of air per mole of methane, the total moles of gas at the time of the explosion would be:

$$n = (9.54 + 1)n_{CH4}$$

The number of moles of nitrogen in the air and in the combustion products gas is 3.77(2) = 7.54 moles/mole of methane (Bodartha, 1980). Thus,

$$7.54 \text{ moles } N_2 + 2 \text{ moles } O_2 + 1 \text{ mole } CH_4 =$$
$$7.54 \text{ moles } N_2 + 1 \text{ mole } CO_2 + 2 \text{ moles } H_2O$$

On a molar basis the reaction products are 71.5% nitrogen, 9.5% carbon dioxide, and 19% water vapor. This compares with a reaction product that is 72.9% nitrogen, 11.6% carbon dioxide and 15.5% water vapor when propane is burned at a stoichiometric ratio (D'Appolonia, 1978). Also, 10.54 moles of the methane-air mixture produces 10.54 moles of reaction products. Thus, the number of moles of air/methane prior to the explosion is the same as the number of moles of the product gas and the above relation for n will be used to compute the heat content in a panel prior to cooling.

$$n_{gas} = 10.54\ n_{CH4} \tag{2}$$

Substituting (2) into (1),

$$10.54\ n_{CH4}\ C_p \frac{dT_g}{dt} = qA_{walls,\ floor,\ roof}$$

or

$$\frac{dT_g}{dt} = \frac{qA_{walls,\ floor,\ roof}}{10.54\ n_{CH4}\ C_p} \tag{3}$$

is the differential equation for the time rate of change of the gas temperature in the panel following an explosion.

F.2.2 Specific Heat

The specific heat, Cp, of the combustion products of the explosion is required by equation (3). In general, the specific heat is a function of temperature over large temperature ranges. Figure C-1 shows plots of specific heats of the combustion products of stoichiometric propane-air mixtures and methane-air mixtures based on data from D'Appolonia (1978) and Reid, et al., (1977). The curves for propane-air mixtures are shown for comparison between the Reid, et al. data and the D'Appolonia data.

For an explosion temperature on the order of 2400 degrees kelvin (°K), and using an average of the wall temperature and gas temperature to evaluate the specific heat, the temperature dependence curve will be evaluated in the region of 1400 °K which is about the maximum useful temperature for the Reid, et al. data.

As shown on Figure F-1, the Reid et al. (1977) and D'Appolonia (1978) data agree well up to a temperature of approximately 1400 °K. At the greater temperatures Reid et al. (1977), and other data indicate a decrease in specific heat with greater temperatures which is not consistent with expectation.

Figure F-2 shows a comparison of Reid et al. (1977) and the D'Appolonia (1978) data multiplied by 0.961, the ratio of specific heats for a methane-air mixture to a propane-air mixture at 300 °K. Below 1400 °K the agreement is very good. Above 1400 °K the curve based on the D'Appolonia data remains valid. Therefore, the specific heat of the combustion products formed from a stoichiometric methane air mixture as a function of temperature is[2]

$$C_p = 1.29\ x\ 10^{-3}\ T + 7.3353 - \frac{32682}{T^2} \tag{4}$$

[2]Equation (4) was obtained by multiplying Equation (9) of Appendix B of D'Appolonia [1978] by 0.961.

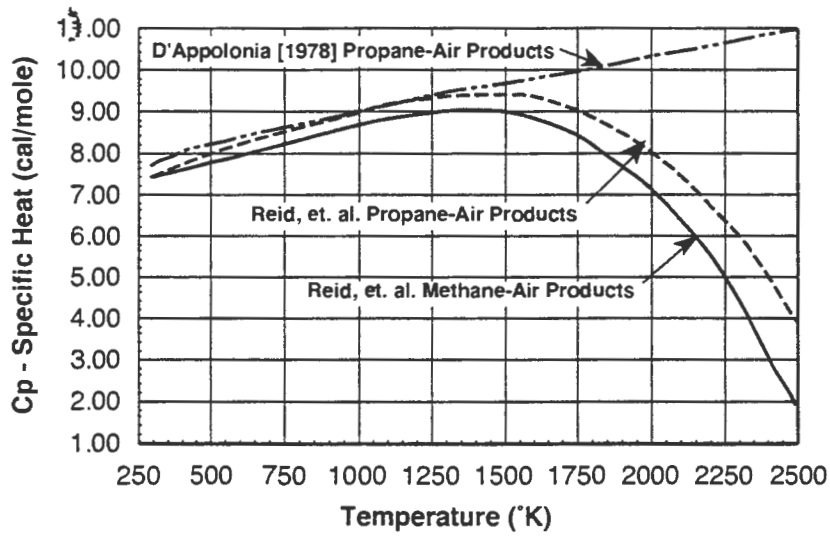


Figure F-1
Specific Heat as a Function of Temperature

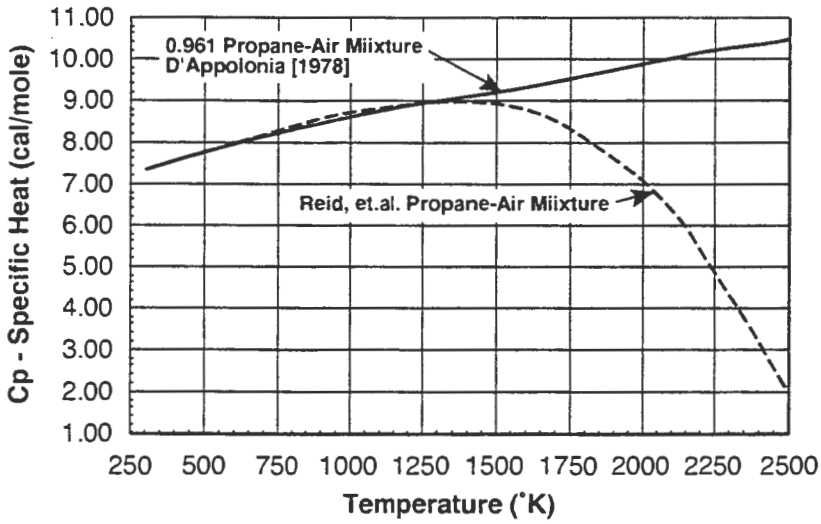


Figure F-2
Specific Heat for Methane-Air Stochiometric Mixture

F.3.0 Heat Transfer to the Walls, Floor, Etc.

Heat is transferred from the gas to the surrounding walls, floor and roof of the panel rooms by both convection and radiation. Heat is then transferred into the walls, floor, roof, via conduction. Thus, the rate of heat conduction into the salt or the wall is governed by the rate at which heat can be conducted into the solids.

F.3.1 Radiation Heat Transfer

Heat transferred from the gas to the walls, floor, roof, is given by:

$$q_{rs} = \sigma\left(T_g^4 - T_w^4\right)$$

where q_{rs} is the heat flux to the walls, floor, roof, σ is the Stefan-Boltzmann constant (1.35×10^{-12} cal/cm^2-sec-°K), and T_w is the temperature of the walls, floor, and roof.

The majority of the surface area of the panel available for heat transfer via both radiation and convection is salt. However, a small portion of the total area will be the inner face of the explosion-isolation wall (or construction-isolation well). Because the wall, floor, roof temperature is controlled by the time dependent conduction of heat into either the walls, floor, roof or the wall faces, and the diffusivities and conductivities of the salt and wall, floor, roof material may be different, the radiation heat transfer is divided into two components.

The radiative heat transfer to the salt (T_{ws}) is:

$$q_{rs} = \sigma\left(T_g^4 - T_{ws}^4\right)$$

and the radiative heat transfer to the explosion-isolation wall (T_{wb}) is:

$$q_{rb} = \sigma\left(T_g^4 - T_{wb}^4\right)$$

The combined radiative heat transfer to the walls, floors, roof is:

$$Q_r = q_{rs}A_s + q_{rb}A_b$$

or

$$Q_r = \sigma\left(A_s\left[T_g^4 - T_{ws}^4\right] + A_b\left[T_g^4 - T_{wb}^4\right]\right) \tag{5}$$

where A_b = Area of the walls, and A_s = area of the salt.

Equation (5) comprises the radiation portion of the right hand side of the differential equation, (3), for the rate of gas temperature in the panel.

F.3.2 Convection Heat Transfer

In addition to radiation, heat is transferred to the walls, floor, roof, and explosion-isolation walls by natural convection. In subsequent discussion, walls denote all exposed surface area of salt within a panel. Explosion-isolation walls denote the surface area of the expendable walls placed in the sealed air-intake and air-exhaust drifts of the panel.

F.3.2.1 Heat Transfer from Gas to the Walls

In addition to radiation, heat is transferred to the walls, floor, roof, and explosion-isolation walls via natural convection. The heat flux due to convection (q_c) is given by:

$$q_c = h\left(T_b - T_w\right)$$

where h = Film coefficient.

As for the case of radiation, the majority of heat transfer by convection will occur to the surrounding salt. However, a portion will be transferred to the explosion-isolation wall. Because the temperature of the explosion-isolation wall may be different from the temperature of the salt, the convective heat transfer is divided into the two components analogous to the radiation heat transfer. For the salt, the convection heat transfer is:

$$q_{cs} = h\left(T_g - T_{ws}\right)$$

and for the explosion-isolation walls:

$$q_{cb} = h\left(T_g - T_{wb}\right)$$

The combined radiative heat transfer (Q_c) to the walls, floors, roof, and explosion-isolation walls is:

$$q_{cb} = h\left(T_g - T_{wb}\right)$$

The combined radiative heat transfer (Q_c) to the walls, floors, roof, and explosion-isolation walls is:
assuming that the heat transfer coefficient does not change with location or material.

$$Q_c = q_{c\ NaCl}\ A_s + q_{cb} A_b$$

Theoretically the convective heat transfer coefficient is different for the face of the explosion-isolation walls, which are vertical compared with the heat transfer coefficient for the roof and floor faces of the panel which are horizontal. Neglecting the difference in heat transfer coefficient due to geometric differences, the above two equations for the heat flow to the walls, floor, roof, and explosion-isolation walls can be combined to give

$$Q_c = h\left(A_s\left[T_g - T_{ws}\right] + A_b\left[T_g - T_{wb}\right]\right) \tag{6}$$

Equation (6) gives the convective heat transfer portion of the right hand side of Equation (3). Combining (3), (5) and (6),

$$\frac{dT_g}{dt} = -\frac{Q_c + Q_r}{10.54\ n_{CH4}\ C_p} \tag{7}$$

where the negative sign indicates that Q_c and Q_r represent heat transferred out of the system consisting of the gas in the room. These same quantities then represent heat transferred into the surrounding salt and explosion-isolation wall.

F.3.2.2 Convection Coefficient

Assuming the convection coefficient is the same at all surfaces and following the methods developed in D'Appolonia (1978), with all units in the centimeter-gram-second (cm-g-sec) system of units,

$$N_u = 0.13[P_r G_r]^{1/3}$$

where P_r is the Prandtl number and G_r is the Grashof number. The Prandtl number is essentially constant and is taken as 0.71 regardless of pressure and temperature. The Grashof number is given by

$$G_r = \frac{g\beta L^3(T_g - T_w)}{\nu^2}$$

where g is the acceleration of gravity, β is the volume coefficient of thermal expansion and ν is the kinematic viscosity of the gas. For ideal gases,

$$\beta = \frac{1}{T_g}$$

and the kinematic viscosity is given by

$$\nu = \frac{\mu}{\rho}$$

where μ is the absolute viscosity ρ = mass density. Substituting for n and β in the expression for the Grashof number,

$$G_r = \frac{g\rho^2 L^3(T_g - T_w)}{T_m \mu^2}$$

where

$$T_m = \frac{T_g + T_w}{2}$$

is the average of the gas and surface temperature.

Substituting for the Grashof number and Prandtl number in the expression for the Nusselt number,

$$N_u = 0.13\left(0.71\frac{g\rho^2 L^3[Tg-T_w]}{T_m\mu^2}\right)^{1/3}$$

$$N_u = 0.146L\left(\frac{g\rho^2}{\mu^2}\left[\frac{T_g-T_w}{T_g+T_w}\right]\right)^{1/3}$$

and substituting for the Nusselt number in the expression for the convection coefficient,

$$h = 0.146k_g\left(\frac{g\rho^2}{\mu^2}\left[\frac{T_g-T_w}{T_g+T_w}\right]\right)^{1/3}$$

Since the thermal conductivity of the gas is given by[3]

$$k_g = 6.4 \ x \ 10^{-5}\left(\frac{T_m}{300}\right)^{.75}$$

$$h = 9.34 \ x \ 10^{-6}\left(\frac{T_g+T_w}{600}\right)^{.75}\left(\frac{g\rho^2}{\mu^2}\left[\frac{T_g-T_w}{T_g+T_w}\right]\right)^{1/3} \qquad (8)$$

Figure F-3 shows h as a function of surface temperature based on a gas temperature of 2400°K and density and viscosity consistent with conditions at the time of an explosion.

Assuming that no additional gas is generated subsequent to the explosion, the density of the gas after the explosion is the same as before the explosion since mass is conserved. Thus, the gas density after the explosion is the molecular weight of n moles of methane plus 9.54n moles of air divided by the initial volume,

[3]D'Appolonia [1978].

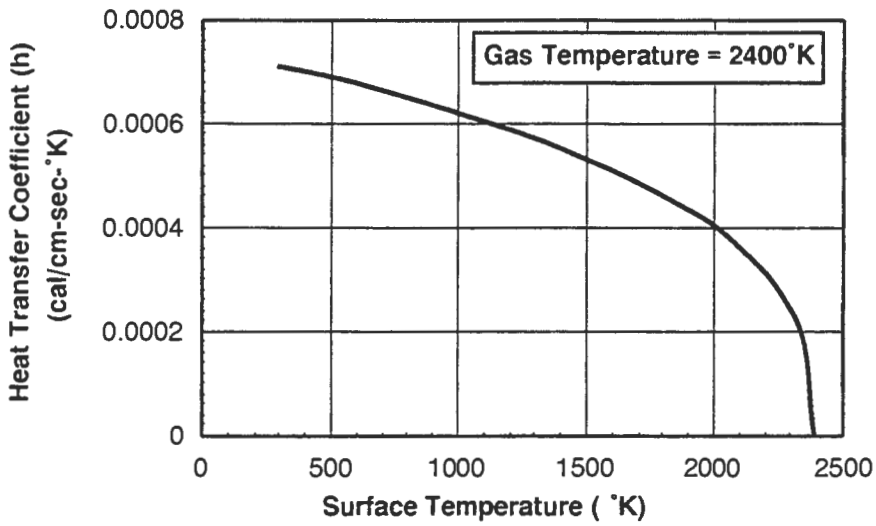


Figure F-3
Convection Heat Transfer Coefficient Versus Temperature

$$\rho = n\left(\frac{M_{w\ CH4} + 9.54M_{w\ air}}{V_{init}}\right)$$

$$\rho = n\left(\frac{16 + 9.54(29)}{V_{init}}\right)$$

$$\rho = \frac{292.66n}{V_{init}} \tag{9}$$

$$\mu = 1.85\ x\ 10^{-4}\left(\frac{T_m}{300}\right)^{0.67} \tag{10}$$

and the viscosity is given by (D'Appolonia, 1978), where the viscosity is evaluated at the average of the surface and gas temperatures.

Because there will be two different surface temperatures, one corresponding to the salt, and one for the explosion-isolation wall, there will be different convective heat transfer coefficients as well.

F.3.3 Conduction Into the Walls, Floor, Roof, and Explosion-Isolation Walls

The temperature which controls the heat transfer from the gas via radiation and convection is controlled by the rate at which heat is conducted into the walls, roof, floor, and explosion-isolation walls. The diffusion of heat into the walls, floor, roof, and explosion-isolation walls is assumed to be governed by a one-dimensional, semi-infinite thermal diffusion model. If the temperature penetrates the explosion-isolation walls, the model is changed to be thermal diffusion across a slab of finite thickness with an ambient gas temperature on the side in the isolation zone.

Thermal diffusion into the walls, floor, roof, and explosion-isolation walls is governed by the partial differential equation,

$$\alpha \frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t}$$

where α is the thermal diffusivity, T is the temperature, x is the distance into the wall, floors, roof, or explosion-isolation walls, and t is time. At x = 0 the flow of heat into the walls, floor, roof, or explosion-isolation walls is governed by the boundary condition,

$$-k \frac{\partial T}{\partial x} = q_{in}$$

where q_{in} is the heat flux into the walls, etc. from the gas via convection and radiation and k is the thermal conductivity. Because the thermal diffusivity and conductivity for salt is different from that of the explosion-isolation wall, two conduction models are required.

F.3.3.1 Heat Conduction to the Salt

The first involves the heat transferred from the gas to the salt and is governed by the partial differential equation,

$$\alpha_s \frac{\partial^2 T_s}{\partial x^2} = \frac{\partial T_s}{\partial t} \tag{11i}$$

where α_s is the thermal diffusivity of salt which is a function of temperature. Figure F-3 shows plots of thermal diffusivity for halite, anhydrite, argillaceous halite and polyhalite (Krieg, 1983). Figure F-4 also shows data from D'Appolonia (1978) that used the relation

$$\alpha_s = \frac{10}{T_s}$$

for salt. The D'Appolonia temperature dependence yields slightly higher values compared with the Waste Isolation Pilot Plant (WIPP) data, but indicates a consistency in the data. For purposes of the post-explosion heat transfer analysis the temperature dependent data for salt has been used.

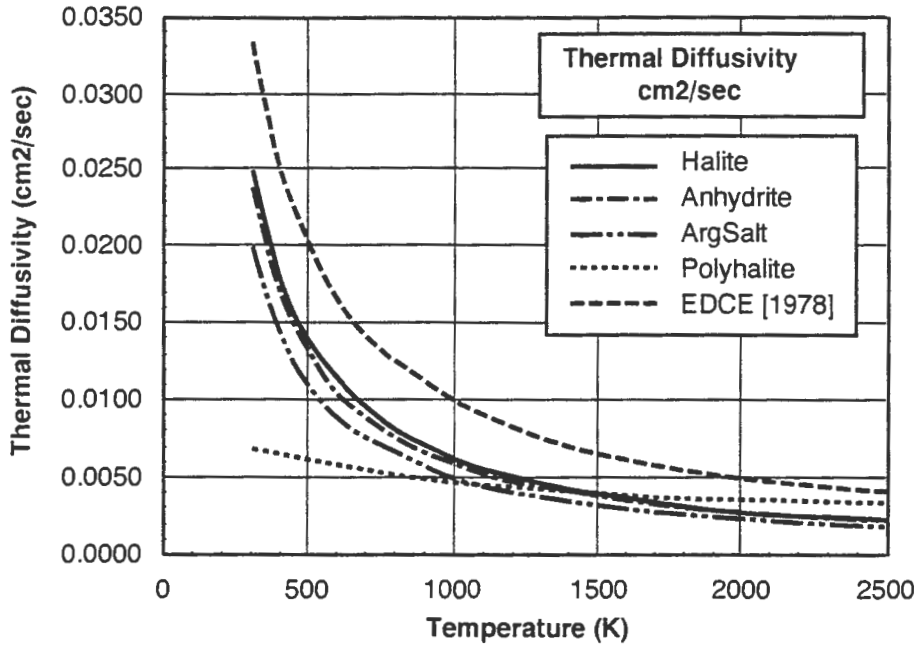


Figure F-4
Thermal Diffusivity of WIPP Geologic Materials

$$\alpha_s = 0.025\left[\frac{300}{T_s}\right]^{1.14} \tag{12i}$$

The boundary condition at the surface of the salt is:

$$-k_s\frac{\partial T_s}{\partial x} = q_{sr}+q_{sc} \tag{13i}$$

where k_s is the thermal conductivity of the salt. Figure F-4 shows plots of thermal conductivities for the same materials as a function of temperature. Again, the thermal conductivity from D'Appolonia (1978):

$$k_s = \frac{4.5}{T_s}$$

is also shown on Figure F-5 to check the consistency of the WIPP data. Again, the thermal conductivity for halite was used for the post-explosion heat transfer analysis.

$$k_s = 0.012\left[\frac{300}{T_s}\right]^{1.14} \tag{14i}$$

The terms q_{sr} and q_{sc} in (13i) couple the heat conduction into the salt with the rate of cooling of the gas via equations (7) through (10). In addition to the boundary conditions given by (12i), initial conditions at time t = 0 are required. It is assumed that at t = 0 the salt is at the ambient temperature in the panel, T_{amb}. Equations (11i) through (14i) with the initial conditions form the complete problem for the temperature in the salt as a function of time as the gas cools following the explosion.

F.3.3.2 Heat Conduction to the Explosion-Isolation Walls

The second model involves the heat transferred from the gas to the explosion-isolation walls and is governed by the partial differential equation,

$$\alpha_b\frac{\partial^2 T_b}{\partial x^2} = \frac{\partial T_b}{\partial t} \tag{11ii}$$

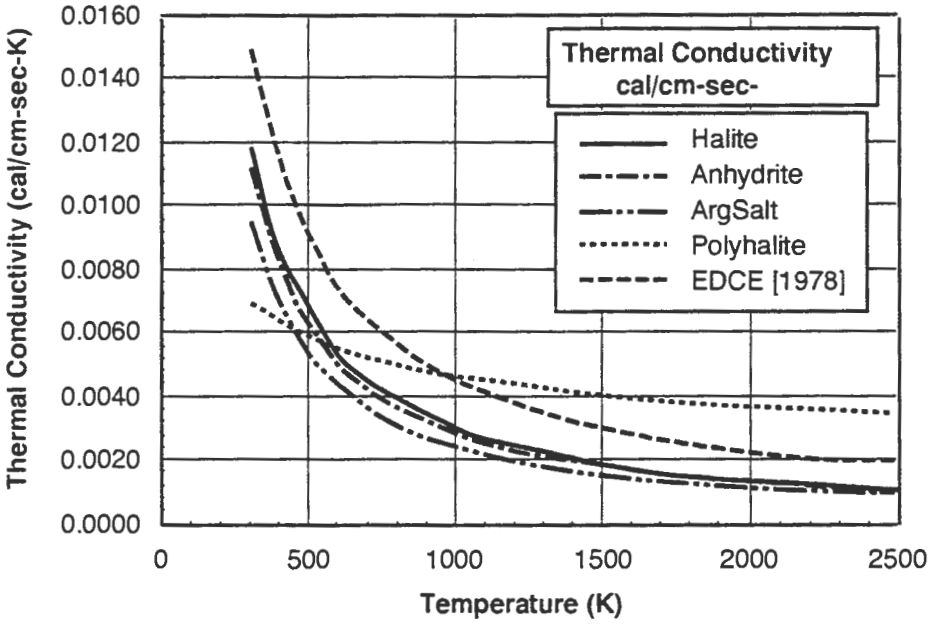


Figure F-5
Thermal Conductivity of WIPP Geologic Materials

where α_b is the thermal diffusivity of explosion-isolation walls. If the explosion-isolation walls are concrete, the thermal diffusivity does not vary with temperature (D'Appolonia, 1978),

$$\alpha_s = 0.005 \tag{12ii}$$

The boundary condition is:

$$-k_b \frac{\partial T_b}{\partial x} = q_{br} + q_{bc} \tag{13ii}$$

where q_{br} = heat flux for the salt, q_{bc} = heat flux for explosion-isolation walls, and k_b is the thermal conductivity of the walls. Again, if the explosion-isolation walls are concrete, the thermal conductivity is constant (D'appolonia, 1978).

$$k_b = 0.002 \tag{14ii}$$

Analogous to the case for salt, the terms q_{br} and q_{bc} in (13ii) couple the heat conduction into the salt with the rate of cooling of the gas via equations (7) through (10). At t = 0 the explosion-isolation walls are at the ambient temperature at the panel level, T_{amb}.

F.4.0 Numerical Model

Equations (1) through (14) were solved using a computer program based on an explicit finite difference representation of the equations. In subsequent discussion the following symbols are used,

τ	=	time step Δt
ε	=	distance between mesh points, Δx, in finite difference representation of semi-infinite solid used to model the explosion-isolation walls.
n	=	subscript denoting the value of a variable at time t.
n+1	=	subscript denoting the value of a variable at time $t+\tau$.
m	=	subscript denoting the value of a variable at mesh point m in a finite difference representation of a semi-infinite solid. m = 0 corresponds to the boundary x = 0.
T_{gn}	=	gas temperature at time t.
T_{s0}	=	temperature at x = 0 in salt.
T_{b0}	=	temperature at x = 0 in an explosion-isolation wall.
T_{smn}	=	temperature in salt at mesh point m and time n.
T_{bmn}	=	temperature in explosion-isolation walls at mesh point m and time n.
α_{sm}	=	thermal diffusivity in salt at mesh point m (function of temperature).

α_{bm} = thermal diffusivity of explosion-isolation wall material at mesh point m (may be constant or a function of temperature).
q_{rsn} = heat flux to wall (salt) via radiation at time point n.
q_{rbn} = heat flux to explosion-isolation wall via radiation at time point n.
q_{csn} = heat flux to wall (salt) via convection at time point n.
q_{cbn} = heat flux to explosion-isolation wall via convection at time point n.

Where symbols are used for parameters that are a function of temperature and consequently also a function of time, the subscripts n and n+1 refer to whether the parameter is evaluated at t or t + Δt.

F.4.1 Overview of Computer Program

Figure F-6 provides a simplified flow chart of the computer program used to solve the equations in the model in explicit finite difference form.

F.4.2 Finite Difference Formulation

For the first past through the calculational loop n = 0 and the gas temperature is set to T_{g0}, the initial temperature. Based on the assumption of constant volume during the explosion, the temperature is related to the pressure by,

$$T_{g0} = T_{gamb}\left(\frac{P_0}{P_{amb}}\right) = 8T_{gamb} \tag{15}$$

where

T_{gamb} = the gas temperature prior to the explosion
P^{amb} = the gas pressure prior to the explosion (taken as 2 atm)
P_0 = the gas pressure caused by the explosion (taken as 16 atm)
T_{g0} = the gas temperature caused by the explosion which is the initial gas temperature for the cooling analysis.

The initial temperature of the salt (T_{smo}) and explosion-isolation walls (T_{bmo}) for the heat conduction calculations are set to the ambient temperature at all mesh points.

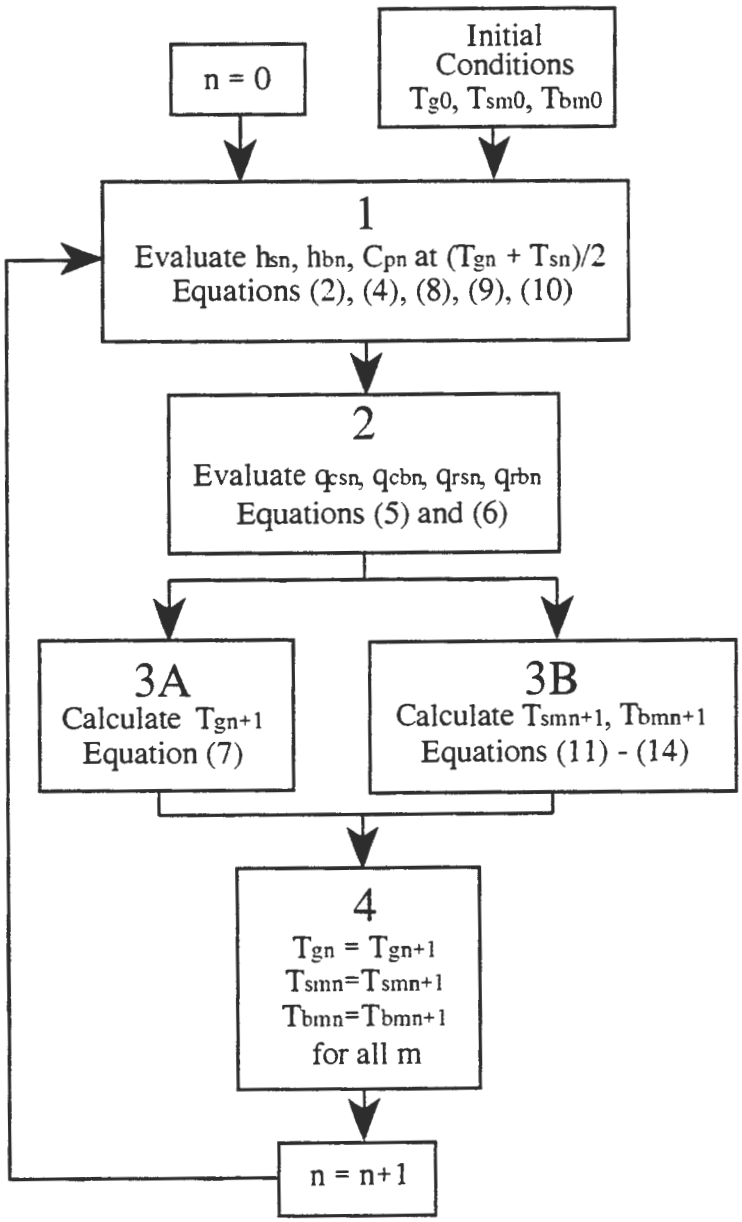


Figure F-6
Program Flow Chart

$$T_{sm0} = T_{amb} \quad m = 1 \ldots M$$
$$T_{bm0} = T_{amb} \quad m = 1 \ldots M \tag{16}$$

where M is the maximum mesh point number used in the finite difference representation of the semi-infinite solid. T_{amb} is the ambient temperature of the salt and explosion-isolation wall at the time of the explosion.

F.4.2.1 Program Section 1

Section 1 of the program (Figure F-3) calculated the parameters required for the determination of the heat fluxes from the hot gas to the cooler walls. These calculations are performed initially based on values for n = 0, initial conditions. Subsequently, they are evaluated based on the temperature values at time point n.

Thus,

$$\mu_{sn} = 1.85 \times 10^{-4} \left(\frac{T_{gn} + T_{s0n}}{600} \right)^{0.67}$$
$$\mu_{bn} = 1.85 \times 10^{-4} \left(\frac{T_{gn} + T_{b0n}}{600} \right)^{0.67} \tag{17}$$

where

μ_{sn} = viscosity of the salt

μ_{bn} = viscosity of the explosion-isolation wall

T_{gn} = gas temperature at time point n

T_{s0n} = wall temperature of the salt at time point n, which is the m = 0 mesh point of the finite difference representation of the semi-infinite solid used to model heat conduction into the salt

T_{b0n} = surface temperature of the explosion-isolation wall.

Since the initial surface temperatures of the salt and the walls are the same, the initial value of μ will be the same at both the salt and the walls. However, with time as the surface temperature of the explosion-isolation walls varies from the surface temperature of the salt, the values of μ will be different for the salt compared with the walls. This plays a role in

having different convection heat transfer coefficients at the salt compared with the explosion-isolation walls.

The convection heat transfer coefficients are given by (8) below.

$$h_{sn} = 9.34 \ x \ 10^{-6} \left(\frac{T_{gn} + T_{s0n}}{600} \right)^{.75} \left(\frac{g\rho^2}{\mu_{sn}^2} \left[\frac{T_{gn} - T_{s0n}}{T_{gn} + T_{s0n}} \right] \right)^{1/3}$$

$$h_{bn} = 9.34 \ x \ 10^{-6} \left(\frac{T_{gn} + T_{b0n}}{600} \right)^{.75} \left(\frac{g\rho^2}{\mu_{bn}^2} \left[\frac{T_{gn} - T_{b0n}}{T_{gn} + T_{b0n}} \right] \right)^{1/3} \qquad (18)$$

The density, ρ, remains constant by virtue of the constant volume and constant number of moles. The acceleration of gravity, g, also remains constant for all time points.

The specific heat of the gas which is required for Section 3A of the program is given by (4) below.

$$C_{pn} = 6.45 \ x \ 10^{-4} \left(T_{gn} + T_{s0n} \right) + 7.3353 - \frac{130728}{\left(T_{gn} + T_{s0n} \right)^2} \qquad (19)$$

Because the specific heat is a bulk property of all of the gas in the panel, it is affected by all of the surface area in the panel. Because the surface area of the salt is orders of magniture larger than the surface area of the explosion-isolation walls, the specific heat at each time is based solely on the surface temperature of the salt.

F.4.2.2 Program Section 2

The heat flux rates to the walls as well as the total heat transfer rates to the walls via convection and radiation are calculated in Section 2 of the program. Flux is required for the boundary condition for the heat conduction analysis of Section 3B and total heat flow is required for the change in gas temperature calculation in Section 3A.

The total heat flow values are given by (5) and (6) which for time step n become where h_{sn} and h_{bn} are given by (18). The total heat flows are used in Section 3A of the program evaluates the time rate of change of the gas temperature using equation (7).

$$Q_{rn} + \sigma\left(A_s\left[T_{gn}^4 - T_{s0n}^4\right] + A_b\left[T_{bn}^4 - T_{b0n}^4\right]\right)$$
$$Q_{cn} = A_s h_{sn}\left(T_{gn} - T_{s0n}\right) + A_b h_{bn}\left(T_{gn} - T_{bn}\right) \tag{20}$$

The total heat flows at time step n given by (20) are heat flow out of the gas occupying the panel volume and into the explosion-isolation walls. For the heat flow into the explosion-isolation walls, the areas, A_s and A_b cancel from the equations representing the boundary conditions at x = 0 for the transient heat conduction problems solved in Section 3B of the program. Thus, for Section 3B, the heat flux values are required. These are the same as (20) without the areas.

$$q_{rn} = \sigma\left(\left[T_{gn}^4 - T_{s0n}^4\right] + \left[T_{gn}^4 - T_{b0n}^4\right]\right)$$
$$q_{cn} = h_{sn}\left(T_{gn} - T_{s0n}\right) + h_{bn}\left(T_{bn} - T_{bn}\right) \tag{21}$$

where q_{rn} and q_{cn} are the heat fluxes due to radiation and convection.

For the total heat flow and heat flux due to radiation, the Stefan-Boltzmann constant is taken to be constand for all values of temperature and hence time.

$$\sigma = 1.355 \ x \ 10^{-12} \tag{22}$$

F.4.2.3 Program Section 3

Section 3 comprises the main body of the program.

F.4.2.3.1 Program Section 3A

Equation (7) governs the rate of change of gas temperature in the panel volume. Using the explicit finite difference approximation,

$$\frac{dT_g}{dt} = \frac{1}{\tau}\left(T_{gn+1} - T_{bn}\right)$$

where $\tau = \Delta t$ is the time increment, Equation (7) becomes

$$T_{gn+1} = T_{gn} - \tau \left(\frac{Q_{cn} + Q_{rn}}{10.54\ n_{CH4}\ C_{pn}} \right) \tag{23}$$

where Q_{cn}, Q_{rn}, and C_{pn} are given by (20) and (19) and n_{CH4} is an input representing the moles of methane in the panel volume at the time of the explosion. Equation (23) gives the gas temperature in the panel at time $t + \Delta t$ in terms of the gas temperature at time t and the total heat flow values at time t.

F.4.2.3.2 Program Section 3B

Section 3B of the program is the most complex. It solves two transient heat conduction problems assuming that the walls, floor, roof, and explosion-isolation walls are semi-infinite solids having thermal conductivities and diffusivities that may or may not be temperature dependent. In the case of the walls, floor and roof, the panel volume the conductivity and diffusivity of salt is dependent on temperature. Assuming that the explosion-isolation wall material is concrete, the conductivity and diffusivity of the explosion-isolation wall are independent of temperature.

Because of the temperature dependence of the conductivity and diffusivity of the salt, and the time-dependent spatial temperature distribution into the walls, floor and roof, the conductivity that is required for the boundary condition at $x = 0$ varies with time and the thermal diffusivity varies in both time and space. The partial differential equation for transient heat conduction when the diffusivity varies spatially is given by:

$$\frac{\partial}{\partial x}\left(\alpha \frac{\partial T}{\partial x} \right) = \frac{\partial T}{\partial t} \tag{a}$$

which can be expanded as:

$$\left(\frac{\partial \alpha}{\partial x} \right) \left(\frac{\partial T}{\partial x} \right) + \alpha \frac{\partial^2 T}{\partial x^2} = \frac{\partial T}{\partial t} \tag{b}$$

Using the finite difference approximations,

$$\frac{\partial \alpha}{\partial x} = \frac{1}{2\varepsilon}\left(\alpha_{m+1} - \alpha_{m-1}\right) \tag{ci}$$

$$\alpha\frac{\partial^2 T}{\partial x^2} = \frac{\alpha_m}{\varepsilon^2}\left(T_{m-1} - 2T_m + T_{m+1}\right) \tag{cii}$$

$$\frac{\partial T}{\partial x} = \frac{1}{2\varepsilon}\left(T_{m+1} - T_{m-1}\right) \tag{cii}$$

where e = Δx, the left hand side of equation (b) becomes

$$\left(\frac{\partial T}{\partial x}\right)\left(\frac{\partial T}{\partial x}\right) + \alpha\frac{\partial^2 T}{\partial x^2} = \frac{1}{4\varepsilon^2}\left(\left[\alpha_{m+1}-\alpha_{m-1}\right]\left[T_{m+1}-T_{m-1}\right]+4\alpha_m T_{m-1}-8\alpha_m T_m+4\alpha_m T_{m+1}\right) \tag{d}$$

or

$$= \frac{1}{4\varepsilon^2}\left(\alpha_{m+1}T_{m+1}-\alpha_{m+1}T_{m-1}-\alpha_{m-1}T_{m+1}+\alpha_{m-1}T_{m-1}\right)+ \frac{1}{4\varepsilon^2}\left(4\alpha_m T_{m-1}-8\alpha_m T_m+4\alpha_m T_{m+1}\right) \tag{e}$$

$$4\varepsilon^2\left(\left[\frac{\partial \alpha}{\partial x}\right]\left[\frac{\partial T}{\partial x}\right]+\alpha\frac{\partial^2 T}{\partial x^2}\right) = v_{m-1}\left(\alpha_{m-1}+4\alpha_m-\alpha_{m+1}\right)-8\alpha_m T_m+T_{m+1}\left(\alpha_{m+1}+4\alpha_m-\alpha_{m-1}\right) \tag{f}$$

Using an explicit finite difference representation of the time derivative as used in Section 3A.

$$\frac{\partial T_m}{\partial t} = \frac{1}{\Delta t}\left(T_{m\,n+1}-T_{m\,n}\right) \tag{g}$$

Substituting (f) and (g) into the partial differential equation (a),

$$T_{m-1\ n}\left(\alpha_{m-1}+4\alpha_m-\alpha_{m+1}\right)-8\alpha_m T_{m\ n}+T_{m+1\ n}\left(\alpha_{m+1}+4\alpha_m-\alpha_{m-1}\right) = \frac{1}{N}\left(T_{m\ n+1}-T_{m\ n}\right) \tag{h}$$

where

$$N = \frac{\Delta t}{4\varepsilon^2} \tag{i}$$

is analogous to the modulus for the case of constant diffusion. Solving (h) for $T_{m\ n+1}$

$$T_{m\ n+1} = T_{m-1\ n}N\left(\alpha_{m-1} + 4\alpha_m-\alpha_{m+1}\right)-\left(8N-1\right)\alpha_m T_{m\ n}+T_{m+1\ n}N\left(\alpha_{m+1}+4\alpha_m-\alpha_{m-1}\right) \tag{j}$$

For the case of constant diffusivity,

$$\alpha_{m-1} = \alpha_m = \alpha_{m+1} = \alpha$$

with

$$M = \frac{\alpha\Delta t}{\varepsilon^2} = 4\alpha N \tag{k}$$

equation (j) becomes

$$T_{m\ n+1} = M\left(T_{m+1\ n} + T_{m-1\ n}\right) - \left(2M-1\right)T_{m\ n} \tag{l}$$

which is the finite difference equation for the case of constant diffusivity (Carslaw and Jaeger, 1959). Thus, equation (j) reduces to the correct equation when the diffusivity is constant and is the finite difference equation for the case of variable diffusivity.

For a numerical stability criteria,

$$M<0.5 \tag{m}$$

the corresponding relation for the case of variable diffusivity becomes equation (n) for all m.

$$MAX(\alpha_m N) < 0.125 \tag{n}$$

The thermal conductivity and thermal diffusivity at each time point are evaluated from the temperature at that time and space as given previously for the temperature variation of the conductivity and diffusivity.

The boundary condition at x = 0, is the same as for the case of constant diffusivity,

$$-k_n \frac{\partial T_n}{\partial x} = q_{rn} + q_{cn} \tag{o}$$

where q_{rn} and q_{rn} are determined in Section 2. Using the finite difference relationship (Carslaw and Jaeger, 1959),

$$\frac{\partial T_n}{\partial x} = \frac{1}{2e}\left(-3T_{0\,n} + 4T_{1\,n} - T_{2\,n}\right) \tag{p}$$

equation (o) becomes:

$$-\frac{k_n}{2\varepsilon}\left(-3T_{0\,n} + 4T_{1\,n} - T_{2\,n}\right) = q_{rn} + q_{cn}$$

$$3T_{0\,n} - 4T_{1\,n} + T_{2\,n} = \frac{2\varepsilon}{k_n}\left(q_{rn} + q_{cn}\right) \tag{q}$$

Substituting for q_{rn} and q_{cn}:

$$3T_{0\,n} - 4T_{1\,n} + T_{2\,n} = \eta_n\left(T_{gn} - T_{0n}\right) + \gamma_n\left(T_{gn}^4 - T_{0n}^4\right)$$

where

$$\eta_n = \frac{2\varepsilon h_n}{-k_n} \tag{r}$$

and

Using the identity
and defining

$$\gamma_n = \frac{2\varepsilon\sigma}{k_n} \tag{s}$$

$$T_{gn}^4 - T_{0n}^4 = (T_{gn} - T_{0n})(T_{gn} + T_{0n})\left(T_{gn}^2 + T_{0n}^2\right)$$

$$f_n = (T_{gn} + T_{0n})\left(T_{gn}^2 + T_{0n}^2\right) \tag{t}$$

$$3T_{0n} - 4T_{1n} + T_{2n} = (\eta_n + \gamma_n f_n)(T_{gn} - T_{0n}) \tag{u}$$

For the case of both convection and radiation equation (u) is a fourth order equation in T_{0n} and has to be solved using a numerical technique such as Newton-Raphson iteration. Since the effect of radiation heating of the walls, floor, roof, and explosion-isolation walls leads to a more rapid cooling of the combustion gas following the explosion, and temperatures effects on the salt or explosion-isolation material is worse for longer durations, it is conservative to neglect radiation heat transfer. In this case, equation (u) becomes linear:

$$3T_{0n} - 4T_{1n} + T_{2n} = \eta_n (T_{gn} - T_{0n}) \tag{v}$$

which can be solved directly for T_{0n}:

$$T_{0n} = \frac{4T_{1n} - T_{2n} + \eta_n T_{gn}}{3 + \eta_n} \tag{w}$$

At each time the field equations are solved based on the previous time. The boundary condition (w) is then applied.

Equations (j) and (u) are formulated for both the salt comprising the walls, floor, and roof and for the explosion-isolation walls. As noted, the field equations for variable diffusivity reduce appropriately to the special case of a constant diffusivity so the above equations are sufficiently general to handle both the material of the explosion-isolation wall and the salt.

F.4.2.4 Program Section 4

In Section 4 of the program, the temperature values at time t+Δt (n+1) become the new values at time t (n). The time counter, n, is incremented by 1 and the program returns to Section 1 to compute the solution at the subsequent time step.

F.4.3 Initial Volume, Surface Area and Number of Moles

The volume of gas to be cooled via heat transfer to the walls, roof, floor, and explosion-isolation walls following an explosion is taken to correspond to the effective panel volume at the time when the air-methane mixture in the panel enters the explosive range. The effective volume is defined as:

$$V_{eff} = \phi V$$

where V is the panel volume considering closure of the panel and Φ is the porosity which accounts for the waste emplaced in the panel. Figure F-7 shows a plot of the effective volume as a function of time.

Based on Figure 4.2 of the Conceptual Design Report (DOE, 1995), the methane-air mixture in the panel volume enters the explosive range at 25 years. From Figure F-7 this corresponds to a panel volume of 1.6×10^{10} cm^3 at the time the postulated explosion occurs.

The surface area at the time of the postulated explosion was obtained from the volume at the time the methane air mixture enters the explosive range at 25 years and the initial ratio of surface area to volume.

$$A_s = \left(\frac{A_{sinit}}{V_{init}} \right) V$$

Figure F-8 shows a plot of panel surface area as a function of time.

Based on the air-methane mixture entering the explosive range at 25 years, the surface area at the time of the explosion is 1.6×10^8 cm^2. The area of two 14 foot x 14 foot explosion-isolation walls is 1.82×10^5 cm^2. Thus the area of the explosion-isolation walls is

$$\frac{1.82 \ x \ 10^5}{1.6 \ x \ 10^8} = 0.0014 = 0.14\%$$

of the total surface area.

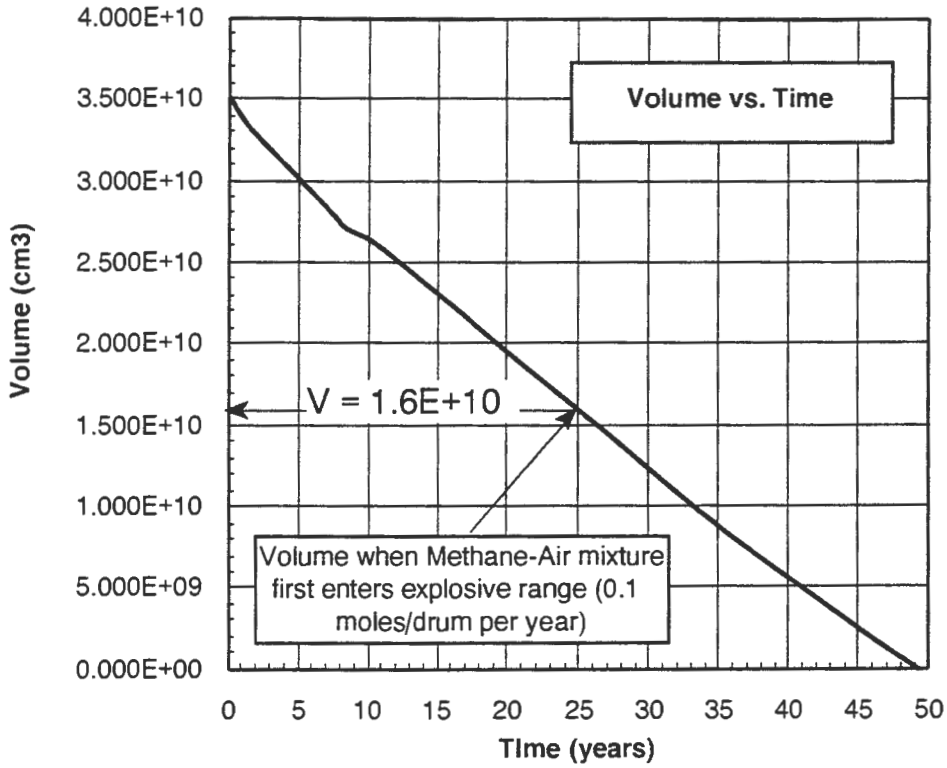


Figure F-7
Effective Panel Volume vs Time

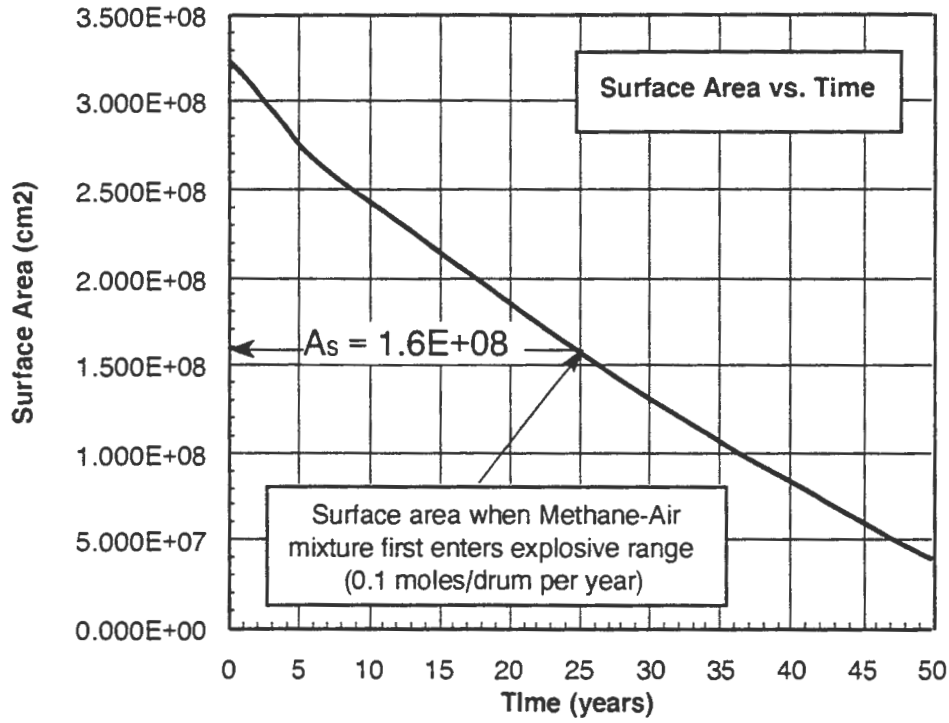


Figure F-8
Surface Area Rooms, Floor and Roof vs Time

The number of moles of combustion gas is found using the ideal gas law based on an initial pressure of 16 atmospheres (atm) and an initial temperature of 2,400 °K.

$$n = \frac{pV}{RT} \tag{24}$$

with

R = 82.06 cm^3-atm/mol-°K (ideal gas law constant)
p = 16 atm
V = 1.6×10^{10}
T = 2400 °K

$$n = \frac{16 \; x \; (1.6 \; x \; 10^{10})}{82.06 \; x \; 2400}$$

$$n = 1.3 \; x \; 10^6 \; moles$$

The program uses the number of moles of methane and air independently to calculate the density. Thus,

$$10.54 \; n_{CH4} = 1.3 \; x \; 10^6 \tag{25}$$

$$n_{CH4} = 1.233 \; x \; 10^5$$

$$n_{air} = 9.54 \; x \; n_{CH4} = 1.176 \; x \; 10^6$$

The density is given by

$$\frac{(1.233 \; x \; 10^5)(16) + (1.176 \; x \; 10^6)(29)}{1.6 \; x \; 10^{10}} = 0.002255$$

F.5.0 Results

The numerical formulation discussed in Section 4.0 was executed using a spatial grid size, ε - 1 cm and a time increment, τ = 10 seconds. No problems with numerical stability were encountered using these values.

At time t = 0, the initial heat transfer from the combustion gas to the salt and explosion-isolation walls results is a large temperature gradient at the surface. To represent this gradient accurately using a finite difference formulation would require an extremely small grid spacing as the initial temperature gradient extends only an infinitesimal distance into the surface. Using a grid spacing sufficiently small to accurately characterize the initial gradient would be prohibitive, relative to the number of mesh points and time steps required.

The initial conditions for the finite difference calculations were determined by using an exact solution for the case of constant convective heat transfer coefficient and constant gas temperature. The use of the closed form solution to determine the initial conditions assumes that the change in gas temperature over small initial times is small and that the heat transfer coefficient is weakly dependent on the temperature difference between the gas and the surfaces of the salt and explosion-isolation walls. Based on the closed form solution, the initial conditions for the finite difference model were taken at a time of 12.7 seconds following the explosion. For shorter initial times, the gradient had not propagated sufficiently far into the surfaces to be represented with a 1 cm. grid spacing. Thus, the initial time for the finite difference calculations was 12.7 seconds with initial temperatures based on the closed form solution.

Figure F-9 shows the gas temperature, salt temperature (walls, floor, and roof) and explosion-isolation wall temperature as a function of time following the explosion. Figure F-10 shows the temperature distribution into the explosion-isolation walls at various times following the explosion. Figure F-11 shows the temperature distribution into the salt at various times following the explosion.

Figure F-9 shows that the temperature of the gas has nearly reached the initial ambient conditions after about 2 hours. Over that span of time, elevated temperature in the explosion-isolation wall has a maximum extent of 15 cm (about 6 inches) into the explosion-isolation wall. Since the explosion-isolation wall is at least 36 inches (91.4 cm) thick, the elevated temperature will not reach the opposite side of the wall. Thus, the assumption of a semi-infinite body in the numerical model is not violated.

A comparison of the results shown on Figure F-9 with the results given in D'Appolonia (1978) is favorable. The ratios of surface area and volume used in D'Appolonia (1978) as well as the initial pressures are not the same as used for this analysis. The temperatures shown on Figure F-9 are slightly higher than those predicted for a pressure of 9 atm as shown

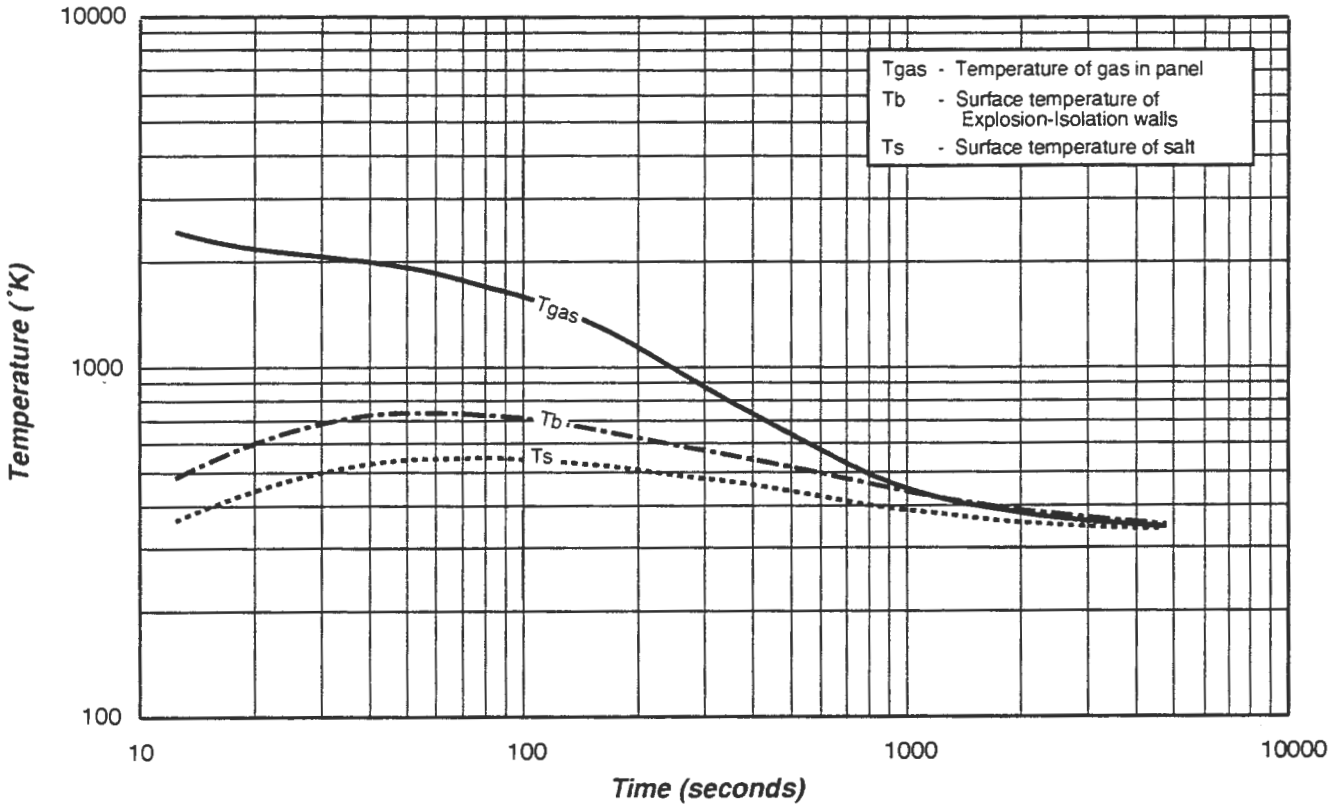


Figure F-9

Temperature Variation with Time for Gas, Salt, and Explosion-Isolation Walls

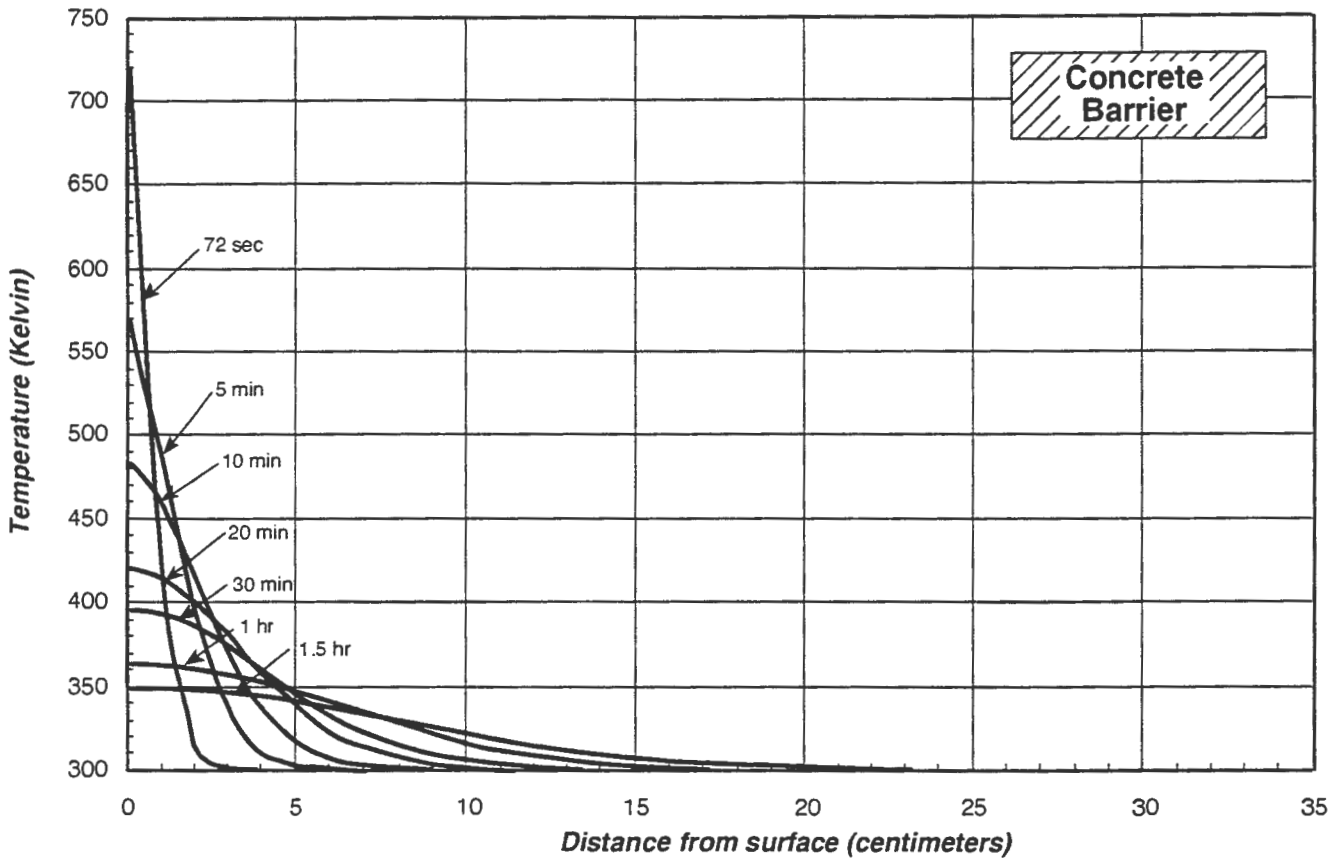


Figure F-10
Temperature Distribution with Time for Concrete Barrier

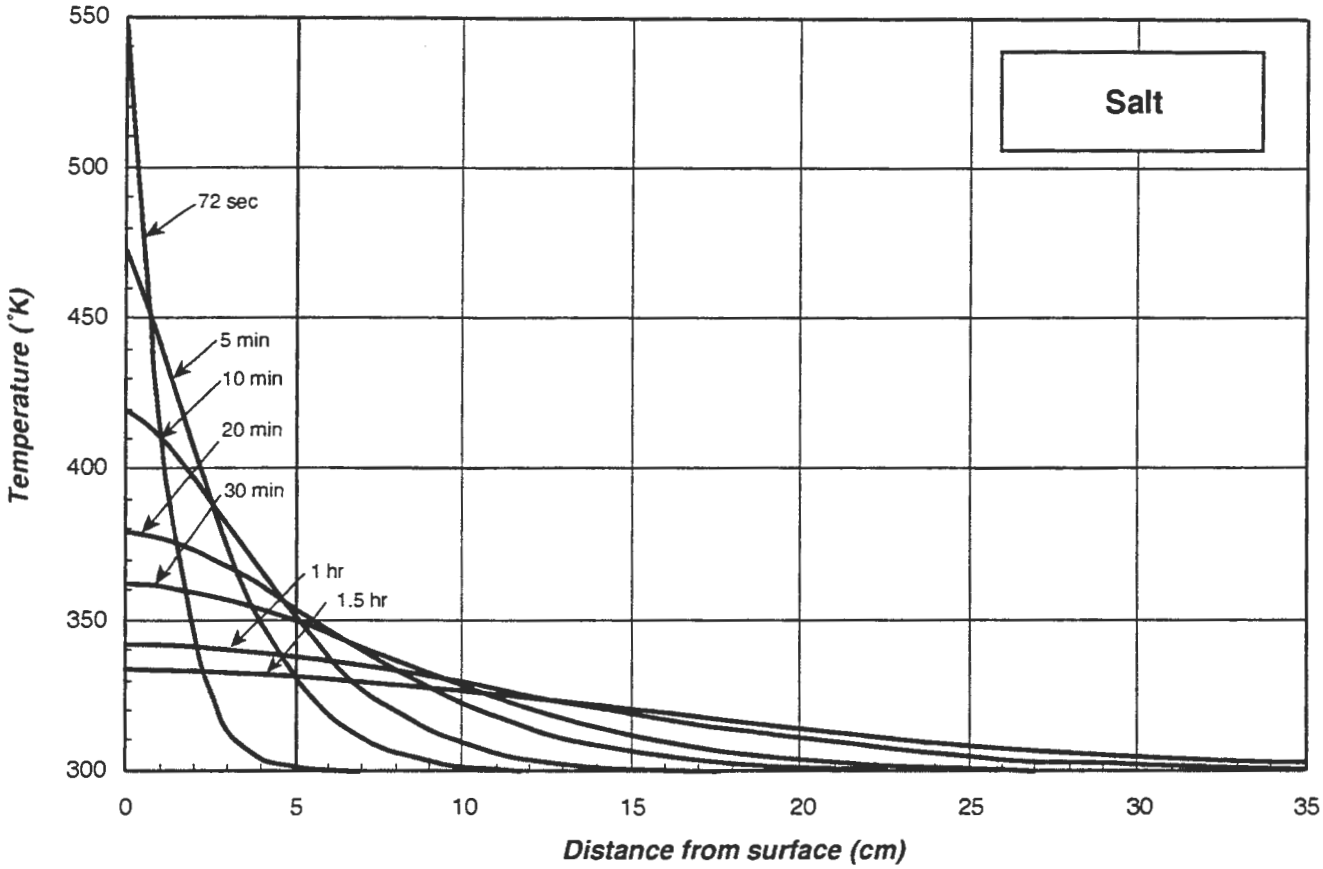


Figure F-11
Temperature Distribution with Time for Salt

in D'Appolonia [1978]. This is as expected since the initial pressure affects the number of moles which determines the rate of temperature decay in the gas. This is illustrated by comparison of the results for 9 atm with those for 27 atm shown in D'Appolonia (1978). The favorable comparison of the results shown on Figure F-9 with those of D'Appolonia (1978) provides verification of the numerical model used in these analyses.

F.6.0 References

Bodurtha, F. T., 1980, *Industrial Explosion Prevention and Control*, McGraw-Hill Book Company, New York, New York.

Carslaw, H. S., and J. C. Jaeger, 1959, *Conduction of Heat in Solids*, 2nd ed., Oxford at the Clarendon Press, Oxford, England.

D'Appolonia Consulting Engineers, 1978, "Potential for Hydrocarbon Explosions and Probable Related Impacts in Mechanically Mined Underground Crude Oil Storage Facilities," D'Appolonia Consulting Engineers, Pittsburg, Pennsylvania.

Krieg, R. D., 1983, "Reference Stratigraphy and Rock Properties for the Waste Isolation Pilot Plant (WIPP) Project," *SAND83-1908*, Sandia National Laboratories, Albuquerque, New Mexico.

Reid, R. C., J. M. Prausnitz, and T. K. Sherwood, 1977, *The Properties of Gases and Liquids*, 3rd ed., McGraw-Hill Book Company, New York, New York.

U.S. Department of Energy (DOE), 1995, "Conceptual Design for Operational Phase Panel Closure Systems," *DOE-WIPP-95-2957*, U.S. Department of Energy, WIPP Project Office, Carlsbad, New Mexico.

APPENDIX G
TECHNICAL SPECIFICATIONS

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 Scope
This section includes:

- Scope of Work
- Definitions and Abbreviations
- Drawings
- Work by Others
- Contractors Use of Site
- Contractors Use of Facilities
- Work Sequence
- Work Plan
- Submittals

1.2 Scope of Work
The Contractor shall furnish all labor, materials, equipment and tools to perform operations in connection with the construction of two (2) panel closure systems for each panel, one of each to be installed in the air intake drift and the air exhaust drift of a waste-emplacement panel, as shown on the drawings and called for in these specifications.

Four (4) possible arrangements of the concrete barrier and isolation walls are shown on the attached Figure 1 "Plan Variations." The specific requirements for the panel closure system will be determined by the Westinghouse WID prior to the time of installation and will be defined in the contract documents.

- Concrete barrier with disturbed rock zone (DRZ) removal up through clay seam G and down through marker bed 139 (MB 139) in combination with a construction isolation wall (Sketch A).

- Concrete barrier with DRZ removal in combination with an explosion isolation wall (Sketch B.)

- Concrete barrier without DRZ removal in combination with construction isolation wall (Sketch C).

- Concrete barrier without DRZ removal in combination with an explosion isolation wall (Sketch D).

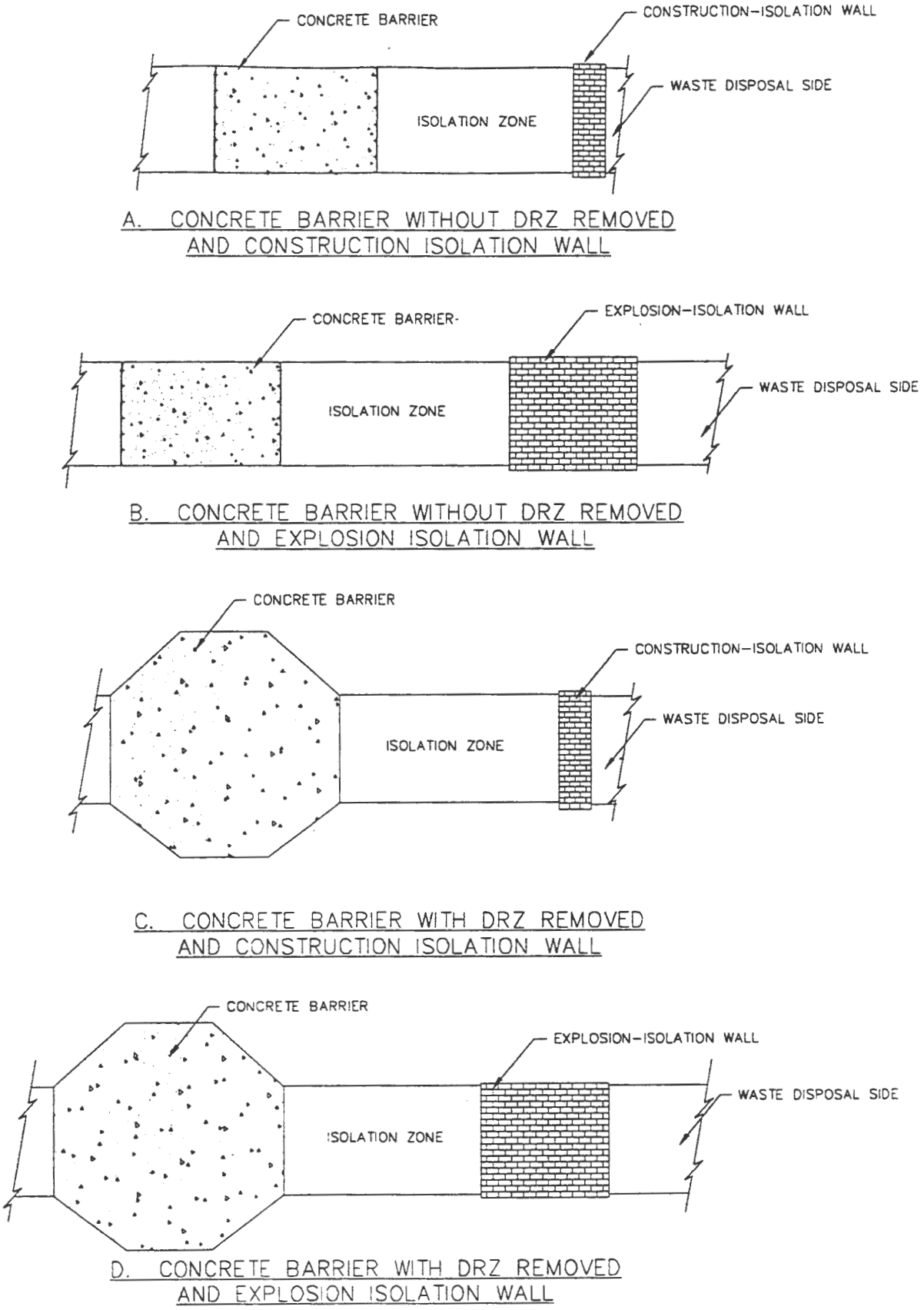


Figure 1
Plan Variations

The scope of work shall include but not be limited to the following units of work:

- Develop work plan, health and safety plan (HASP) and contractors quality control plan (CQCP)

- Prepare and submit all plans requiring approval

- Mobilize to site

- Coordinate construction with operations

- Perform the following for the air intake entry and the air exhaust entry.
  - Excavate the surface preparation for the explosion (or construction) isolation wall
  - Construct the explosion (or construction) isolation wall
  - Excavate the DRZ if required by contract
  - Install the form work for the concrete barrier
  - Place concrete for the concrete barrier
  - Grout the interface of concrete barrier/back wall
  - Provide contact grouting along the contact surface (if required by the engineer)

- Clean up construction areas in underground and above ground

- Submit all required record documents

- Demobilize from site

1.3 Definitions and Abbreviations

Definitions

Contact-handled waste—Contact-handled defense transuranic (TRU) waste with a surface dose rate not to exceed 200 millirem per hour.

Concrete barrier—A barrier placed in the access drifts of a panel to restrict the mass flow rate of volatile organic compounds (VOC).

Concrete block—Concrete used for construction of either an explosion-isolation wall or a construction-isolation wall.

Construction-isolation wall—A wall immediately adjacent to the panel waste-emplacement area that is made of concrete block, with mortar or of steel to isolate construction personnel from coming into contact with the waste.

Creep—Plastic deformation of salt under deviatoric stress.

Design migration limit—A mass flow rate that results in an exposure of the affected individual that is at least 1 order of magnitude below the health-based exposure levels for VOCs during the Waste Isolation Pilot Plant (WIPP) operational period.

Disturbed rock zone (DRZ)—A zone surrounding underground excavations where stress redistribution occurs with attendant dilation and fracturing.

Explosion-isolation wall—A concrete-block wall adjacent to the panel waste-emplacement area with mortar that can sustain the pressure and temperature transients of a methane explosion.

Health-based concentration level—The annual average concentration level for a VOC in air that must not be exceeded at the point of compliance.

Health-based migration limit—The mass flow rate of a VOC from all closed panels that results in the health-based concentration level at the point of compliance.

Hydration temperature—The transient temperature developed by a cementitious material due to the hydration of the cement.

Interface grouting—Grouting performed through grout boxes and pipe lines to fill the void at the concrete barrier/back-wall interface.

Methane explosion—A postulated deflagration caused by the buildup of methane gas to explosive levels.

Partial closure—The process of rendering a part of the hazardous waste management unit in the underground repository inactive and closed according to approved facility closure plans. The partial-closure process is considered complete after partial-closure activities are performed in accordance with approved Resource Conservation and Recovery Act (RCRA) partial closure plans.

Point of compliance—The operating point of compliance for VOC health-based exposure levels at the WIPP, which is the WIPP site boundary.

Remote-handled waste—Any of the various forms of high beta-gamma defense TRU waste requiring remote-handling due to a surface dose rate exceeding 200 millirem per hour.

Standard barrier—A concrete barrier emplaced into the panel-access drifts without major excavation of the surrounding rock.

Volatile Organic Compound (VOC)—Any VOC comprising the land-disposal-restricted indicator VOC constituents in the WIPP waste inventory.

Westinghouse—Westinghouse Electric Corporation, Waste Isolation Division (WID) as the construction management authority.

Abbreviations/Acronyms

ACI	American Concrete Institute
AISC	American Institute for Steel Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DRZ	disturbed rock zone
EPA	U.S. Environmental Protection Agency
MB 139	Marker Bed 139
MSHA	U.S. Mining Safety and Health Administration
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
RCRA	Resource Conservation and Recovery Act
SMC	Salado Mass Concrete
USACE	U.S. Army Corps of Engineers
WID	Waste Isolation Division
WIPP	Waste Isolation Pilot Plant

1.4 List of Drawings

The following drawings are made apart of this specification:

762447-E1	Panel closure system, air intake and exhaust drifts, title sheet
762447-E2	Panel closure system, underground waste-emplacement panel plan
762447-E3	Panel closure system, air intake drift, construction details
762447-E4	Panel closure system, air exhaust drift, construction details
762447-E5	Panel closure system, construction and explosion walls, construction details
762447-E6	Panel closure system, air intake and exhaust drifts, grouting and miscellaneous details

1.5 Work by Others

Survey

All survey work to locate the barriers and walls, control and confirm excavation, and complete the work will be supplied by Westinghouse. All survey measurements for record purposes will also be performed by Westinghouse. The Contractor shall be responsible for verifying the excavation dimensions to develop the form work to fit the excavation.

Excavation

The Westinghouse WID may elect to perform certain portions of the work, notably the excavation. The work performed by the Westinghouse will be defined prior to the contract.

1.6 Contractor's Use of Site

Site Conditions

The site is located near Carlsbad, New Mexico, as shown on the site location maps and the title sheet drawing. The underground arrangements and location of the WIPP waste-emplacement panels are shown on the plan view drawing. The work described above is to construct the concrete barriers in the air intake and exhaust drifts of one of the panels upon completion of the disposal phase of that panel. The waste-emplacement panels are located approximately 2,150 feet below the ground surface. The Contractor shall visit the site and become familiar with the site and site conditions prior to preparing his bid proposal.

Contractor's Use of Site

Areas at the ground surface will be designated for the Contractor's use in assembling and storing his equipment and materials. The Contractor shall utilize only those areas designated.

Limited space within the underground area will be designated for the Contractor's use for storage of material and setup of equipment.

Coordination of Contractor's Work

The Contractor is advised that on-going waste emplacement and excavation operations are being conducted throughout the period of construction of the panel barrier system. The Contractor shall coordinate his construction operations with that of the waste emplacement and mining operations. All coordination shall be through Westinghouse WID.

1.7 Contractor's Use of Facilities

Existing facilities at the site which are available for use by the Contractor are:

- WIPP roadheader
- Waste shaft conveyance
- Salt skip hoist
- (1) 20 ton forklift

- (1) 40 ton forklift
- 460 volt AC, 3 phase power
- Water (underground, at waste shaft only) (above ground, at location designated by Engineer)

Additional information on these facilities is presented in Section 02010.

1.8 Work Sequence
Work Sequence shall be as shown on the drawings and directed by Westinghouse WID .

1.9 Work Plan
The Contractor shall prepare and submit for approval by Westinghouse WID a Work Plan fully describing his proposed construction operation. The work plan shall define all proposed equipment. The work plan shall also include the method of excavation, grouting, and pumping concrete. The work plan shall also contain such items as control of surface dust emissions. No work shall be performed prior to approval of the Work Plan.

1.10 Health and Safety Plan (HASP)
The Contractor shall obtain, review, and agree to applicable portions of the existing WIPP Safety Manual, WP 12-1. The Contractor shall prepare and submit for approval to Westinghouse, a project-specific HASP taking into account all applicable sections of the WIPP Safety Manual. The Contractor shall also perform a Job Hazard Analysis in accordance with WP 12-111.

1.11 Contractor Quality Control Plan (CQCP)
The Contractor shall prepare and submit for approval to Westinghouse a CQCP identifying all personnel and procedures to produce an end product which complies with the contract requirements. The CQCP shall comply with all Westinghouse WID requirements and Section 01400, Contractor Quality Control, of this specification.

1.12 Submittals
Submittals shall be in accordance with Westinghouse WID Submittal Procedures and as required by the individual specifications.

PART 2 - PRODUCTS

(Not used)

PART 3 - EXECUTION

(Not Used)

SECTION 01010

SUMMARY OF WORK

SECTION 01090

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 Scope
This section includes:

- Provision of Reference Standards at Site.

- Acronyms used in Contract Documents for Reference Standards. Source of Reference Standards.

1.2 Quality Assurance

For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

Conform to reference by date of issue current on the date of the owner-contractor agreement.

The Contractor shall obtain copy of the standards referenced in the individual specification sections. Maintain a copy at jobsite during submittals, planning, and progress of the specific work, until completion of work.

Should specified reference standards conflict with the contract documents, request clarification from the Engineer before proceeding.

1.3 Schedule of References
Various publications are referenced in other sections of the specifications to establish requirements for the work. These referenced are identified by documents number and title. The addresses of the organizations whose publications are referenced are listed below.

ACI	ACI International P.O. Box 19150 Detroit,MI 48219-0150 Ph: 313-532-2600 Fax: 313-533-4747

AITC	American Institute of Timber Construction 7012 So. Revere Parkway, Suite 140 Englewood, CO 80112 Ph: 303-792-9559 Fax: 303-792-0669
AISC	American Institute of Steel Construction One E. Wacker Dr., Suite 3100 Chicago, IL 60601-2001 Ph: 312-670-2400 Fax: 312-670-5403
ANSI	American National Standards Institute 11 West 42nd St. New York NY 10036 pH: 212-642-4900 Fax: 212-302-1286
API	American Petroleum Institute 1220 L. St., NW Washington, DC 20005 Ph: 202-682-8375 Fax: 202-962-4776
ASTM	American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103 Ph: 610-832-9585 Fax: 215-977-9679
AWS	American Welding Society 550 LeJeune Road Miami, FL 33135 Ph: 800-443-9353 Fax: 305-443-7559
CFR	Code of Federal Regulations Government Printing Office Washington, DC 20402 Ph: 202-783-3238 Fax: 202-223-7703

EPA	Environmental Protection Agency Public Information Center 401 M St., SW Washington, DC 20460 Ph: 202-260-2080
FTM-STO	Federal Test Method Standards Standardization Documents Order Desk Bldg. 4D 700 Robbins Ave. Philadelphia, PA 19111-5094 Ph: 215-697-2179 Fax: 215-697-2978
NRMCA	National Ready-Mixed Concrete Association 900 Spring St. Silver Spring, MD 20910 Ph: 301-587-1400 Fax: 301-585-4219
NTIS	National Technical Information Service U.S. Department of Commerce Springfield, VA 22161 (703) 487-4650
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077
USACE	U.S. Army Corps of Engineers U.S. Army Engineer Waterway Experiment Station ATTN: Technical Report Distribution Section, Services Branch, TIC 3909 Halls Ferry Rd. Vicksburg, MS 39180-6199 Ph: 601-634-2355 Fax: 601-634-2506
WID	Westinghouse Electric Corporation Waste Isolation Division Carlsbad, New Mexico 88221

End of Section

SECTION 01090

REFERENCE STANDARDS

SECTION 01400

CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

1.1 Scope
This section includes:

- Contractor Quality Control Plan (CQCP)
- Reference Standards
- Quality Assurance
- Tolerances
- Testing Services
- Inspection Services
- Submittals

1.2 Related Sections

- 01090 - Reference Standards
- 01600 - Material and Equipment
- 02222 - Excavation
- 02722 - Grouting
- 03100 - Concrete Formwork
- 03300 - Cast-in-Place Concrete
- 04100 - Mortar
- 04300 - Unit Masonry System

1.3 Contractor Quality Control Plan
The Contractor shall prepare and submit for approval by Westinghouse WID, a Quality Control Plan, as described in Section 3.2. No work shall be performed prior to approval of the Contractor's Quality Control Plan.

1.4 References and Standards
Refer to individual specification sections for standards referenced therein, and to Section 01090 - Reference Standards for general listing.

Standards referenced in this section are as follows:

ASTM C1077-95a	Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

ASTM C1093-88	Practice for Accreditation of Testing Agencies for Unit Masonry
ASTM E329-95	Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction
ASTM E543-95	Practice for Determining the Qualification of Nondestructive Testing Agencies
ASTM E548-94	Practice for Preparation of Criteria for Use in the Evaluation of Testing Laboratories and Inspection Bodies

1.5 Quality Assurance

- Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality
- Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship
- Perform work by persons qualified to produce required and specified quality
- Verify that field measurements are as indicated on shop drawings
- Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.6 Tolerances

Monitor excavation fabrication and installation tolerance control of work and products to produce acceptable work. Do not permit tolerances to accumulate.

Adjust products to appropriate dimensions; position before securing products in place.

1.7 Testing Services

Unless otherwise indicated by Westinghouse WID, the Contractor shall employ an independent firm to perform the testing services and other services specified in the individual specification sections, and as required by Westinghouse WID. Testing and source quality control may occur on or off the project site.

The testing laboratory shall comply with applicable sections of the reference standards and shall be authorized to operate in the state in which the project is located.

Testing equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

1.8 Inspection Services

The Contractor shall employ an independent firm to perform inspection services as a supplement to the Contractor's quality control as specified in the individual specification sections, and as required by Westinghouse WID. Inspection may occur on or off the project site.

The inspection firm shall comply with applicable sections of the reference standards.

1.9 Submittals

The Contractor shall submit a Contractors' Quality Control Plan as described herein.

Prior to start of work, the Contractor shall submit for approval, the testing laboratory name, address, telephone number and name of responsible officer of the firm. He shall also submit a copy of the testing laboratory compliance with the reference ASTM standards, and a copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards with memorandum of remedies of any deficiencies reported by the inspection.

Prior to start of work, the Contractor shall submit for approval the inspection firm name, address, telephone number and name of responsible officer of the firm. He shall also submit the personnel proposed to perform the required inspection, along with their individual qualifications and certifications (Example: Certified AWS Welding Inspector.)

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 General

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both on site and off site, and shall be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work on the job. The project superintendent in this context shall mean the individual with the responsibility for the overall management of the project including quality and production.

3.2 Quality Control Plan

3.2.1 General

The Contractor shall furnish for review and approval by Westinghouse WID, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract. The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. Construction will be permitted to begin only after acceptance of the CQC Plan.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both on site and off site, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

- The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

- Description of the CQC System Manager's responsibilities and delegation of authority to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities.

- Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off site fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Westinghouse WID Submittal Procedures.

- Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be subject to approval by Westinghouse WID.)

- Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

- Reporting procedures, including proposed reporting formats.

- A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be submitted to Westinghouse WID for approval.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Owner reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify Westinghouse WID in writing of any proposed change. Proposed changes are subject to acceptance by Westinghouse WID.

3.3 Quality Control Organization

3.3.1 General

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel supplemented by independent testing and inspection firms as required by the specifications, to ensure contract compliance. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by Westinghouse WID.

3.3.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, with a minimum of five years construction experience on construction similar to this contract. This CQC System Manager will be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate will be the same as for the designated CQC System Manager.

3.3.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel or third party inspectors to assist the CQC System Manager. These individuals shall be employed by the prime Contractor; be

responsible to the CQC System Manager; have the necessary education and/or experience. These individuals shall have no other duties other than quality control.

3.3.4 Organizational Changes

The Contractor shall maintain his CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to Westinghouse WID for acceptance at the Contractors' expense.

3.4 Tests

3.4.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to Westinghouse WID duplicate samples of test specimens for possible testing by Westinghouse WID. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of an approved testing laboratory. The Contractor shall perform the following activities and record and provide the following data:

- Verify that testing procedures comply with contract requirements.
- Verify that facilities and testing equipment are available and comply with testing standards.
- Check test instrument calibration data against certified standards.
- Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- Results of all tests taken, both passing and failing tests, will be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by Westinghouse WID, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an off site or commercial test facility will be provided directly to Westinghouse WID. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.5 Testing Laboratory

The testing laboratory shall provide qualified personnel to perform specified sampling and testing of products in accordance with specified standards, and ascertain compliance of materials and mixes with requirements of Contract Documents. The testing laboratory shall promptly notify Westinghouse WID and Contractor of any observed irregularities or non-conformance of Work or Products.

Reports indicating results of tests, and compliance (or noncompliance) with the contract documents will be submitted in accordance with Westinghouse WID submittal procedures.

The Contractor shall cooperate with the independent testing firm, furnish samples, storage, safe access, and assistance by incidental labor as required. Testing by the independent firm does not relieve the contractor of the responsibility to perform the work to the contract requirements.

The laboratory may not:

- Release, revoke, alter, or enlarge on requirements of the contract
- Approve or accept any portion of the work
- Assume any duties of the Contractor.

The laboratory has no authority to stop the work.

3.6 Inspection Services

The inspection firm shall provide qualified personnel at site to supplement the Contractor's Quality Control Program to perform specified inspection of Products in accordance with specified standards. He shall ascertain compliance of materials and mixes with requirements of Contract Documents, and promptly notify the CQC System Manager, Westinghouse WID and the Contractor of observed irregularities or non-conformance of Work or Products. The inspector does not have the authority to stop the work. The inspector shall refer such cases to the CQC System Manager who has the authority to stop work (see Section 3.2.2).

Reports indicating results of the inspection and compliance (or noncompliance) with the contract documents will be submitted in accordance with Westinghouse WID submittal procedures.

The Contractor shall cooperate with the independent inspection firm, furnish samples, storage, safe access and assistance by incidental labor, as requested.

Inspection by the independent firm does not relieve the Contractor of the responsibility to perform the work to the contract requirements.

3.7 Completion Inspection

3.7.1 Pre-Final Inspection

At the completion of all work the CQC System Manager shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Once this is accomplished the Contractor shall notify Westinghouse WID that the facility is complete and is ready for the "Prefinal" inspection. Westinghouse WID will perform this inspection to verify that the facility is complete. A "Final Punch List" will be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure

that all items on this list have been corrected and notify Westinghouse WID so that a "Final" inspection can be scheduled. Any items noted on the "Final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph will be accomplished within the time slated for completion of the entire work.

3.7.2 Final Acceptance Inspection

The final acceptance inspection will be formally scheduled by Westinghouse WID based upon notice from the Contractor. This notice will be given to Westinghouse WID at least 14 days prior to the final acceptance inspection and must include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection.

3.8 Documentation

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- Contractor/subcontractor and their area of responsibility.
- Operating plant/equipment with hours worked, idle, or down for repair.
- Work performed each day, giving location, description, and by whom.
- Test and/or quality control activities performed with results and references to specifications/drawings requirements. List deficiencies noted along with corrective action.
- Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- Submittals reviewed, with contract reference, by whom, and action taken.
- Off-site surveillance activities, including actions taken.
- Instructions given/received and conflicts in plans and/or specifications.
- Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to Westinghouse

WID daily. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.9 Notification of Noncompliance

Westinghouse WID will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the worksite, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, Westinghouse WID may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

End of section.

SECTION 01400
CONTRACTOR QUALITY CONTROL

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.1 Scope
This section includes:

- Equipment
- Products
- Transportation and handling
- Storage and protection
- Substitutions

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 02010 - Mobilization and Demobilization
- 02222 - Excavation
- 02722 - Grouting
- 03100 - Concrete Formwork
- 03300 - Cast-in-Place Concrete
- 04100 - Mortar
- 04300 - Unit Masonry System

1.3 Equipment
The Contractor shall specify his proposed equipment in the Work Plan. Power equipment for use underground shall be either electrical or diesel engine driven. All diesel engine equipment shall be certified for use underground.

1.4 Products
The Contractor shall specify in the Work Plan, or in subsequently required submittals the proposed products including, but not limited to the grout mix and its components, concrete mix and its components, mortar mix and its components, formwork, and masonry. The proposed products shall be supported by laboratory test results as required by the specifications. All products shall be subject to approval by Westinghouse WID.

1.5 Transportation and Handling

- Transport and handle products in accordance with manufacturer's instructions.
- Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.6 Storage and Protection

- Store and protect products in accordance with manufacturers' instructions.
- Store with seals and labels intact and legible.
- Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- For exterior storage of fabricated products, place on sloped supports above ground.
- Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.7 Substitutions

1.7.1 Equipment Substitutions

The Contractor may substitute equipment for that proposed in the Work Plan subject to Westinghouse WID's approval. The Contractor shall demonstrate the need for the substitution, and the applicability of the proposed substitute equipment.

1.7.2 Product Substitutions

The Contractor may not substitute products after the proposed products have been approved by Westinghouse WID unless he can demonstrate that the supplier/source of that product no longer exists in which case he shall submit alternate products with lab test results to

Westinghouse WID for approval. In the case that product is a component in a mix, the Contractor shall perform mix testing using that component and submit laboratory test results.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

End of section.

SECTION 01600
MATERIAL AND EQUIPMENT

SECTION 02010

MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.1 Scope
This section includes:

- Mobilization of equipment and facilities to site
- Contractor use of site
- Use of existing facilities
- Demobilization of equipment and facilities
- Site cleanup

1.2 Related Sections

- 01010 - Summary of Work
- 01600 - Material and Equipment

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 Mobilization of Equipment and Facilities to Site
Upon authorization to proceed, the Contractor shall mobilize his equipment and facilities to the jobsite. Equipment and facilities shall be as specified, and as defined in the Contractor's Work Plan. The Contractor shall erect the batch plant and assemble his equipment and materials in the areas designated by Westinghouse WID. Facilities shall be located as near as practical to the existing utilities.

Westinghouse WID will provide utilities (460 volt AC, 3 phase, and water) at designated locations. The Contractor shall be responsible for all hookups and tie-ins required for his operations.

The Contractor shall be responsible for providing his own office, storage, and sanitary facilities.

Areas will be designated for the Contractor's use in the underground area in the vicinity of the panel closure system installation. These areas are limited.

3.2 Use of Site

The Contractor shall use only those areas specifically designated for his use by Westinghouse WID. The Contractor shall limit his on-site travel to the specific routes required for performance of his work, and designated by Westinghouse WID.

3.3 Use of Existing Facilities

Existing facilities at the site which are available for use by the Contractor are:

- WIPP roadheader
- Waste shaft conveyance
- Salt skip hoist
- (1) 20 ton forklift
- (1) 40-ton forklift
- 460 Volt AC, 3 phase power
- Water (in mine, at waste shaft only-above ground at location designated by Westinghouse WID).

The Contractor shall arrange for use of the facilities with Westinghouse WID and coordinate his actions/requirements with that of the ongoing operations.

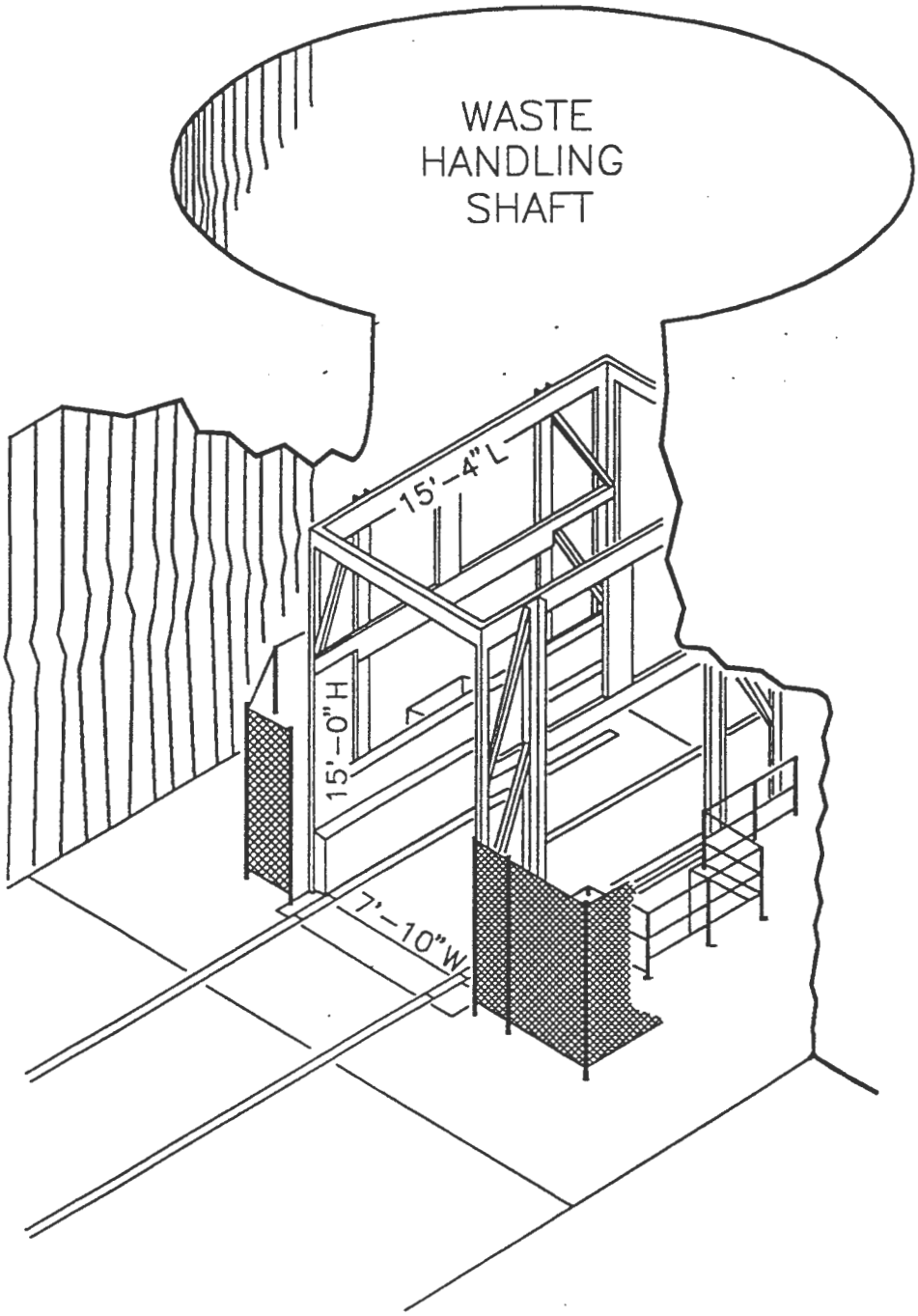
Use of water in the underground will be restricted. No washout or cleanup will be permitted in the underground. Above ground washout/cleanup or equipment will be allowed in the areas designated by Westinghouse WID.

The Contractor is cautioned to be aware of the physical dimensions of the waste conveyance and the air lock (see Figures 2 and 3, attached).

The Contractor shall be responsible for any damage incurred by the existing site facilities as a result of his operations. Any damage shall be reported immediately to Westinghouse WID and repaired at the Contractor's cost.

3.4 Demobilization of Equipment and Facilities

At completion of this work, the Contractor shall demobilize his equipment and facilities from the job site. The batch plant shall be disassembled and removed along with any unused material. All Contractor's equipment and materials shall be removed from the mine and all disturbed areas restored. Utilities shall be removed to their connection points unless otherwise directed by Westinghouse WID.



NOTES

(1) CAGE DIMENSIONS SHOWN ARE INSIDE.

(2) WASTE HOIST DESIGN CAPACITY IS 80,000 LBS.

Figure 2

Waste Handling Shaft Cage Dimensions

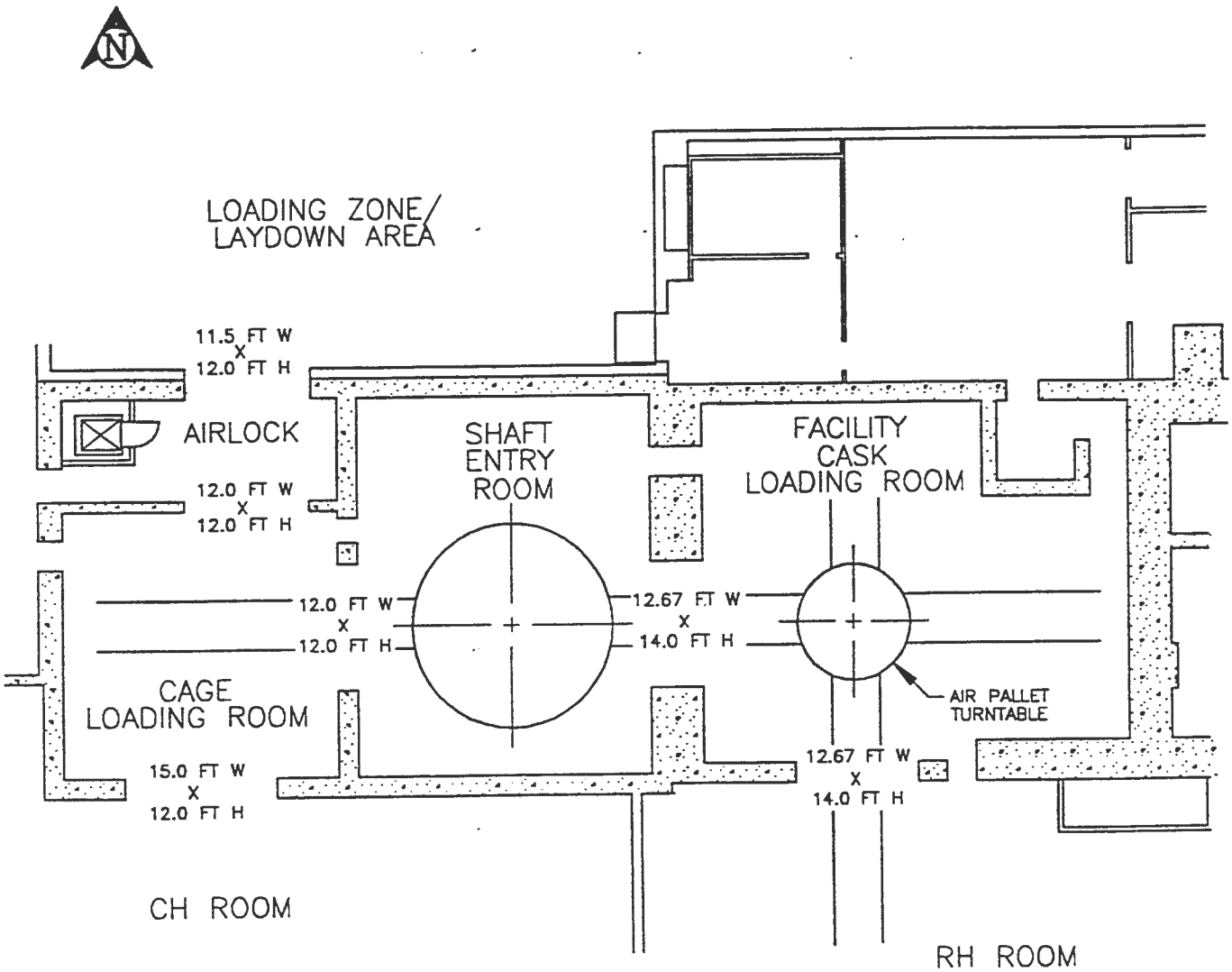


Figure 3

Waste Shaft Collar and Airlock Arrangement

3.5 Site Cleanup

At conclusion of the work, the Contractor shall remove all trash, waste, debris, excess construction materials, and restore the affected areas to its prior condition, to the satisfaction of Westinghouse WID. A final inspection of the areas will be conducted by Westinghouse WID and the Contractor before final payment is approved.

End of section.

SECTION 02010
MOBILIZATION AND DEMOBILIZATION

SECTION 02222

EXCAVATION

PART 1 - GENERAL

1.1 Scope
This section includes:

- Excavation for main concrete barrier
- Excavation for surface preparation and levelling of base areas for isolation walls
- Disposition of excavated materials.

1.2 Related Sections

- 01010 - Summary of Work
- 01600 - Material and Equipment
- 03100 - Concrete Form Work
- 04300 - Unit Masonry System.

1.3 Reference Documents
"Reference Stratigraphy and Rock Properties for the Waste Isolation Pilot Plant (WIPP) Project" by R.D. Krieg-Sandia National Laboratory Document Sand 83-1908. [Available through National Technical Information Service (NTIS).]

1.4 Field Measurements and Survey
All survey required for performance of the work will be provided by Westinghouse WID. To develop the concrete formwork to fit the excavation, the Contractor shall be responsible for verifying the excavation dimensions.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 Excavating for Concrete Barrier
Excavation for the main concrete barrier shall be performed to the lines and grades shown on the drawings. Excavate the back a minimum of 1 inch to 3 inches beyond clay seam G, and the floor a minimum of 1 inch to 3 inches below the anhydride marker bed 139 (MB-139) to

assure removal of the disturbed rock zone (DRZ). Excavation shall be performed utilizing mechanical means such as a cutting head on a suitable boom, by drilling boreholes and using an expansive agent to fragment the rock or other competent equipment or methods submitted to Westinghouse WID for review and approval. The use of explosives is prohibited. The existing WIPP roadheader mining machine may also be available for use. The Contractor is to determine availability and coordinate proposed use of the roadheader with Westinghouse WID. The existing roadheader is capable of excavating the back and the portions of the ribs above the floor level. However, it is not capable of excavating the portion below floor level.

The tolerances for the concrete barrier excavation shall be +6 inches, to 0 inch. In addition, the Contractor is to remove all loose or spalling rock from the excavation surface to provide a sound surface abutting the concrete barrier. The Contractor shall provide and install roof bolts for support as required for personnel protection and approved ground control plans.

3.2 Excavating for Surface Preparation and leveling of Base Areas for Isolation Walls

The Contractor shall excavate a 6-inch surface preparation around the entire perimeter of the isolation walls. The surface preparation in the floor shall be made level to produce a surface for placing the first course of block in the isolation walls. Tolerances for the leveled portion of the surface preparation are ±1 inch. Excavation may be performed by either mechanical or manual means. Use of explosives is prohibited.

3.3 Disposition of Excavated Materials

The Contractor shall remove all excavated materials from the panel-access drift where they are excavated. Excavated materials shall be removed from the mine via the salt skip to the surface, where they will be disposed on site at a location as directed by Westinghouse WID.

3.4 Field Measurements and Survey

All survey required for performance of the work will be provided by Westinghouse WID. The Contractor shall protect all survey control points, bench marks, etc., from damage by his operations. WID will verify by survey that the Contractor has excavated to the required lines and grades. The Contractor shall be responsible for verifying the excavation dimensions to develop concrete formwork to fit the excavation. No form work or block work is to be erected until this survey is completed. The Contractor is to coordinate the survey work with his operations to assure against lost time. The Contractor shall notify Westinghouse WID at least 24 hours prior to the time surveying is required

End of section.

SECTION 02222
EXCAVATION

SECTION 02722

GROUTING

PART 1 - GENERAL

1.1 Scope

This section includes:

- Grouting of concrete barrier.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 03100 - Concrete Form Work
- 03300 - Cast-in-Place Concrete

1.3 References

ASTM C1107-91a Standard Specification for Dry, Hydraulic Cement Grout (Nonshrink)

ASTM C109/ C109M-95 Test Method for Compressive Strength of Hydraulic Cement Mortars

1.4 Submittals for Review and Approval

Thirty days prior to the initiation of grouting, the Contractor shall submit to Westinghouse WID for review and approval, the following:

- Type of grout proposed

- Product data:

  - Manufacturer's specification and certified laboratory tests for the manufactured grout, if proposed

  - Certified laboratory tests for the salt-saturated grout, if proposed, using project-specific materials

- Proposed grouting method, including equipment and materials and construction sequence in Work Plan.

1.5 Submittals for Construction

Daily grouting report indicating the day, date, time of mixing and delivery, quantity of grout placed, water used, pressure required, problems encountered, action taken, quality control data, testing results, etc., no later than 24 hours following construction.

PART 2 - PRODUCTS

2.1 Grout Materials

Grout used for grouting in connection with fresh water/plain cement concrete shall be nonshrink, cement-based grout, Five Star 110 as manufactured by Five Star Products Inc., 425 Stillson Road, Fairfield, Connecticut 06430 or approved equal. Mixing and installation shall be in accordance with the manufacturer's recommendations.

As an alternate to the above grout, in connection with the Salado Mass concrete mix, the Contractor shall use, subject to the approval of Westinghouse WID, a salt saturated grout. The following formulation is suggested to the Contractor as an initiation point for selection of the grout mix. Salt saturated grout strength shall be 4500 psi at 28 days.

Salt-Saturated Grout (BCT-1F)

Component	Percent of total Mass (wt.)
Class H cement	48.3
Class C fly ash	16.2
Cal Seal (plaster - from Halliburton)	5.7
Sodium chloride	7.9
Dispersant	0.78
Defoamer	0.02
Water	21.1

Water for mixing shall be of potable quality, free from injurious amounts of oil, acid, alkali, salt, or organic matter, sediments, or other deleterious substances, as specified for concrete, Section 03300-2.3.

2.2 Product Data

If the Contractor proposes to utilize a manufactured nonshrink cement-based grout, he shall submit complete manufacturer's specifications for the product, along with certified laboratory test results of the material.

If the Contractor proposes to utilize the salt-saturated grout in connection with the Salado Mass concrete mix, he shall submit manufacturer's/supplier's specifications for the component materials, and certified laboratory test results for the resultant mix.

PART 3 - EXECUTION

3.1 General

The Contractor shall furnish all labor material, equipment, and tools to perform all operations in connection with the grouting.

Grout delivery and return lines for interface grouting shall be installed in the form work or in the area to be grouted to provide uniform distribution of the grout as shown on the drawings. The exact location of the boxes and lines shall be determined in the field. Additional grout delivery and return lines and boxes may be required by Westinghouse WID.

Pumps shall be positive displacement piston type pump designed for grouting service capable of operating at a discharge pressure of 100 psi. The Contractor shall supply a standby pump to be utilized in the event of a breakdown of the primary unit.

Mixers shall be high velocity "colloidal" type with a rotary speed of 1,200 to 1,500 rpm. Grout shall be mixed to a pumpable mix as per the manufacturer's recommendations.

Mixing water shall be accurately metered to control the consistency of the grout.

The Contractor shall provide all necessary valves, gages, and pressure hoses.

Water for mixing is available at the waste shaft. The Contractor is cautioned that <u>no free water discharges or spills are permitted</u> in the mine. All cleanup and washout operations shall be performed at the ground surface.

Potential spill areas in the underground shall be identified by the Contractor in the work plan. The Contractor shall provide measures to contain suitable containment. Isolation measures shall include, but are not limited to, lining with a membrane material (PVC, hypalon, HDPE), draped curtains (polyethylene,PVC, etc.), corrugated sheet metal protective walls or a combination of these and other measures.

If salt-saturated grout is selected for use, the Contractor shall make provisions to accurately proportion the components. Proportioning shall be by weighing. Sufficient quantities of dry

components shall be developed prior to initiation of the grouting to perform the work so as not to incur delays during the mixing/placing sequence.

3.2 Interface Grouting of Concrete Barrier

After each cell of the concrete barrier has been allowed to cure for a period of seven days, or as directed by Westinghouse WID, the Contractor shall interface grout the remaining space between the back wall and the top surface of the concrete barrier.

Each cell of the concrete barrier shall be grouted before the next adjacent cell is formed and concrete placed. Grout delivery and return lines shall be installed with the form work as shown and called for on the drawings, or as directed by Westinghouse WID.

The placing of grout, unless otherwise directed by Westinghouse WID shall be continuous until completed. Grouting shall progress from lower to higher grout pipes. Grouting shall proceed through a single delivery line until grout escapes from the adjacent return line. The Contractor shall then secure these lines and move to the next adjacent set of delivery and return lines. Pressure shall be adjusted to adequately deliver the grout to the forms, as witnessed by grout in the return line.

The grouting operation shall be conducted in a manner such that it does not affect the stability of the concrete barrier structure.

3.3 Contact Grouting

After completion of interface grouting if directed by Westinghouse WID, the Contractor shall contact grout to fill any remaining voids at the concrete barrier/back wall interface. Contact grouting includes all operations to drill, clean, and grout holes installed in the concrete barrier.

The Contractor shall drill and grout the interface zone to the main concrete barrier as directed by Westinghouse WID.

The location, direction, and depth of each grout hole shall be as directed by Westinghouse WID. The order in which the holes are drilled and the manner in which each hole is drilled and grouted, the proportions of the water used in the grout, the time of grouting, the pressures used in grouting, and all other details of the grouting operations shall be as directed by Westinghouse WID.

Wherever required, contact grouting will entail drilling the hole to a limited depth, installing a packer, and performing grouting.

3.3.1 Drilling

The holes shall be drilled with rotary-type drills. Drilling grout holes with percussion-type drills will not be permitted except as approved by Westinghouse WID.

The requirements as to location, depth, spacing, and direction of the holes shall be as directed by Westinghouse WID.

The minimum diameter shall be approximately 11/2 inches.

When the drilling of each hole or stage of has been completed, compressed air will be used to flush out drill cuttings. The hole shall then be temporarily capped or otherwise suitably protected to prevent the hole from becoming clogged or obstructed until it is grouted.

3.3.2 Materials for Contact Grouting

Standard weight black steel pipe conforming to ASTM A-53 shall be set in the concrete in the locations as directed by Westinghouse WID. All pipe and fittings shall be furnished by the Contractor.

The size of the grout pipe for each hole and the depth of the holes for setting pipe for grouting shall be as directed by Westinghouse WID. Care shall be taken to avoid clogging or obstructing the pipes before being grouted, and any pipe that becomes clogged or obstructed from any cause shall be cleaned satisfactorily or replaced.

The packers shall be furnished by the Contractor and shall consist of expansible tubes or rings of rubber, leather, or other suitable material attached to the end of the grout supply pipe. The packers shall be designed so that they can be expanded to seal the drill hole at the specified locations and when expanded shall be capable of withstanding without leakage, for a period of 5 minutes, air pressure equal to the maximum grout pressures to be used.

3.3.3 Grouting Procedures

Different grouting pressures will be required for grouting different sections of the grout holes. Pressures as high as necessary to deliver the grout but which, as determined by trial, are safe against concrete displacement shall be used in the grouting.

If, during the grouting of any hole, grout is found to flow from adjacent grout holes or connections in sufficient quantity to interfere seriously with the grouting operation or to cause appreciable loss of grout, such grout holes and connections shall be capped temporarily. Where such capping is not essential, holes shall be left open to facilitate the escape of air as the grout is forced into other holes. Before the grout has set, the grout pump shall be connected to adjacent capped holes and to other holes from which grout flow was observed, and grouting of all holes shall be completed. If during the grouting of any hole, grout is found to flow from points in the barrier, any parts of the concrete structure, or other locations, such flows or leaks shall be plugged or caulked by the Contractor as directed by Westinghouse WID.

As a safeguard against concrete displacement, excessive grout travel, or while grout leaks are being caulked, Westinghouse WID may require the reduction of the pumping pressure, intermittent pumping, or the discontinuance of pumping.

The consistency of the grout mix shall be varied, as directed by Westinghouse WID, depending on the conditions encountered. Where the grout hole or connection continues to take a large amount of grout after the mix has been thickened, Westinghouse WID may require that pumping be done intermittently, waiting up to 8 hours between pumping periods to allow grout in the barrier to set. After the grouting is complete, the pressure shall be maintained by means of stopcocks, or other suitable valve that it will be retained in the holes or connections being grouted.

3.4 Cleanup

No clean-up or washing of equipment with water is allowed in the underground. No free water spills are permitted. All clean out or wash out requiring water will be performed above ground at the location approved by Westinghouse WID. See note above regarding potential spill areas in Section 3.1 - General.

3.5 Quality Control

The Contractor shall provide a third-party quality control inspector at the site throughout the grout placement operations. The inspector shall determine that the grout mix is properly proportioned and properly mixed to the approved consistency. The inspector shall sample and make one set of grout cubes for compression testing for every 50 cubic feet of grout placed, or fraction thereof, for each day of grout placement.

End of section.

SECTION 02722
GROUTING

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 Scope

This section includes:

- Formwork for cast-in-place concrete with shoring, bracing, and anchorage
- Accessory items, grout pipes, concrete delivery pipes.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 02722 - Grouting
- 03300 - Cast-in-Place Concrete
- 04300 - Unit Masonry System

1.3 References

ACI 301-89	Specifications for Structural Concrete for Buildings
ACI 318-89(92)	Building Code Requirements for Reinforced Concrete
ACI 347-94	Recommended Practice for Concrete Formwork
ASTM A-36/ A36M-91	Standard Specification for Structural Steel
ASTM A-53-90b	Standard Specification for Pipe, Steel, Black, and Hot-Dipped Zinc Coated Welded and Seamless
ASTM A-325-91c	Standard Specification for Structural Bolts, Steel, Heat-Treated 120/105 ksi Minimum Tensile Strength
ASTM A-615-95b	Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AWS A3.0-94	Welding Terms and Definitions

AWS A5.1-91	Specification for Mild Steel Covered Arc Welding Electrodes
AWS D1.1-94	Structural Welding Code-Steel
AISC	Manual of Steel Construction Latest Edition

1.4 Submittals

The Contractor shall submit the following supporting documentation for the adequacy of the formwork 30 days prior to initiation of work at site:

- Shop detail drawings with appropriate calculations to support the adequacy of the formwork.
- Mill test certification of materials utilized in construction of the forms.
- Details of installation contained in the Contractor's Work Plan.

1.5 Quality Assurance

The design and detail of the formwork shall be conducted under direct supervision of a professional structural Engineer experienced in design of this work. Responsibilities include:

- Fabricating formwork in accordance with AISC manual of steel construction.
- Performing all welding in accordance with AWS D1.1 structural welding code.
- Performing all bolting in accordance with AISC specification for structural joints using ASTM A325 or A490 bolts.
- Performing work in accordance with ACI 301, 318, and 347, AISC and AWS standards. Maintain one copy of all standards at site.

PART 2 - PRODUCTS

2.1 Form Materials

Forms for the concrete barrier shall be constructed of ASTM A-36 steel.

Pipe inserts shall be ASTM A-53 black standard weight pipe.

Form spacers shall be ASTM A-36 round stock.

Bolts shall be ASTM A325 high strength structural bolts.

Grout pipes shall be ASTM A-53 standard weight pipe or flex conduit as shown on the drawings.

Rock anchors shall develop strength equal to or greater than ASTM A-36 round stock.

Welding electrodes shall conform to AWS A5.1.

PART 3 - EXECUTION

3.1 General

The Contractor shall furnish all labor material equipment and tools to perform all operations in connection with the design, detail, fabrication and erection of the formwork and the fabrication and installation of grout pipes for the main concrete barrier. All work shall be performed according to standards referred to in Paragraph 1.3.

The Contractor may, at his option submit an alternate design or modify the design shown on the drawings, subject to the approval of Westinghouse WID. All designs must be supported by design calculations stamped and sealed by a registered professional engineer.

The Contractor shall furnish, fabricate and install all grout pipes and grout boxes for both the concrete barrier and the isolation walls.

3.2 Shop Drawings

The Contractor shall design and detail all formwork for the concrete barrier, complete with any required bracing and shoring for the concrete barrier as shown on the drawings, in accordance with ACI 318 and 347 and the AISC manual of steel construction.

The details shall incorporate provision for adjusting and modifying the formwork to suit the excavation. Excavation tolerances are given in Section 02222 Excavation.

The Contractor shall be responsible for verifying the excavation dimensions to develop the concrete formwork to fit the excavation.

Prior to fabrication, the Contractor shall submit shop drawings complete with supporting calculations for review/approval by Westinghouse WID 30 days prior to initiating work. The contractor shall incorporate all Westinghouse WID's comments, revisions, resolve all questions and resubmit drawings for final approval prior to proceeding with fabrication.

3.3 Fabrication

The Contractor shall fabricate all formwork and ancillary items in accordance with the latest edition of the AISC Manual of Steel Construction and the approved detail drawings.

Formwork shall contain all inserts for grouting and pumping concrete. Sufficient valving shall be provided on inserts to allow shut off of concrete and grout to prevent back flow through the form work.

All welding shall be in accordance with AWS D1.1 structural welding code including operator and procedure certifications. Elements shall be welded using E-7018 low hydrogen electrodes. Panels shall be piece marked to correspond to the erection drawing(s) and sequence at fabrication.

3.4 Installation

3.4.1 Grout Pipes

The Contractor shall furnish, fabricate, and install all grout pipes and boxes as approved by Westinghouse WID. Grout pipes and boxes shall be attached to the back surface using masonry anchors as shown on the drawings or other approved methods. Grout pipes shall be connected to the inserts installed in the permanent forms and securely fastened to the formwork. All grout pipes will be blown out with compressed air after installation and prior to closure of the formwork to assure they are clean and free from debris or obstructions. Grout pipes shall then be temporarily capped to prevent entry of foreign matter until ready for grouting. The Contractor shall apply masking tape to the grout box openings to prevent concrete infiltration during concrete placement.

3.4.2 Formwork

The steel formwork for the concrete barrier is to remain in place at completion of each segment of the barrier, therefore all formwork shall be free from oil, grease, rust, dirt, mud or other material that would prevent bonding by the concrete. Forms will not be oiled or receive application of release agent.

The Contractor shall install formwork at the locations shown on the drawings to the lines and grades shown. Forms are to be mortar tight. The Contractor shall adjust the formwork to suit the contour of the excavation. Rock may be trimmed or chipped to suit where interferences are encountered. Where overexcavation has occurred in excess of the designed-in adjustability of the formwork, modifications shall be proposed to Westinghouse WID for his approval prior to installation. Installation of the formwork shall be reviewed and approved by Westinghouse WID prior to proceeding with concrete installation.

The Contractor shall provide a sealant or gasket material subject to the approval of Westinghouse WID.

3.5 Quality Control

The Contractor shall arrange for and contract with an approved third party inspector to provide inspection/testing services for the fabrication and installation of the formwork and ancillary items, as required by the QA/QC plan.

The Contractor shall furnish certified mill test reports for all materials utilized in the fabrication.

All welding shall be in accordance with AWS D1.1 structural welding code. The Contractor shall furnish welding operator and procedure certifications for all operators and procedures utilized.

Fabricated components shall be inspected for dimension and overall quality. Welds shall be inspected by an AWS certified welding inspector.

The inspector shall visually inspect the installation for fit-up and dimensionally for location.

3.6 Handling, Shipping, Storage

The Contractor shall handle, ship, and store fabricated components with care to avoid damage. Stored components shall be placed on timbers or pallets off the ground to keep the units clean. Components shall be tarped while in outdoor storage. Components that become spattered or contaminated with mud will be thoroughly cleaned during erection, and prior to concrete emplacement. Damaged components will be rejected by the inspector and replaced by the contractor at his cost.

End of section.

SECTION 03100
CONCRETE FORMWORK

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 Scope

This section includes:

- Cast-in-place concrete for concrete barrier
- Concrete mix design.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 02222 - Excavation
- 02722 - Grouting
- 03100 - Concrete Formwork

1.3 References

ACI 211.1-91	Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete
ACI 318.1-89(92)	Building Code Requirements for Structural Plain Concrete
ACI 304R-89	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ASTM C 33-93	Standard Specification for Concrete Aggregates
ASTM C 39-94	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94-94	Standard Specification for Ready-Mixed Concrete
ASTM C 136-95a	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143-90a	Standard Specification for Slump of Hydraulic Cement Concrete

ASTM C 150-95	Standard Specification for Portland Cement
ASTM C 186-94	Standard Test Method for Heat of Hydration of Hydraulic Cement
ASTM C 403/ C 403M-95	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 494-95	Standard Specification for Chemical Admixtures for Concrete
ASTM C 618-94a	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolam for Use as an Admixutre in Portland Cement Concrete
ASTM C 845-90	Standard Specification for Expansivce Hydraulic Cement
ASTM D 2216-92	Standard Test Method for Laboratory Determination of Water (moisture) Content of Soil and Rock
USACE CRD-C 36	Method of Test for Thermal Diffusivity of Concrete
USACE CRD-C 48	Standard Test Method for Water Permeability of Concrete
API 10	Cements
NRMCA	Check List for Certification of Ready Mixed Concrete Production Facilities
NRMCA	Concrete Plant Standards

Westinghouse WID Standards

WIPP-DOE-71	Design Criteria Waste Isolation Pilot Plant, Revised Mission Concept -- IIA (DOE, 1984)
WP 03-1	WIPP Startup and Acceptance Test Program (Westinghouse, 1993b)
WP 09-010	Design Development Testing (Westinghouse, 1991)
WP 09-CN3021	Component Numbering (Westinghouse, 1994a)
WP 09-024	Configuration Management Board/Engineering Change Proposal (ECP) (Westinghouse, 1994b)

1.4 Submittals for Review/Approval

The Contractor shall submit the following for approval 30 days prior to initiating any work at the site:

Type of concrete proposed

Product Data - Laboratory test data and trial mix data for the proposed concrete to be utilized for the concrete barrier.

Proposed method of installation, including equipment and materials in work plan.

1.5 Submittals at Completion

Laboratory test data developed during the installation of the concrete barrier.

1.6 Quality Assurance

Perform work in accordance with the Contractor's Quality Control Plan and referenced ACI and ASTM standards.

Acquire cement, aggregate and component materials from the same source throughout the work.

PART 2 - PRODUCTS

2.1 Cement

Portland cement shall conform to ASTM C150 Type II modified with Pozzolan or IV for plain cement concrete or API 10 Class H oil well cements. Cement utilized in the mix shall be Portland cement, Type II modified with pozzolan or type IV, to limit the heat of hydration of the resultant mix. The source of the cement to be used shall be indicated and manufacturer's certification that the cement complies to the applicable standard shall be provided with each shipment.

2.2 Aggregates

Aggregates shall be quartz aggregates conforming to the requirements of ASTM C33.

Fine aggregate shall meet the requirements of ASTM C33 having a fineness modulus in the range of 2.80 to 3.00.

Coarse aggregate maximum size shall be 1 1/2 inches and shall be clean, cubical, angular, 100 percent crushed aggregate without flat or elongated particles.

The source of the aggregate is to be indicated and test reports certifying that the aggregate complies with the applicable standard are to be submitted for approval with the trial mix data.

2.3 Water

Water used in mixing concrete shall be of potable quality, free of injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

Water shall conform to the provisions in ASTM C94, and in addition, shall conform to the following:

- pH not less 6.0 or greater than 8.0
- Carbonates and/or bicarbonates of sodium and potassium: 1000 ppm maximum
- Chloride ions (C1): 250 ppm maximum
- Sulfate ions (SO_4): 1000 ppm maximum
- Iron content: 0.3 ppm maximum
- Total solids: 2000 ppm maximum

When ice is used in concrete mix, the water used for making ice shall meet all of the above requirements.

The source of water is to be indicated and certified copies of test data from an approved laboratory confirming that the water to be used meets the above requirements shall be submitted for approval with the trial mix data.

2.4 Admixtures

Pozzolan shall conform to ASTM C618. Sampling and testing of pozzolans shall conform to ASTM C311. Approximately 5 percent by weight of pozzolan may be used to replace cement in the mixes when approved.

All admixtures shall conform to ASTM C-494. The source of any admixtures proposed are to be indicated and certified copies of test data from an approved laboratory shall be submitted for approval with the trial mix.

2.5 Target Properties of the Concrete Mix

The Contractor shall develop and proportion a plain cement concrete mix for use in constructing the concrete barrier. The Contractor shall demonstrate by trial mix that the proposed concrete meets the following properties:

Target properties for Barrier Concrete

Property	Comment
4-hr working time	Indicated by 8-inch slump (ASTM C 142) after 3-hr intermittent mixing. Max 10-inch slump at mixing.
Less than 25 °F heat rise prior to placement	Difference between initial condition and temperature after 4 hr.
4,000 psi compressive strength (f'_c)	At 28 days after casting (ASTM C 39)
Volume stability	Length change between +0.05 percent and -0.02 percent (ASTM C 490)
Minimal entrained air	2 percent to 3 percent air

The Contractor shall use water reducing agents, plasticizers and other admixtures to achieve the slump and workability of the mix without adding excessive mixing water or excessive water-cement ratio. All admixtures shall conform to ASTM C-294.

The Contractor shall provide certified copies of test data from an approved laboratory demonstrating compliance with the above target properties.

In addition to the target properties the Contractor shall provide certified test data for the trial mix for the following properties:

- Heat of hydration ASTM C-186
- Concrete Set ASTM C-403
- Thermal Diffusivity USACE CRD-C36
- Water Permeability USACE CRD-C43

2.6 Salado Mass Concrete

The Contractor may elect to utilize the Salado Mass concrete in preference to developing a plain cement concrete. If Salado Mass concrete is selected, the Contractor shall demonstrate that the Salado Mass concrete meets the target properties shown above. Recommended initial proportioning of the Salado Mass concrete is as follows:

Component	Percent of Total Mass
Class H cement (API 10)	4.93
Chem Comp III (ASTM C-845 Type K)	2.85
Class F fly ash (ASTM C-618)	6.82
Fine aggregate	33.58
Coarse aggregate	43.02
Sodium chloride	2.18
Defoaming agent	0.15
Sodium citrate	0.09
Water	6.38

The Contractor shall prepare a trial mix and provide certified test data from an approved testing laboratory for slump, compressive strength, heat rise, heat of hydration, concrete set time, thermal diffusivity, and water permeability as indicated above for the plain concrete mix.

PART 3 - EXECUTION

3.1 General

The Contractor shall provide all labor material, equipment and tools necessary to develop, supply, mix, transport and place mass concrete in the forms as shown on the drawings and called for in these specifications. All work shall be according to the standard references in paragraph 1.3.

The Contractor will be required to provide and erect on the site a batch plant, suitable to store, handle, weight and deliver the proposed concrete mix. The batch plant shall be certified to NRMCA standards. The batch plant shall be erected on site in the location as directed by Westinghouse WID.

The Contractor shall batch, mix, and deliver to the underground, sufficient quantity of concrete to complete placement of concrete within one form section, as shown on the drawings. Once begun, placement of concrete in a section shall be continuous until completed. Target time for concreting one section is eight to ten hours allowing an additional two hours for clean up of equipment, for a total 10- to 12-hour shift.

It is expected that addition of water to the dry materials and mixing of the concrete will occur at the ground surface with transport of wet concrete to a pump at the underground level where it will be pumped into the forms.

The Contractor is to provide all transport vehicles or means to transfer the wet concrete from the mixer truck to the pump. It is expected that the Contractor will use the waste conveyance hoist to transfer from the ground surface to the mine level. The Contractor is to familiarize himself with the dimensions of the waste conveyance and the airlock in order to provide suitable transport vehicles. The Contractor is also to familiarize himself with the capacity and speed of the conveyance to allow transfer of sufficient concrete to sustain the continuing placement of concrete. (See Figures 2 and 3 attached to Section 02010 - Mobilization and Demobilization).

The Contractor shall determine the horizontal distance to the entry where placement of the concrete barrier is to occur, and develop a route, with the approval of Westinghouse WID for traffic flow within the underground.

Details of the logistics for handling the concrete shall be included in the Contractors' Work Plan, and submitted to Westinghouse WID for approval prior to start of work at the site.

Potential spill areas in the underground shall be identified by the Contractor in the Work Plan. The Contractor shall provide measures to contain and isolate any water from contact with the halite in these areas. Suitable containment isolation measures shall include but are not limited to, lining with a membrane material (PVC, hypalon, HDPE), draped curtains (polyethylene, PVC, etc.), corrugated sheet metal protective walls or a combination of these and other measures.

3.2 Pumping Concrete

The Contractor shall provide pumping equipment suitable for placing the concrete into the forms. The Contractor at a minimum, shall provide an operating and a spare pump, to be used in the event of breakdown of the primary unit. After transporting and prior to pumping the concrete shall be remixed to compensate for segregation of aggregate during transport. The Contractor shall indicate the equipment proposed for pumping (manufacturer, model, type, capacity, pressure and remixing at the point of delivery in the Work Plan).

Each batch of concrete shall be checked at the surface at the time of mixing and again at the point of transfer to the pump for slump and temperature, and shall conform to the following:

- Max. slump at mixing - 10 inches
- Max. slump at delivery to pump - 8 inches
- Max. temperature at placement = 70°F

Note: No water is to be added to the mix after the initial mixing and slump are determined.

The Contractor shall connect to the pipe ports fabricated into the forms for delivery of the concrete, beginning with the lowest ports first. Pumping shall continue until concrete is seen in the adjacent port at which time the delivery hose will be transferred to that port and the first port capped.

Pumping shall continue moving laterally then upward until the entire form is filled and the pour is completed.

3.4 Coordination of Work

The Contractor is to coordinate his work mixing, transporting, and placing the mass concrete with the on-going operations in the underground. Coordination of use of the facilities and existing equipment shall be through Westinghouse WID.

3.5 Clean-Up

No clean up or washing of equipment with water will be allowed in the underground. No free water spills are permitted in the underground. All clean-out or wash-out requiring water will be performed above ground at the location approved by Westinghouse WID.

3.6 Quality Control

The Contractor shall provide a third-party quality control inspector at the site throughout the concrete placement. The inspector shall be responsible for determining that the batch plant is proportioning the mix according to the approved proportions. The batch plant shall provide a print out of batch quantities for each truck delivered to the mine. The inspector shall also determine the slump for each batch as it is mixed and allow additional water to be added until the initial slump is achieved. No additional water is to be added after this time. Temperature will also be recorded at this time.

The inspector shall also determine the slump and temperature following the remixing when concrete is transferred to the pump. Concrete not meeting or exceeding the specification is to be rejected and removed from the underground.

Concrete test cylinders to determine unconfined compression strength shall be taken by the inspection at the delivery from remixer to the pump in the underground. Four (4) cylinders shall be made for each 50 cubic yards of concrete placed. Cylinders shall be sealed with polyethylene and taped and field cured at ambient temperatures in the mine adjacent to the concrete barrier area. Two (2) samples shall be tested at 7 days and the remaining two (2) at 28 days.

End of section.

SECTION 03300
CAST-IN-PLACE CONCRETE

SECTION 04100

MORTAR

PART 1 - GENERAL

1.1 Scope
This section includes:

- Mortar for Isolation Wall Construction.

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment
- 04300 - Unit Masonry System

1.3 References

ASTM C91-95	Standard Specification for Masonry Cement
ASTM C144-93	Standard Specification for Aggregate for Masonry Mortar
ASTM C150-95	Standard Specification for Portland Cement
ASTM C207-91	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270-94	Standard Specification for Mortar for Unit Masonry
ASTM C780-94	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C1142-94	Ready-Mixed Mortar for Unit Masonry
ASTM E447-92	Test Methods for Compressive Strength of Masonry Prisms

1.4 Submittals for Review and Approval
The Contractor shall submit for approval the following 30 days prior to the initiation of work at the site.

Design mix.

Certified laboratory tests for the proposed design mix, indicating conformance of mortar to property requirements of ASTM C270, and test and evaluation reports to ASTM C780.

1.5 Submittals at Completion

Certified laboratory test results for the construction testing of mortar mix.

1.6 Quality Assurance

Perform work in accordance with the Contractor's Quality Control Plan and referenced ASTM standards. Acquire cement, aggregate, and component materials from the same source throughout the work.

1.7 Delivery Storage Handling

Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.

PART 2 - PRODUCTS

2.1 Mortar Mix

The Contractor shall provide mortar for Isolation Walls, which shall be in conformance with ASTM C270 type M, using the property specification (3,000 psi at 28 days).

Sand for mortar shall conform to ASTM C144.

Water used for mixing mortar shall be of potable quality, free of injurious amounts of oil, acid alkali, organic matter, sediments, or other deleterious substances, as specified for Concrete, Section 03300 2.3.

The supply of materials as defined in the design mix shall remain the same throughout the job.

PART 3 - EXECUTION

3.1 General

The Contractor shall furnish all labor material equipment and tools to perform all operations in connection with supplying and mixing mortar for constructing the isolation walls.

The Contractor shall fully describe his proposed mortar mixing operation, including proposed equipment and materials in the Work Plan.

3.2 Mortar Mixing

Mortar shall be machine-mixed with sufficient water to achieve satisfactory workability. Maintain sand uniformly damp immediately before the mixing process. If water is lost by evaporation, retemper only within one and one half hours of mixing. Use mortar within two hours of mixing at ambient temperature of 85° in the mine.

3.3 Installation

The Contractor shall install mortar to the requirements of Section 04300 Unit Masonry System.

3.4 Field Quality Control

The Contractor shall provide a third party Quality Control Inspector to perform all sampling and testing to confirm that the mortar mix conforms to the proposed mix properties developed in the design mix.

Construction testing of mortar mix shall be in accordance with ASTM C780 for compression strength. Four (4) prism specimens shall be taken for each 50 cu. ft. of mortar or fraction thereof placed each day.

End of Section.

SECTION 04100
MORTAR

SECTION 04300

UNIT MASONRY SYSTEM

PART 1 - GENERAL

1.1 Scope
This section includes:

- Concrete Masonry Units

1.2 Related Sections

- 01010 Summary of Work
- 01400 Contractor Quality Control
- 01600 Material and Equipment
- 02722 Grouting
- 03100 Concrete Formwork
- 04100 Mortar

1.3 References

ASTM C55-94a Standard Specification for Concrete Building Brick

ASTM C140-94a Standard Method of Sampling and Testing Concrete Masonry Units

1.4 Submittals for Revision and Approval
The Contractor shall submit for approval the following 30 days prior to initiation of the work at the site.

Certified laboratory test results for the proposed solid masonry units.

1.5 Quality Assurance
Perform the work in accordance with the Contractor's Quality Control Plan.

PART 2 - PRODUCTS

2.1 Concrete Masonry Units
Concrete masonry units shall be solid (no cavities or cores), load bearing high-strength units having a minimum compressive strength of 3500 psi. Concrete masonry units shall be tested

in accordance with ASTM C140. All other aspects of the concrete masonry units shall comply with ASTM C55, Type I Moisture Controlled.

Nominal modular size shall be 8 x 8 x 16 inches, or as otherwise approved by Westinghouse WID.

Concrete brick shall comply with ASTM C55, Grade N, Type I (moisture controlled) having a minimum compressive strength of 3500 psi (Avg. 3 units) or 3000 psi for individual unit.

2.2 Mortar

Mortar shall be as specified in Section 04100 Mortar.

PART 3 - EXECUTION

3.1 General

The Contractor shall furnish all labor, material, equipment and tools to perform all operations of installing Unit Masonry Isolation Walls to the lines and grades shown on the drawings.

The Contractor shall examine the excavation of the entry to affirm that the keys have been properly leveled and cut to the appropriate depths, at the proper locations prior to any to any work.

3.2 Installation

The Contractor shall install the isolation walls using concrete masonry units as specified above. Masonry units shall be installed with 3/8-inch mortar joints with full mortar bedding and full head joints. Masonry units shall be installed in running bond with headers every third course. Masonry units shall be mortared tight to the ribs and the back wall to provide a seal all around the isolation wall.

Concrete brick may be used as required for fit-up around grout pipes, or minimizing the dimensional fit-up at the top or sides of the isolation walls as approved by Westinghouse WID. The interface between the top of the isolation wall and the back wall shall be completely mortared to provide full contact between the back and the block wall.

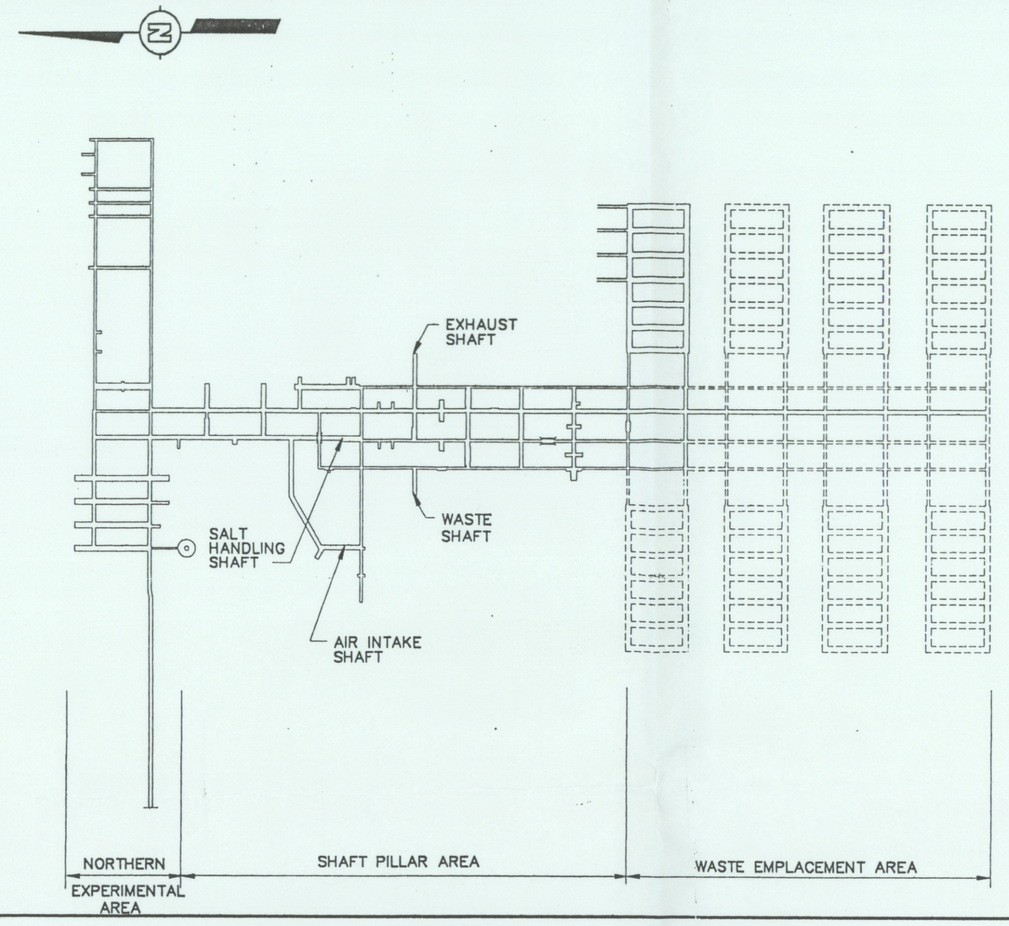
3.3 Field Quality Control

The Contractor shall provide a third-party Quality Control Inspector to inspect the installation of the Concrete Masonry Unit Isolation Walls. Inspection and testing of the mortar shall be in accordance with Section 04100 Mortar.

End of Section

SECTION 04300
UNIT MASONRY SYSTEM

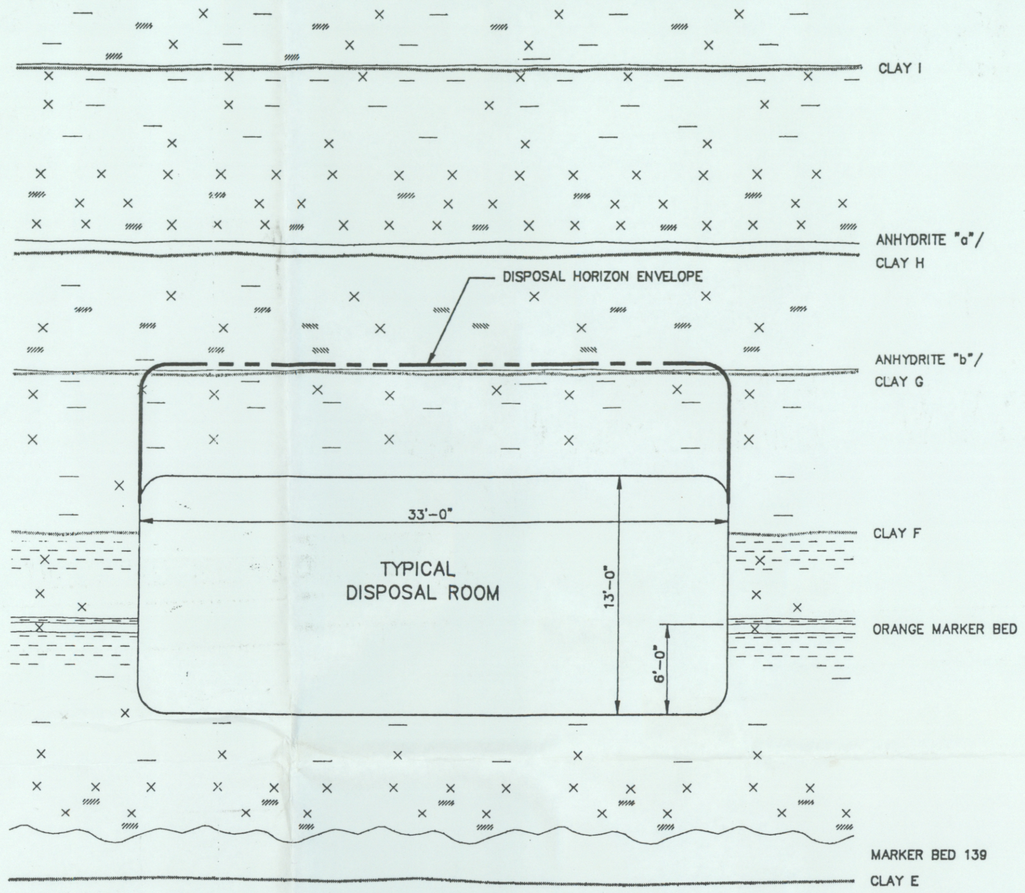
APPENDIX H
DESIGN DRAWINGS



UNDERGROUND REPOSITORY LAYOUT PLAN
NTS

INDEX OF DRAWINGS

DRAWING NO.	TITLE
762447–E1	TITLE SHEET
762447–E2	UNDERGROUND WASTE DISPOSAL PANEL–PLAN
762447–E3	PANEL CLOSURE SYSTEM–AIR INTAKE DRIFT–CONSTRUCTION DETAILS
762447–E4	PANEL CLOSURE SYSTEM–AIR EXHAUST DRIFT–CONSTRUCTION DETAILS
762447–E5	PANEL CLOSURE SYSTEM–CONSTRUCTION AND EXPLOSION WALLS–CONSTRUCTION DETAILS
762447–E6	PANEL CLOSURE SYSTEM–AIR ENTRANCE AND EXHAUST DRIFT GROUTING AND MISCELLANEOUS DETAILS

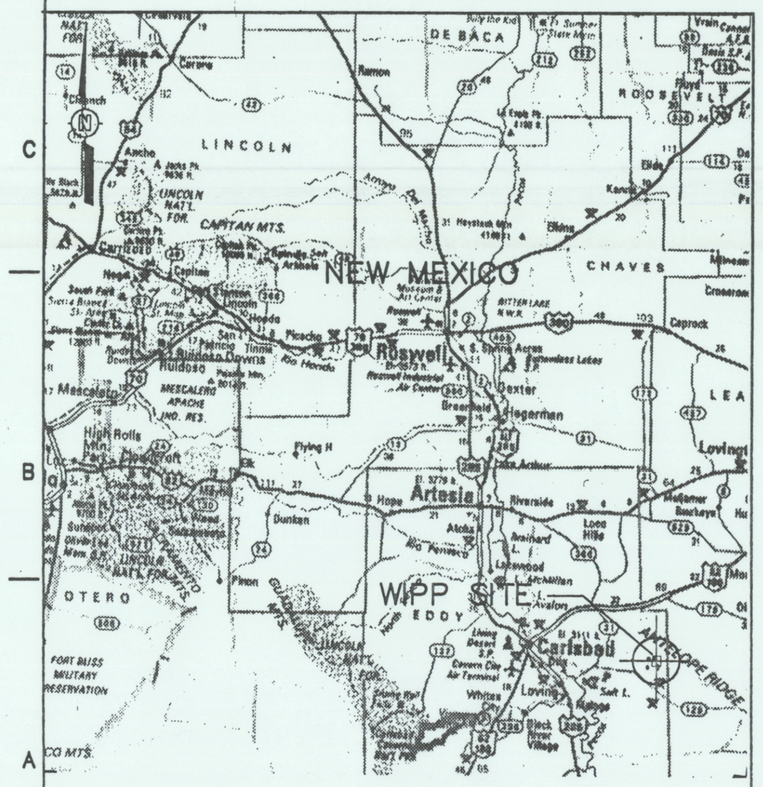


DETAILED STRATIGRAPHY AT THE REPOSITORY HORIZON
NTS

WASTE ISOLATION PILOT PLANT
PANEL CLOSURE SYSTEM
CARLSBAD, NEW MEXICO

prepared by

IT CORPORATION
ALBUQUERQUE, NEW MEXICO



GENERAL LOCATION MAP
NTS

REVISION	DATE	BY	CHK'D	APR'VD	DESCRIPTION
A	10/12/95	JES	EP	MSC	FOR CLIENT REVIEW

NAME DATE THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): PWR: N/A

DFTR:
CHKR:
COG:
CM:
QA:
SFTY:
APPD:
APPD:
DM:
DOE:

U.S. DEPARTMENT OF ENERGY
Westinghouse Waste Isolation Division AND IT CORPORATION
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

PANEL CLOSURE SYSTEM
AIR INTAKE AND EXHAUST DRIFTS
TITLE SHEET

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU00				

SIZE	SYS	DWG NO	REV
E	AU00	762447–E1	NEW

SCALE: AS NOTED | INTERPRET DWG PER ANSI Y14 | DWG: 1 OF 6

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

I.T. DRAWING NUMBER	762447–E1
	10/12/95 11/18/95
CHECKED BY	EP MSC
APPROVED BY	
STRIT	09–08–95
DRAWN BY	

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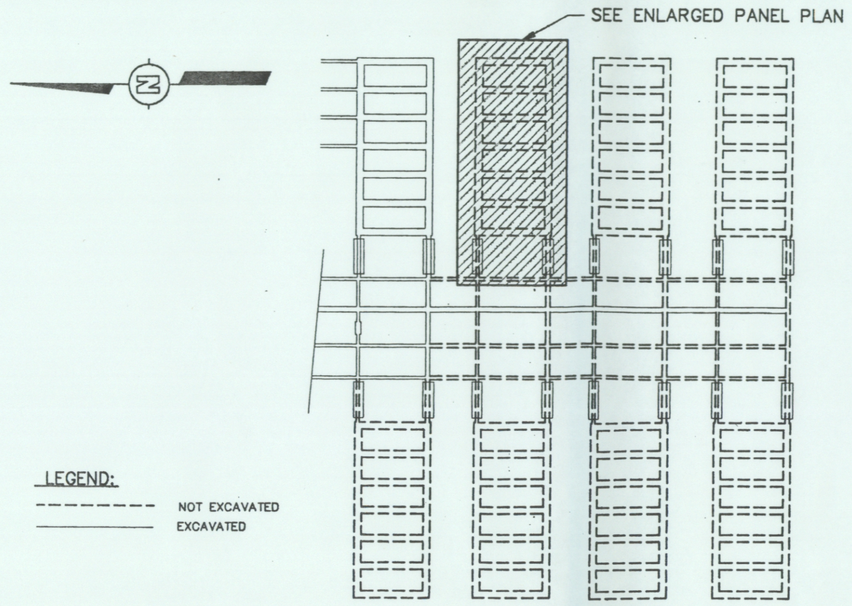
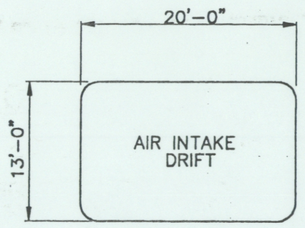
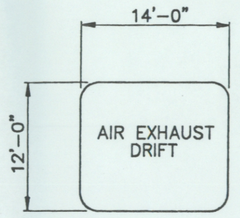


KEY PLAN

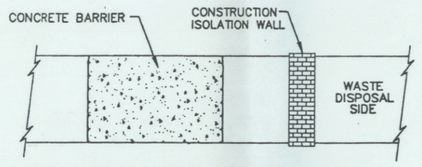
UNDERGROUND WASTE DISPOSAL PANELS



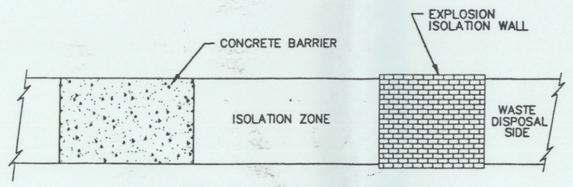
SECTION 1 – 1



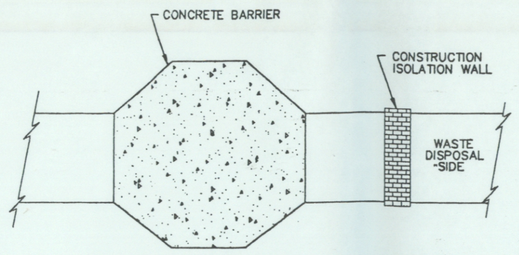
SECTION 2 – 2



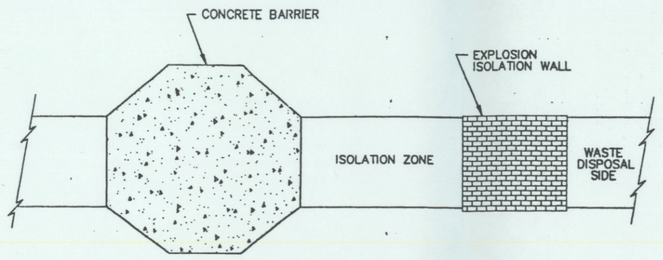
CONCRETE BARRIER WITHOUT DRZ REMOVED AND CONSTRUCTION ISOLATION WALL



CONCRETE BARRIER WITHOUT DRZ REMOVED AND EXPLOSION ISOLATION WALL

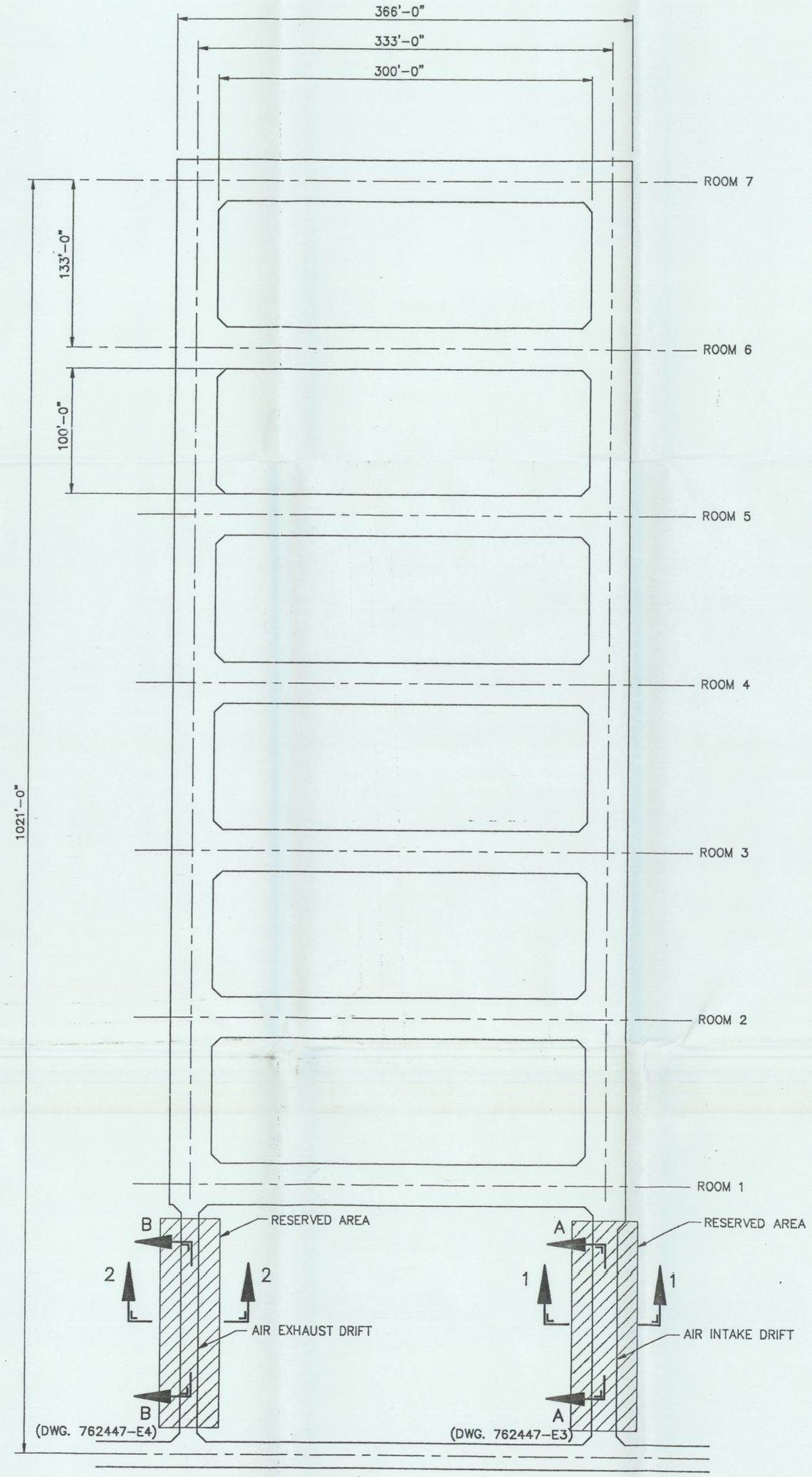


CONCRETE BARRIER WITH DRZ REMOVED AND CONSTRUCTION ISOLATION WALL



CONCRETE BARRIER WITH DRZ REMOVED AND EXPLOSION ISOLATION WALL

PLAN VARIATIONS



TYPICAL ENLARGED WASTE DISPOSAL PANEL

GENERAL NOTES

1. THE GEOLOGIC STRUCTURES ARE BASED ON REPRESENTATIVE CORE HOLE LOGS, AND SHAFT AND TEST ROOM MAPPING. ACTUAL CONFIGURATION MAY VARY LOCALLY FROM THAT SHOWN.
2. GROUND CONTROL NOT SHOWN. INSTALL WITH APPROVED GROUND CONTROL PLANS.
3. VENTILATION CONTROLS NOT INCLUDED. INSTALL IN ACCORDANCE WITH APPROVED VENTILATION PLANS.
4. ALL DIMENSIONS REPRESENT NOMINAL VALUES AND MAY VARY FROM LOCATION TO LOCATION.
5. THE SELECTION OF THE CONCRETE BARRIER AND WALL(S) LOCATION AND CROSS SECTION FOR CONSTRUCTION SHALL BE AT THE DIRECTION OF THE WESTINGHOUSE WID.

GENERAL CONCRETE NOTES

1. ALL CONCRETE WORK SHALL BE IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE (ACI) 318 LATEST EDITION, BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE AND REFERENCED ACI AND ASTM STANDARDS IN THE SPECIFICATIONS.
2. NO CONCRETE SHALL BE PLACED WITHOUT THE APPROVAL OF WESTINGHOUSE WID.
3. CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS (SEE SPECIFICATIONS TYPE AND MIX).
4. INTERFACE AND CONTACT GROUT SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS (SEE SPECIFICATIONS).

STRUCTURAL STEEL NOTES

1. ALL STRUCTURAL STEEL SHALL BE ASTM A36 (FY=36000 PSI).
2. DETAILING, FABRICATION AND ERECTION OF STRUCTURAL STEEL SHALL CONFORM WITH THE LATEST EDITION OF AISC "SPECIFICATION FOR THE DESIGN FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS AND REFERENCED ACI AND ASTM STANDARDS IN THE SPECIFICATIONS.
3. SHOP CONNECTIONS TO BE WELDED. ALL WELDING AND PREPARATION SHALL BE PERFORMED IN ACCORDANCE WITH WITH THE LATEST REVISION OF THE AMERICAN WELDING SOCIETY CODE D1.1.
4. USE E70XX ELECTRODES FOR ALL WELDING.
5. THE MINIMUM WELD SIZE SHOULD BE 1/4" FILLET (UN).
6. FORM WORK SPACERS SHALL BE FABRICATED FROM A36 STEEL ROUND STOCK.
7. FIELD CONNECTIONS MAY BE BOLTED OR WELDED, BOLTS SHALL BE 3/4"ø HIGH STRENGTH, FRICTION TYPE BOLTS ASTM-A325.
8. SEAL ALL FORMS FOR MINIMAL LEAKAGE DURING CONCRETE PLACEMENT.
9. EMBED ROCK ANCHORS AS PER VENDOR SPECIFICATION TO DEVELOP FULL SHEAR AND TENSION VALUES.

EXISTING REFERENCE DWG.

DRAWING NO. 51-W-214-W PREPARED BY WESTINGHOUSE WASTE INSOLATION DIVISION, REV. NEW, DATE: 3/28/95.

REFERENCE DWG'S.

762447-E3	PANEL CLOSURE SYSTEM – AIR INTAKE DRIFT – CONSTRUCTION SEQUENCE NOTES AND CONSTRUCTION DETAILS
762447-E4	PANEL CLOSURE SYSTEM – AIR EXHAUST DRIFT – CONSTRUCTION DETAILS
762447-E5	PANEL CLOSURE SYSTEM – CONSTRUCTION & EXPLOSION WALLS CONSTRUCTION DETAILS
762447-E6	PANEL CLOSURE SYSTEM – AIR INTAKE EXHAUST DRIFT – GROUTING & MISC. DETAILS

REVISION	DATE	BY	CHK'D	APR'VD	DESCRIPTION
B	11/17/95	RJC	EAP	JBC	APPROVAL REVIEW UPGRADE
A	10/12/95	JES	EAP	JBC	FOR CLIENT REVIEW

	NAME	DATE
DFTR:		
CHKR:		
COG:		
CM:		
QA:		
SFTY:		
APPD:		
APPD:		
DM:		
DOE:		

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): PWR: N/A

U.S. DEPARTMENT OF ENERGY

Westinghouse Waste Isolation Division AND IT CORPORATION

Waste Isolation Pilot Plant

CARLSBAD, NEW MEXICO

PANEL CLOSURE SYSTEM
UNDERGROUND WASTE DISPOSAL PANEL
PLAN

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU00				

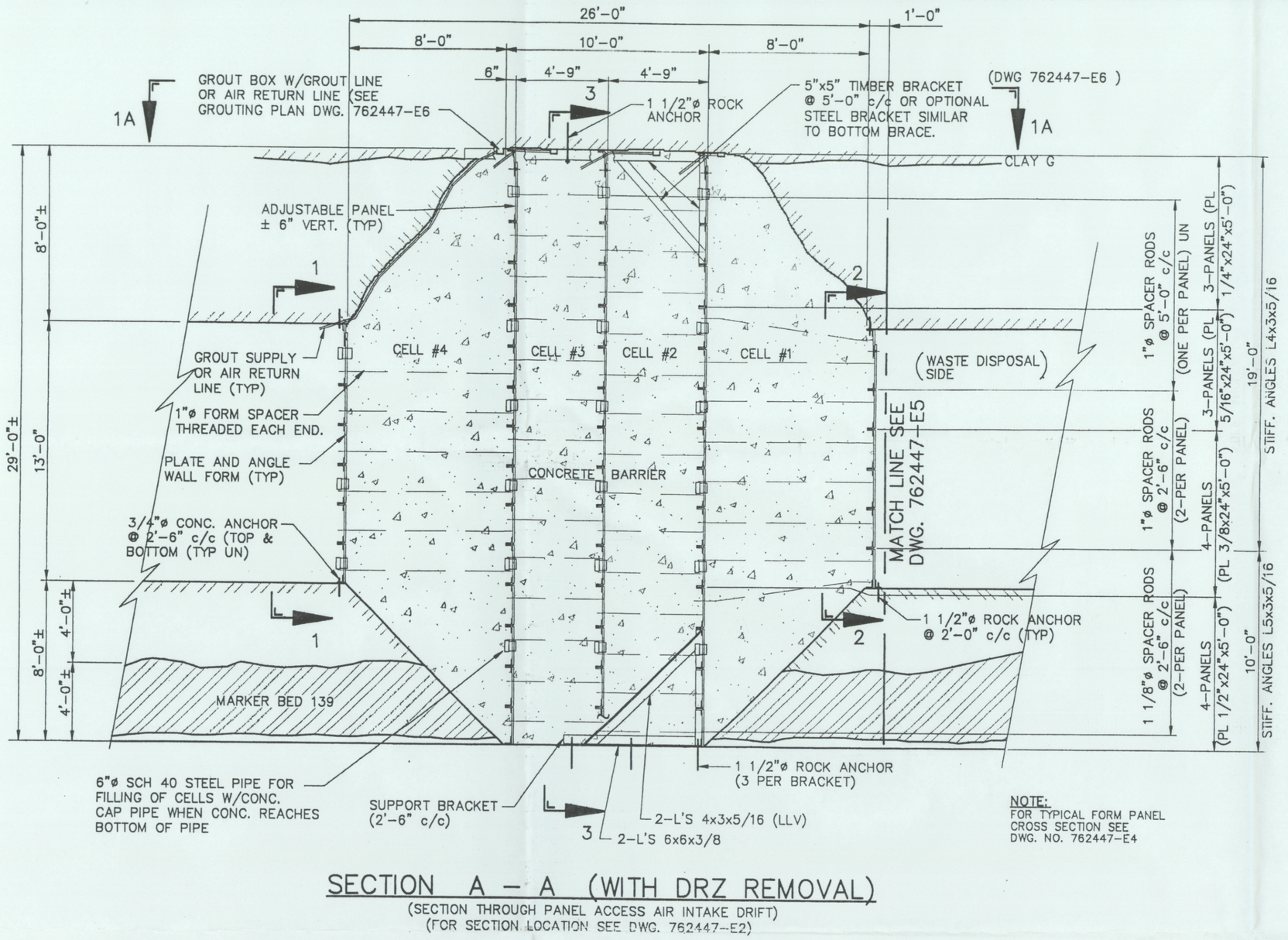
SIZE	SYS	DWG NO	REV
E	AU00	762447-E2	NEW

SCALE: AS NOTED | INTERPRET DWG PER ANSI Y14 | DWG: 2 OF 6

THIS DRAWING TAKEN FROM: N/A

DRAWN BY	STRIT	09-08-95	CHECKED BY	EAP	10/23/95	I.T. DRAWING NUMBER 762447-E2
			APPROVED BY	JBC	10/23/95	

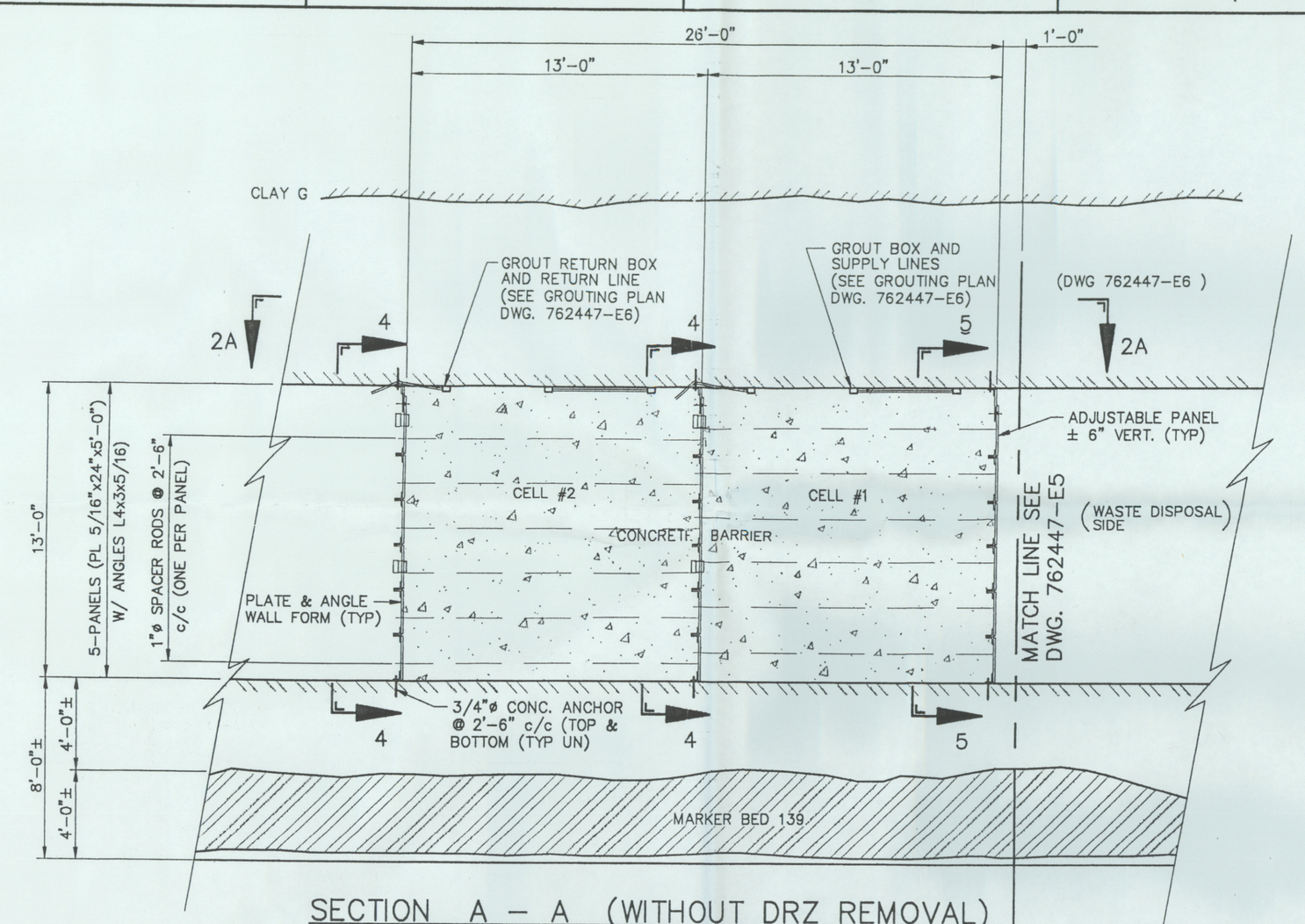
"Do Not Scale This Drawing"



NOTE:
FOR TYPICAL FORM PANEL CROSS SECTION SEE DWG. NO. 762447-E4

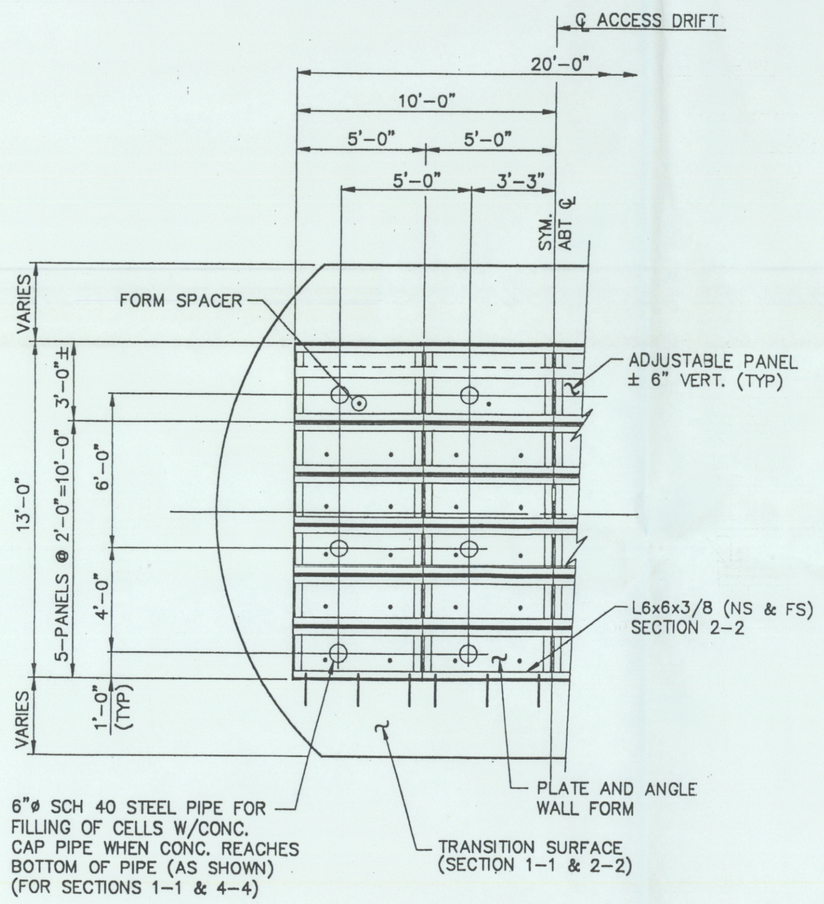
SECTION A – A (WITH DRZ REMOVAL)

(SECTION THROUGH PANEL ACCESS AIR INTAKE DRIFT)
(FOR SECTION LOCATION SEE DWG. 762447-E2)

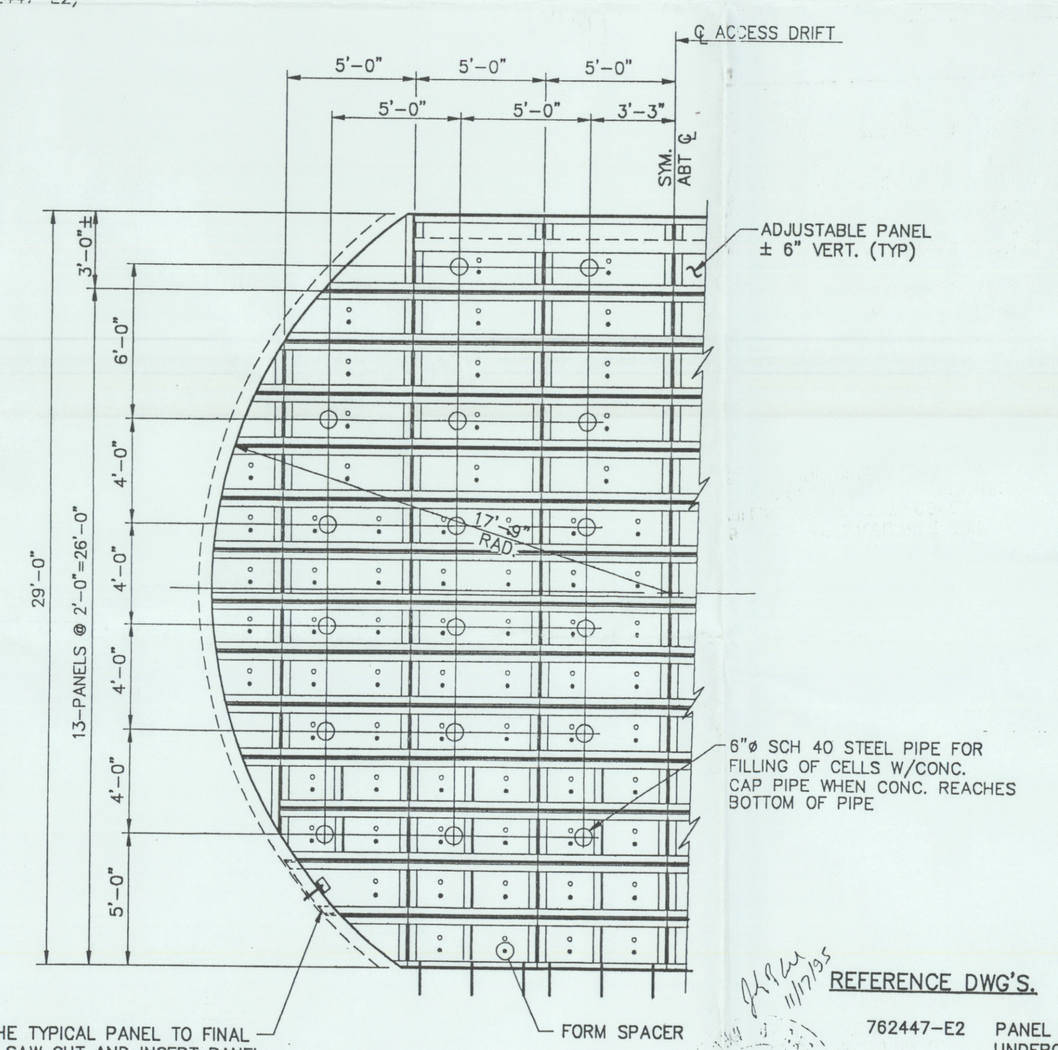


SECTION A – A (WITHOUT DRZ REMOVAL)

(SECTION THROUGH PANEL ACCESS AIR INTAKE DRIFT)
(FOR SECTION LOCATION SEE DWG. 762447-E2)



SECTION 1 – 1 (AS SHOWN & NOTED)
SECTION 2 – 2 (AS SHOWN & NOTED)
SECTION 4 – 4 (SIMILAR & NOTED)
SECTION 5 – 5 (SIMILAR & NOTED)



SECTION 3 – 3

(3-PLACES)

REFERENCE DWG'S.

762447-E2	PANEL CLOSURE SYSTEM – UNDERGROUND WASTE DISPOSAL PANEL PLAN AND GENERAL NOTES.
762447-E5	PANEL CLOSURE SYSTEM – CONSTRUCTION & EXPLOSION WALLS – CONSTRUCTION DETAILS
762447-E6	PANEL CLOSURE SYSTEM – AIR INTAKE & EXHAUST DRIFT – GROUTING & MISC. DETAILS

CONSTRUCTION SEQUENCE:

[CONCRETE BARRIER SECTION A–A OR B–B WITH OR WITHOUT DISTURBED ROCK ZONE (DRZ) REMOVED]

1. THE CONCRETE BARRIER WILL BE LOCATED BY THE WESTINGHOUSE WID SITE ENGINEER. SURVEY CONTROLS FOR ALIGNMENT AND ELEVATION WILL BE ESTABLISHED FOR THE AS–BUILT CONDITIONS DOCUMENTATION BY WESTINGHOUSE WID.
2. ALL CONTRACTORS TO REVIEW JOB "WORK PLAN/SAFETY PROCEDURES" BEFORE STARTING CONSTRUCTION. LOGISTICS OF MATERIALS, SUPPLIES DELIVERY AND CONSTRUCTION SCHEDULING WILL BE COMPATIBLE WITH SITE OPERATIONS AS DETERMINED BY WESTINGHOUSE WID.
3. WHEN DRZ REMOVAL IS REQUIRED TO CONSTRUCT THE CONCRETE BARRIER, CROSS–SECTIONS 1–1, 2–2, & 3–3 SHOW CONTOUR CUTS REQUIRING A MINIMUM OF ONE TO THREE INCHES OF PENETRATION ABOVE CLAY SEAM "G" AND BELOW THE BASE OF MARKER BED 139. ALL DIMENSIONS REPRESENT NOMINAL VALUES AND MAY VARY FROM LOCATION TO LOCATION. THE FINAL EXCAVATION OUTLINE WILL BE REVIEWED AND APPROVED BY WESTINGHOUSE WID.
4. WHEN DRZ REMOVAL IS NOT REQUIRED INSPECT ALL SURFACES FOR LOOSE AND LATENT MATERIALS AND CONSTRUCT BY FOLLOWING STEPS 5 THRU 8.
5. FORM WORK CONSTRUCTION GUIDELINES ARE SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXCAVATION DIMENSIONS TO DEVELOP THE CONCRETE FORMWORK TO FIT THE EXCAVATION. FORM WORK DESIGNS/DETAILS WILL BE SUBMITTED TO WESTINGHOUSE WID FOR REVIEW AND APPROVAL BEFORE CONCRETE PLACEMENT.
6. THE CONCEPTUAL FORM WORK SHOWS 2'–0" x 5'–0" PRE–FABRICATED PANELS OF A36 STEEL WITH PERIMETER STIFFENER ANGLES BOLTED WITH 3/4"ø A325 HIGH STRENGTH BOLTS. SEAL ALL PANELS TO PREVENT LEAKAGE. FIELD FIT WALL AND ROOF PANELS FOR TIGHT–FIT; ADDING STRUCTURAL BRACKET BRACING; SIDE WALL SUPPORT ANGLE AT THE WALL INTERFACE AND TIMBER BRACKETS FOR TOP PANEL SUPPORT. FORM WORK SPACERS WILL BE FABRICATED FROM A36 STEEL ROUND STOCK. ALL SPACERS ARE STAGGERED FROM FORM TO FORM AND MUST BE DISCONTINUOUS THRU EACH PLACEMENT. ALL FORMS WILL REMAIN EMBEDDED. BEFORE PLACING FORM WORK, ROCK BOLTING FOR ROOF SECURITY MAY BE REQUIRED AS DIRECTED BY WESTINGHOUSE WID. PROTECTIVE NETTING OR SCREENING REQUIREMENT FOR OVERHEAD SAFETY WILL BE REVIEWED PER SITE.
7. ROOF (BACK) MOUNTED GROUT BOXES AND A TRANSPORT PIPING SYSTEM WILL BE INSTALLED FOR INTERFACE GROUTING. FIELD RUN GROUT LINES FOR BEST ROUTING AND SUPPORT SEE DWG. 762447–E6 FOR DETAILS. GROUT TO BE PLACED AS DIRECTED BY WESTINGHOUSE WID. ADDITIONAL CONTACT GROUTING MAY BE REQUIRED UPON REVIEW BY WESTINGHOUSE WID. SEE DWG. 762447–E6 AND SPECIFICATION 02722 FOR DETAILS.
8. PLACE PUMPED CONCRETE THRU THE 6"ø FILL PORTS IN 4'–0" HIGH LIFTS. VISUALLY INSPECT EACH LIFT, CAP ALL PORTS AND CONTINUE IN 4'–0" LIFT INCREMENTS. BEFORE CONCRETE PLACEMENT WESTINGHOUSE WID WILL REVIEW ALL FORMS FOR PROPER SUPPORT AND ADEQUATE PERIMETER SEALING.

REVISION	DATE	BY	CHK'D	APR'VD	DESCRIPTION
0	10/12/95	JES			FOR CLIENT REVIEW

NAME | DATE | THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): | PWR: N/A

DFTR: | CHKR: | COG: | CM: | QA: | SFTY: | APPD: | APPD: | DM: | DOE:

U.S. DEPARTMENT OF ENERGY
Westinghouse Waste Isolation Division AND IT CORPORATION
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

PANEL CLOSURE SYSTEM
AIR INTAKE DRIFT
CONSTRUCTION DETAILS

SIZE E | SYS AU00 | DWG NO 762447-E3 | REV NEW
SCALE: 1/4"=1'-0" | INTERPRET DWG PER ANSI Y14 | DWG: 3 OF 6

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU00				

I.T. DRAWING NUMBER	762447-E3
CHECKED BY	EAP 10/12/95
APPROVED BY	JAC 11/17/95
STRIT	09-07-95
DRAWN BY	

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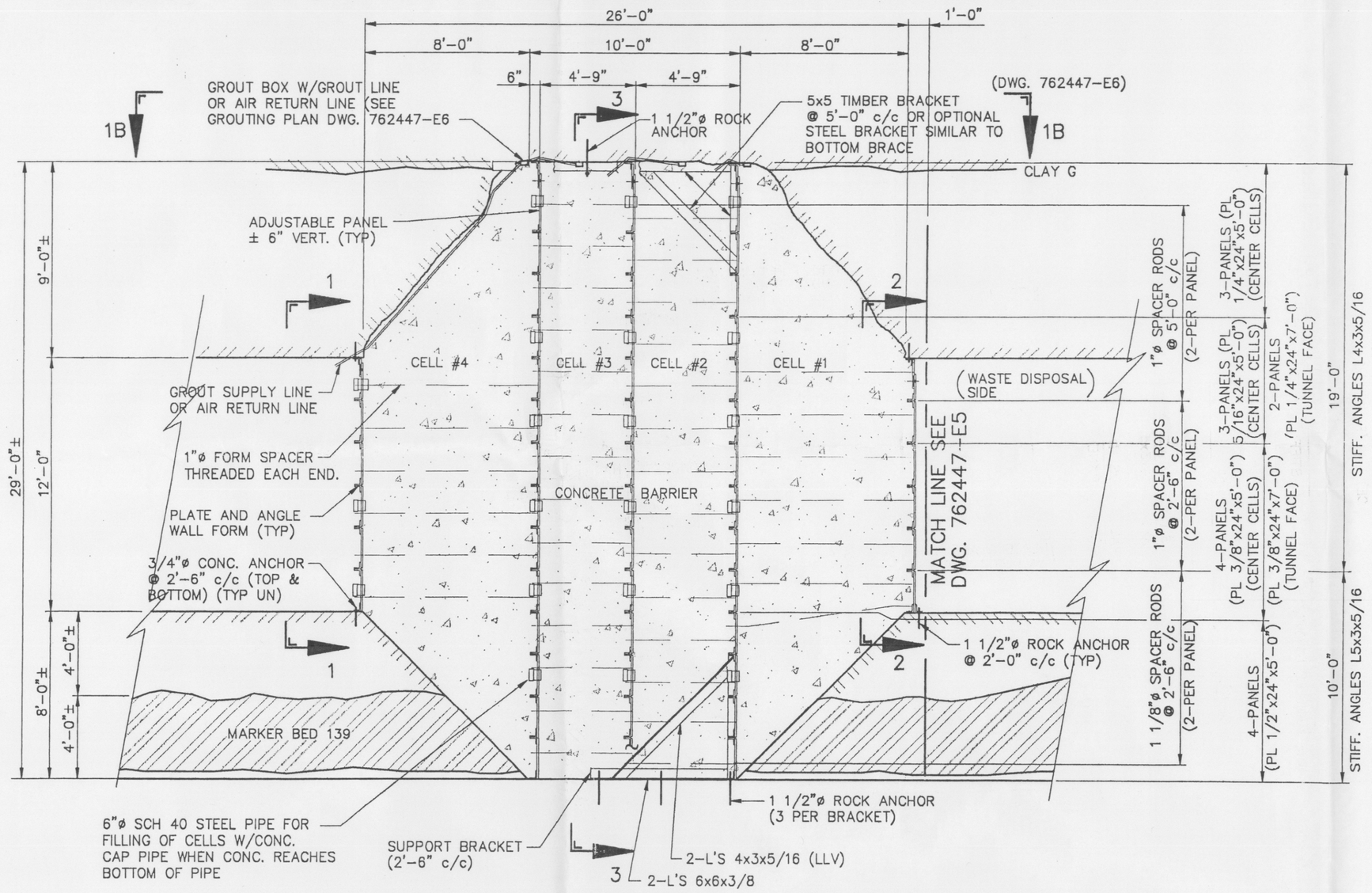
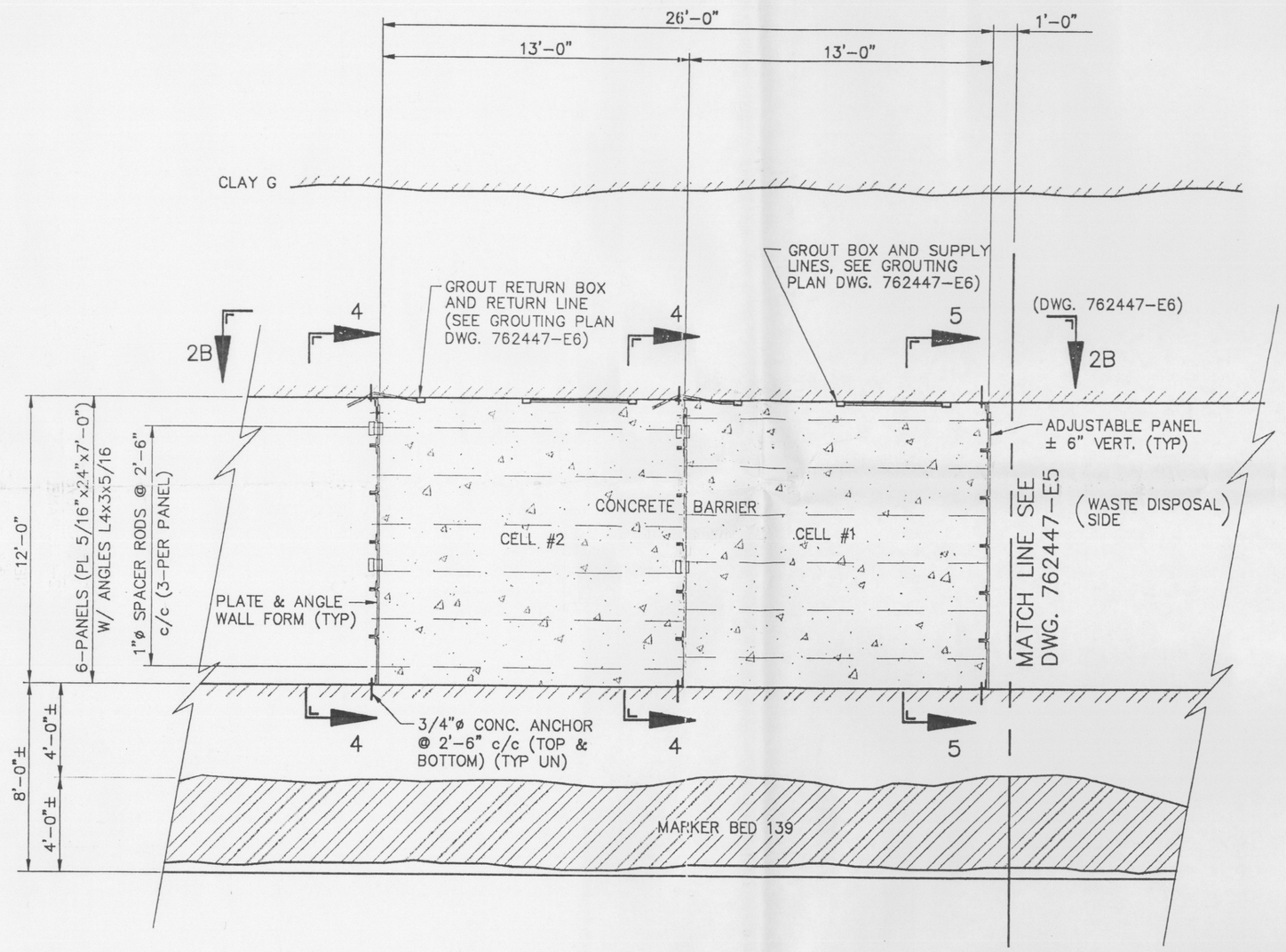


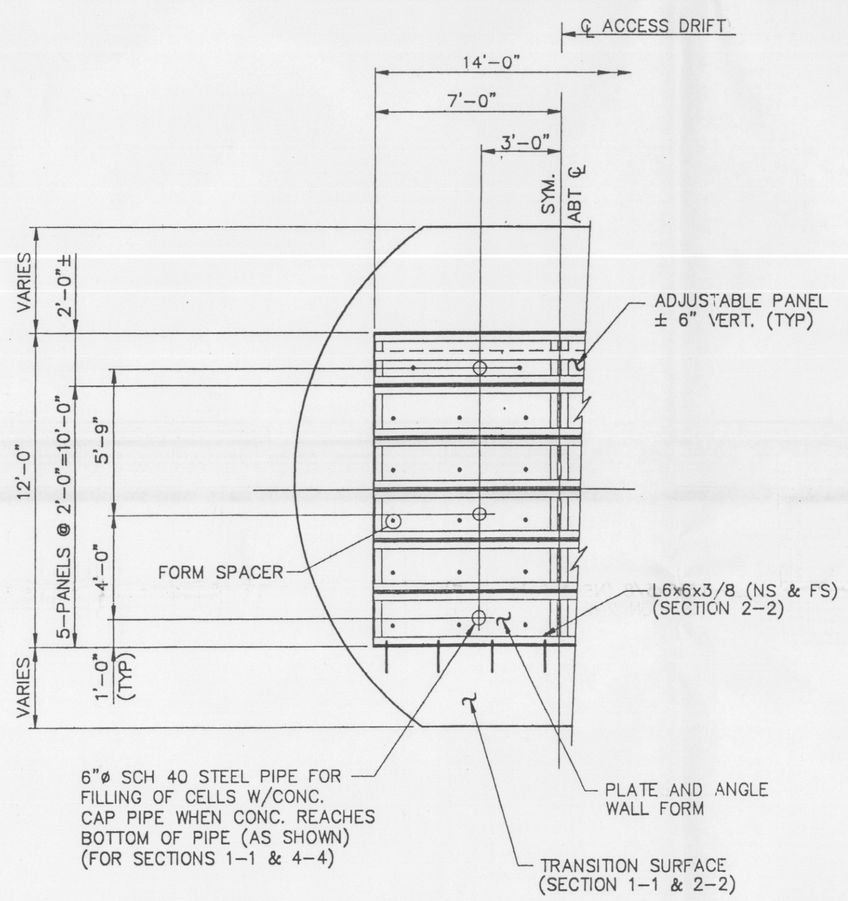
SECTION B – B (WITH DRZ REMOVAL)

(SECTION THROUGH PANEL ACCESS AIR EXHAUST DRIFT)
(FOR SECTION LOCATION SEE DWG. 762447-E2)

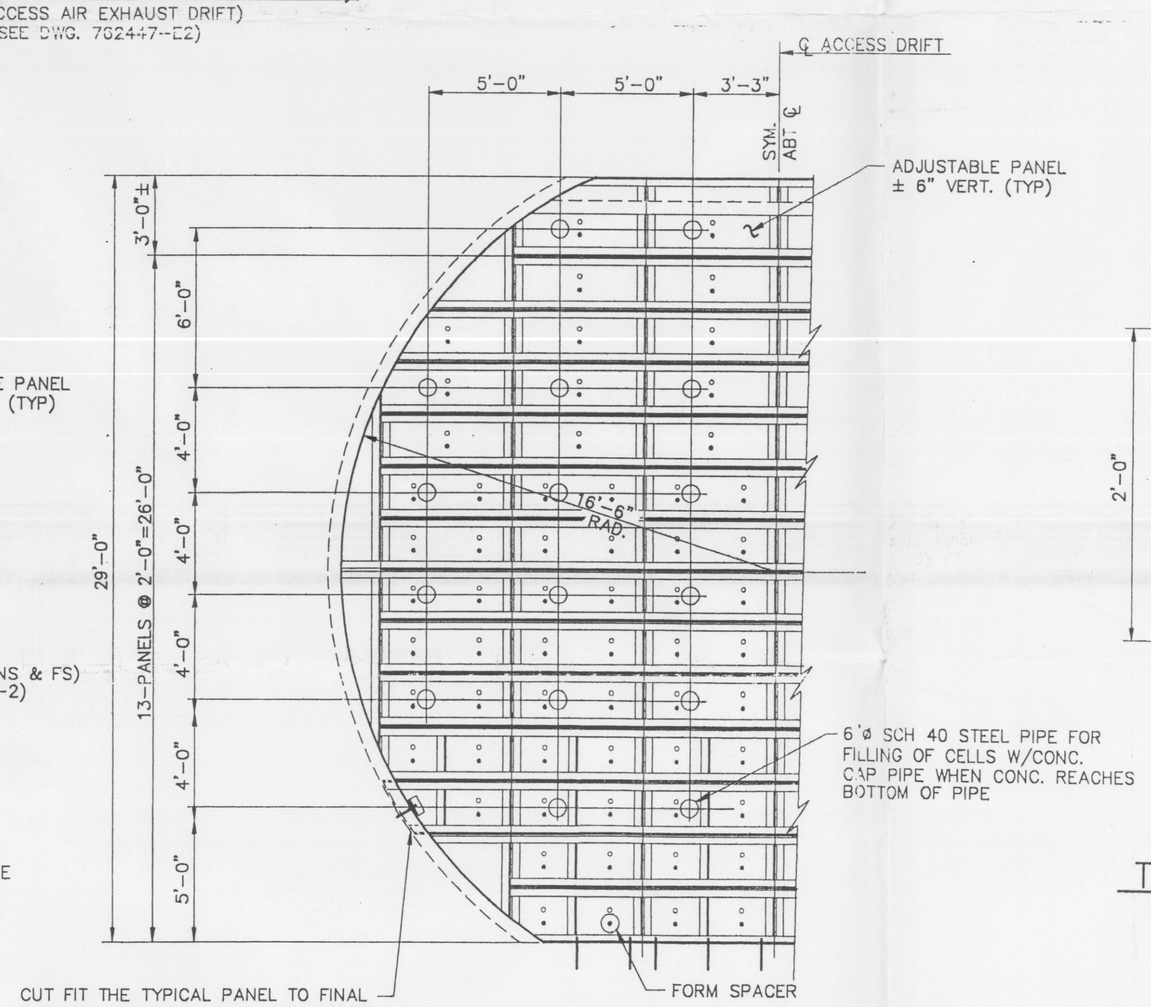


SECTION B – B (WITHOUT DRZ REMOVAL)

(SECTION THROUGH PANEL ACCESS AIR EXHAUST DRIFT)
(FOR SECTION LOCATION SEE DWG. 762447-E2)

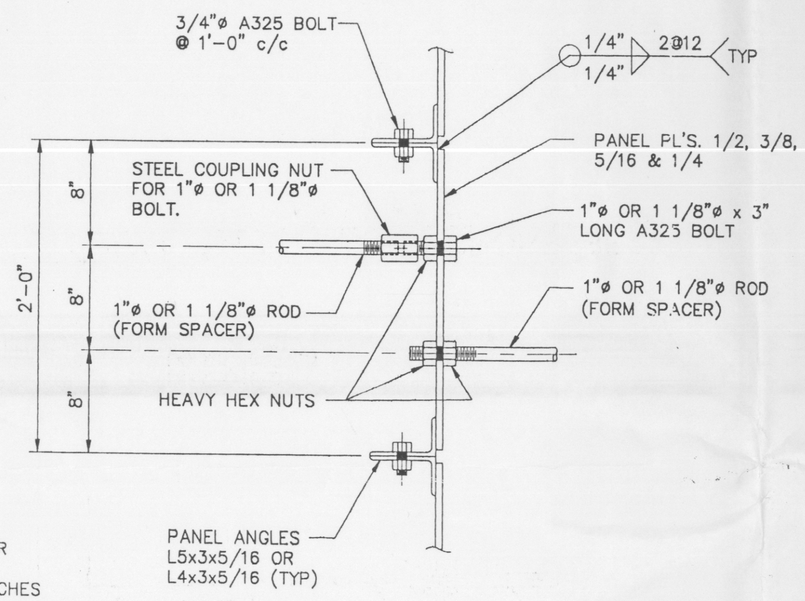


SECTION 1 – 1 (AS SHOWN & NOTED)
SECTION 2 – 2 (AS SHOWN & NOTED)
SECTION 4 – 4 (SIMILAR & NOTED)
SECTION 5 – 5 (SIMILAR & NOTED)



SECTION 3 – 3

(3-PLACES)



TYPICAL FORM PANEL CROSS SECTION

SCALE: 1/4" = 1'-0"

NOTE:
FOR CONSTRUCTION SEQUENCE SEE DWG. 762447-E3.

REFERENCE DWG'S.

762447-E2	PANEL CLOSURE SYSTEM – UNDERGROUND WASTE DISPOSAL PANEL PLAN AND GENERAL NOTES.
762447-E3	PANEL CLOSURE SYSTEM – AIR INTAKE DRIFT – CONSTRUCTION DETAILS AND CONSTRUCTION SEQUENCE NOTES.
762447-E5	PANEL CLOSURE SYSTEM – CONSTRUCTION & EXPLOSION WALLS – CONSTRUCTION DETAILS
762447-E6	PANEL CLOSURE SYSTEM – AIR INTAKE & EXHAUST DRIFT – GROUTING & MISC. DETAILS

REVISION	DATE	BY	CHK'D	APR'VD	DESCRIPTION
A	10/12/95	JES	EAP		FOR CLIENT REVIEW

NAME DATE THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): PWR: N/A

DFTR:
CHKR:
COG:
CM:
QA:
SFTY:
APPD:
APPD:
DM:
DOE:

U.S. DEPARTMENT OF ENERGY
Westinghouse Waste Isolation Division
IT CORPORATION
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

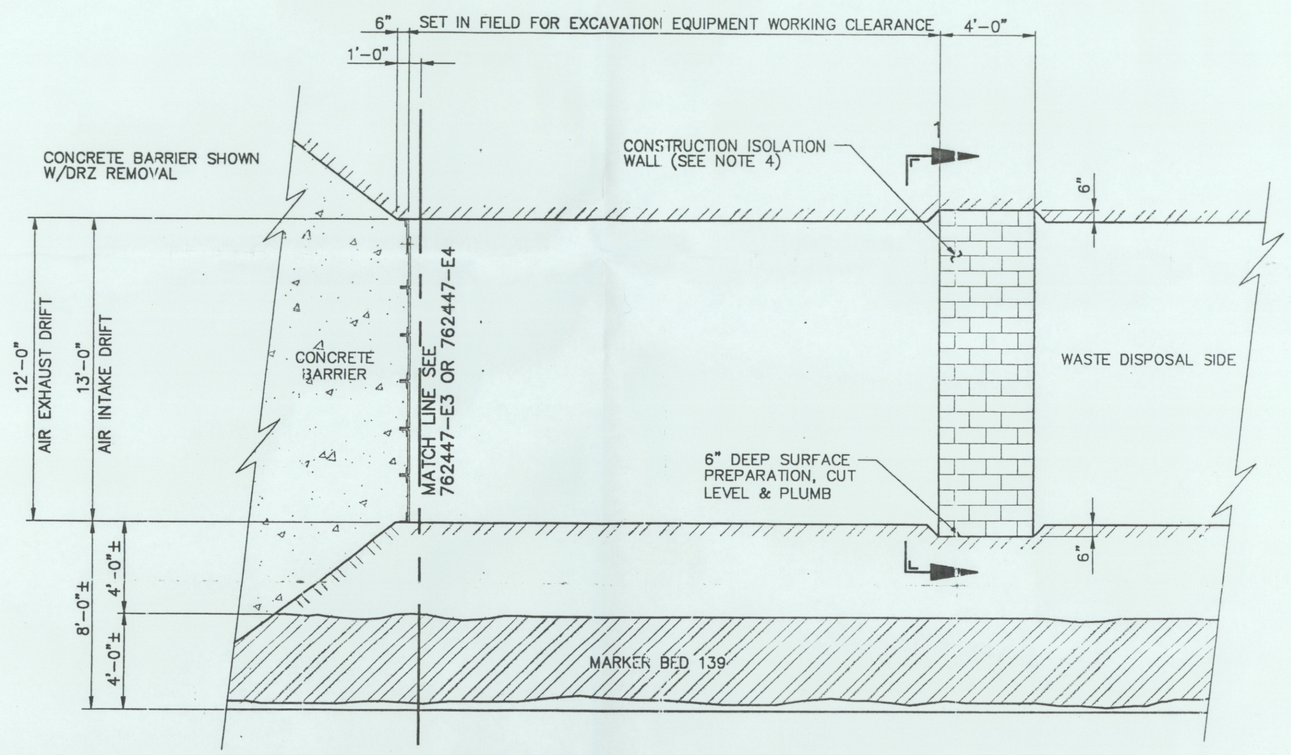
PANEL CLOSURE SYSTEM
AIR EXHAUST DRIFT
CONSTRUCTION DETAILS

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU00				

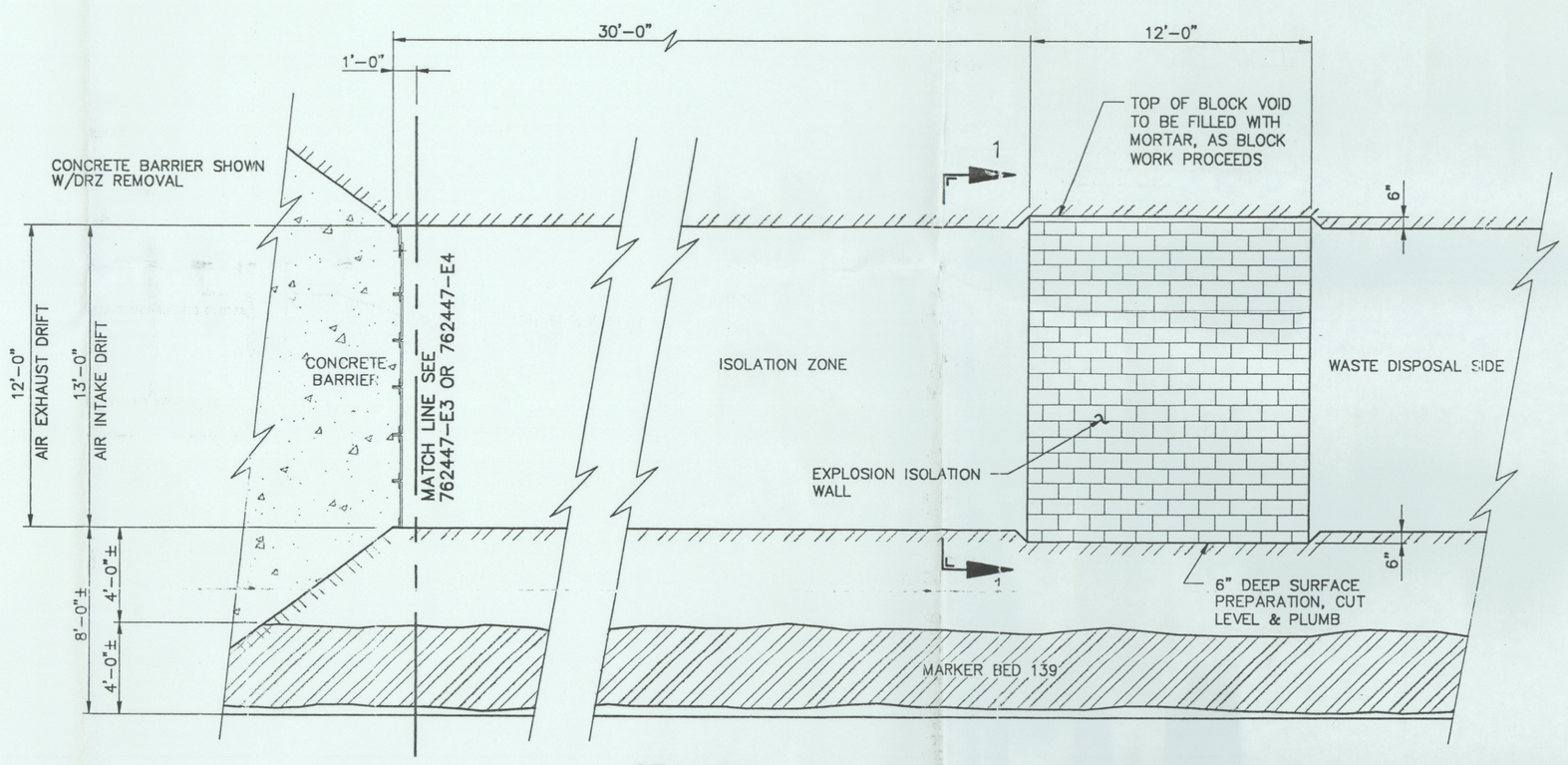
SIZE E | SYS AU00 | DWG NO. 762447-E4 | REV NEW
SCALE: 1/4"=1'-0" | INTERPRET DWG PER ANSI Y14 | DWG: 4 OF 8
THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

DRAWN BY	STRIT 09-07-95	CHECKED BY	APPROVED BY	I.T. DRAWING NUMBER 762447-E4

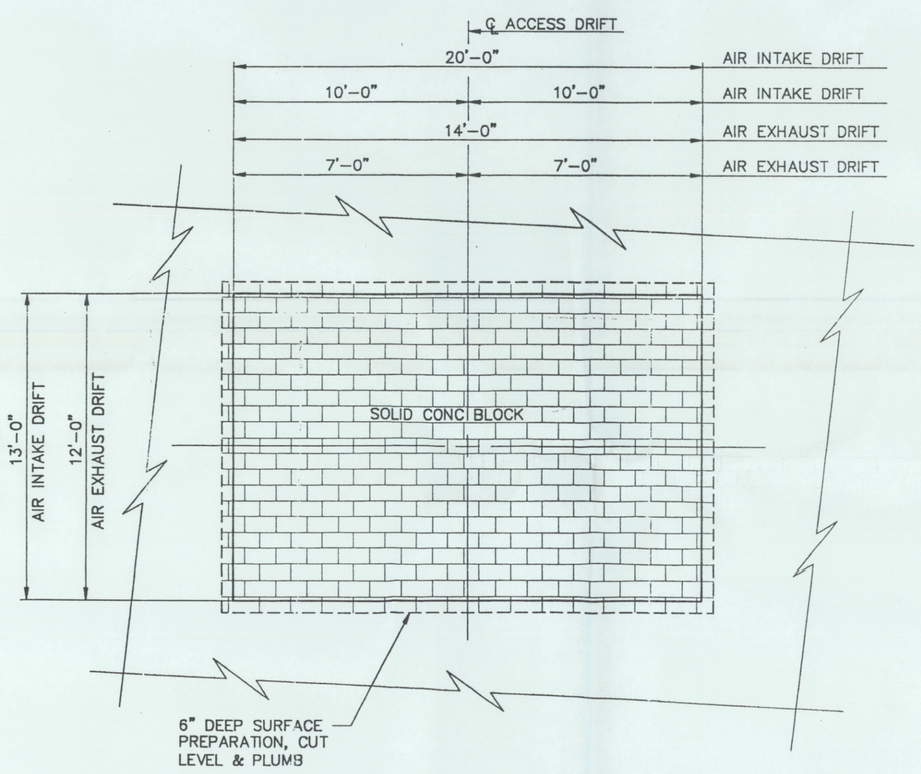
"Do Not Scale This Drawing"



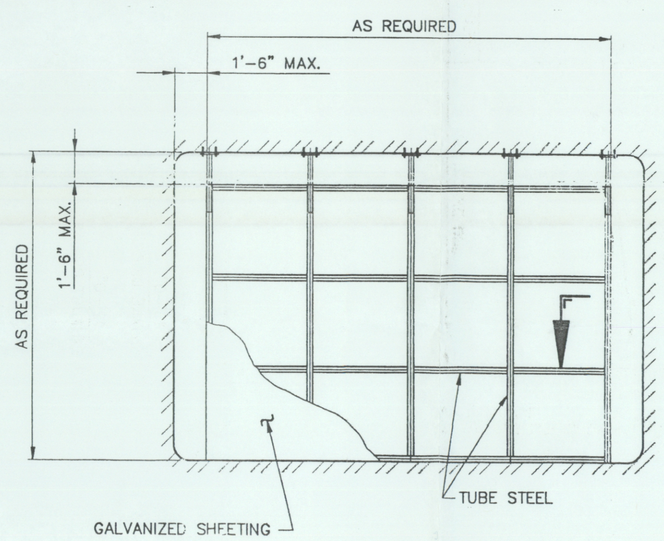
SECTION A -- A (CONT.)
SECTION B -- B (CONT.)
(CONSTRUCTION ISOLATION WALL)
(FOR SECTION LOCATION SEE DWG. 762447-E2)



SECTION A – A (CONT.)
SECTION B – B (CONT.)
(EXPLOSION ISOLATION WALL)
(FOR SECTION LOCATION SEE DWG. 762447-E2)

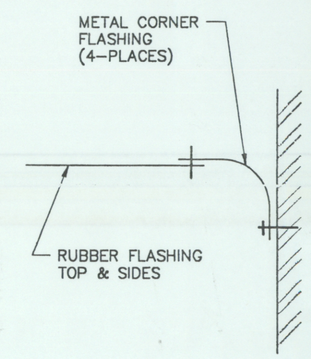


SECTION 1 – 1



ELEVATION

STANDARD STEEL STOPPING
(SEE NOTE 4)



PERIMETER FLASHING DETAIL

CONSTRUCTION SEQUENCE:

1. THE CONSTRUCTION ISOLATION & EXPLOSION ISOLATION WALLS WILL BE LOCATED BY THE WESTINGHOUSE WID.
2. ALL CONTRACTORS TO REVIEW JOB "WORK PLAN/SAFETY PROCEDURES" BEFORE STARTING CONSTRUCTION. LOGISTICS OF MATERIALS, SUPPLY DELIVERIES AND CONSTRUCTION SCHEDULING WILL BE COMPATIBLE WITH SITE OPERATIONS AS DETERMINED BY THE WESTINGHOUSE WID.
3. PREPARE ALL SURFACES BY REMOVING SIX (6) INCHES OF MATERIAL ALL-AROUND OPENING TO SQUARE AND LEVEL FOR BLOCK LAYING. TYPE M 2500 PSI MORTAR GROUT WILL BE USED TO LEVEL THE FIRST COURSE. ALL BLOCK WALLS ARE CONSTRUCTED WITH SOLID (NO VOIDS) HIGH-STRENGTH CONCRETE MASONRY UNITS (f'mc 3500 TO 3750 PSI) USING COMPATIBLE TYPE M MORTAR. SIDE WALL (RIB) AND ROOF (BACK) TO BLOCK WILL BE MORTAR SEALED.
4. THE PURPOSE OF THE CONSTRUCTION ISOLATION WALL IS TO PROTECT THE STACKED WASTE CONTAINERS FROM ACCIDENTAL CONTACT BY CONSTRUCTION/EXCAVATION EQUIPMENT DURING INSTALLATION OF THE CONCRETE VOC BARRIER. ITS CONSTRUCTION MAY BE OF VARIOUS MATERIALS TYPICALLY USED AT THE WIPP FOR THIS PURPOSE. SOLID CONCRETE MASONRY UNITS MAY BE USED AS WELL AS LIGHT WEIGHT FLYASH BLOCKS OR THE WIPP STANDARD STEEL STOPPINGS, AS APPROPRIATE AT THE TIME.

MASONRY NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH U.B.C. (LATEST EDITION).
2. ALL CONCRETE MASONRY SHALL MEET ASTM C-55 GRADE N, HIGH STRENGTH BLOCK WITH A STRENGTH OF 3500 PSI (MIN.).
3. ALL MORTAR AND MASONRY GROUT SHALL MEET ASTM-C270 (TYPE M) WITH f'c=2500 PSI MIN. AT 28 DAYS.

NOTE:

FOR THE CONCRETE BARRIER CONSTRUCTION SEQUENCE SEE DWG. 762447-E3

REFERENCE DWG'S.

762447-E3	PANEL CLOSURE SYSTEM – AIR INTAKE DRIFT – CONSTRUCTION DETAILS
762447-E4	PANEL CLOSURE SYSTEM – AIR EXHAUST DRIFT – CONSTRUCTION DETAILS
762447-E6	PANEL CLOSURE SYSTEM – AIR INTAKE & EXHAUST – GROUTING & MISC. DETAILS

REVISION	DATE	BY	CHK'D	APR'VD	DESCRIPTION
B	1/17/95	RJC			APPROVAL REVIEW UPGRADE
A	10/12/95	JES	EAP	JBC	FOR CLIENT REVIEW

THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO): PWR: N/A

	NAME	DATE
DFTR:		
CHKR:		
COG:		
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SFTY:		
APPD:		
APPD:		
DM:		
DOE:		

U.S. DEPARTMENT OF ENERGY
Westinghouse Waste Isolation Division
and
IT CORPORATION
Waste Isolation Pilot Plant
CARLSBAD, NEW MEXICO

PANEL CLOSURE SYSTEM
CONSTRUCTION & EXPLOSION WALLS
CONSTRUCTION DETAILS

SIZE	SYS	DWG NO	REV
E	AU00	762447-E5	NEW

SCALE: 1/4"=1'-0" INTERPRET DWG PER ANSI Y14 DWG: 5 OF 6

THIS DRAWING TAKEN FROM: N/A

INDEX CODE NUMBER				
SYSTEM	WBS	DWG TYPE	CL	VENDOR
AU00				

DRAWN BY	STRIT	09-07-95	CHECKED BY	EAP	10/23/95	I.T. DRAWING NUMBER 762447-E5
			APPROVED BY	JBC	10/23/95	

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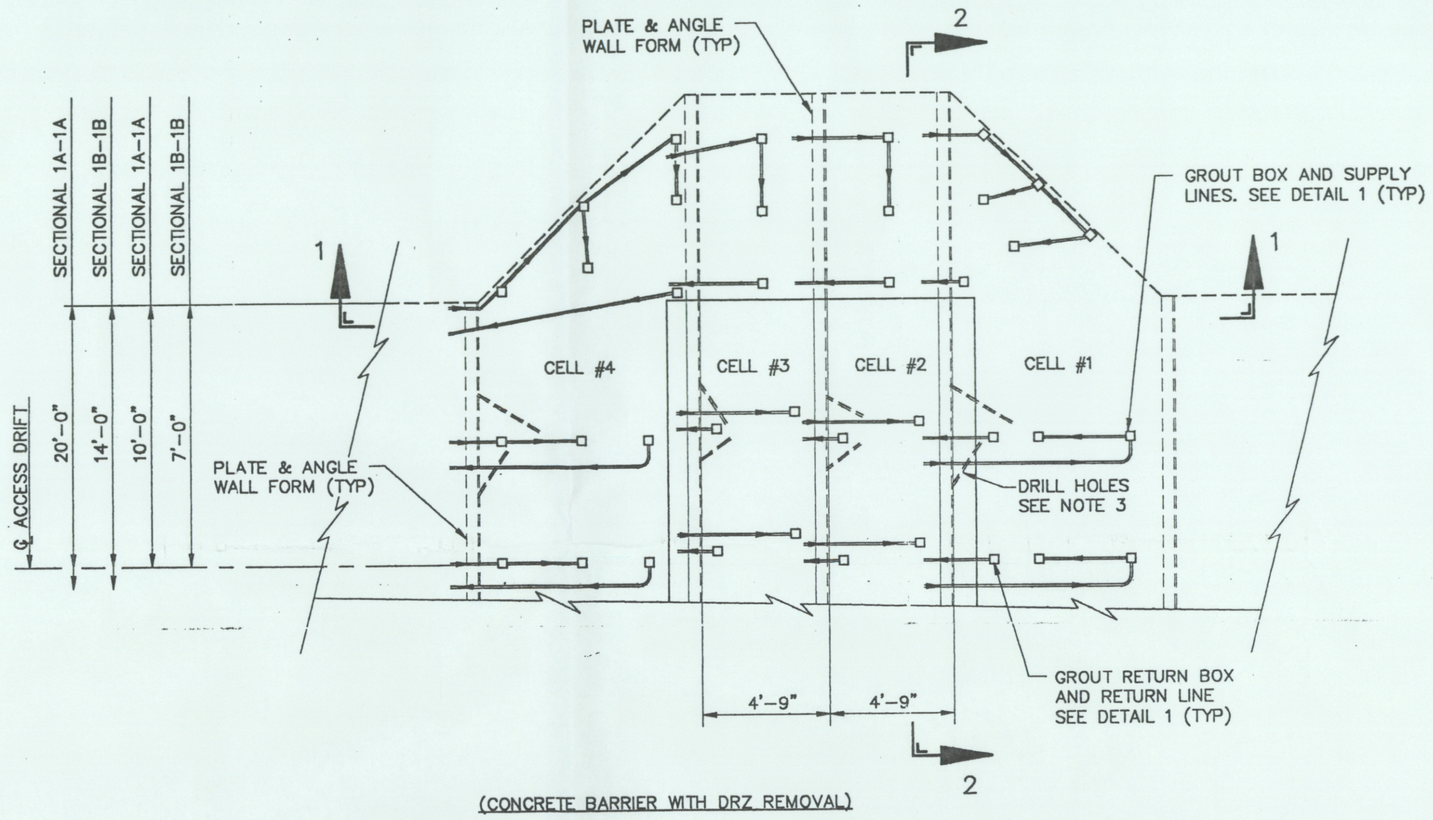


(CONCRETE BARRIER WITH DRZ REMOVAL)

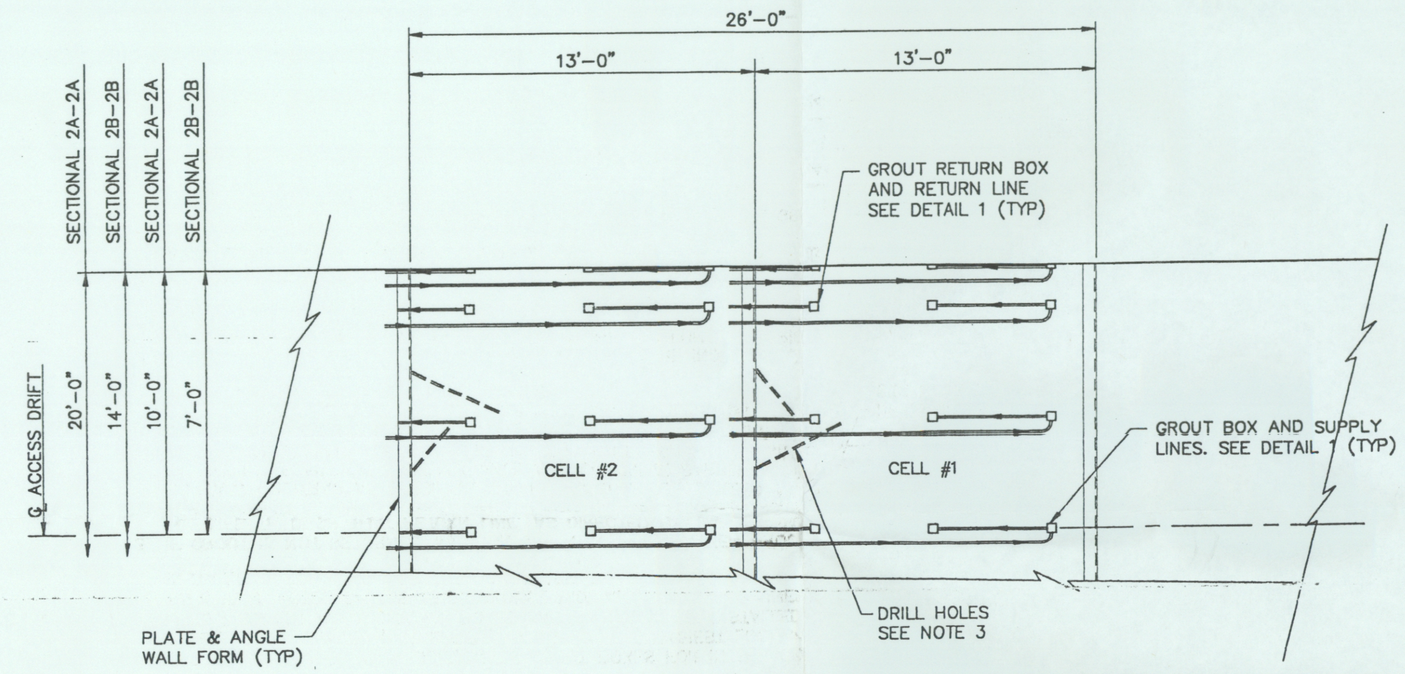
SECTIONAL PLAN 1A – 1A (AIR INTAKE) (AS SHOWN & NOTED)

(FOR SECTION LOCATION SEE DWG. 762447–E3)

SECTIONAL PLAN 1B – 1B (AIR EXHAUST) (AS SHOWN & NOTED)

(FOR SECTION LOCATION SEE DWG. 762447–E4)

SCALE: 1/4" = 1'–0"



(CONCRETE BARRIER WITHOUT DRZ REMOVAL)

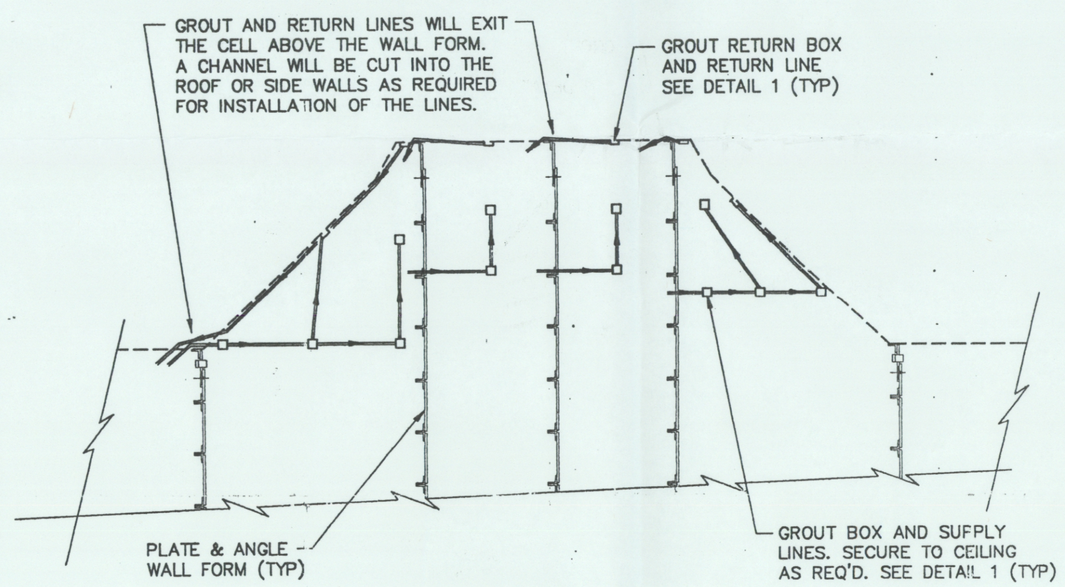
SECTIONAL PLAN 2A – 2A (AIR INTAKE) (AS SHOWN & NOTED)

(FOR SECTION LOCATION SEE DWG. 762447–E3)

SECTIONAL PLAN 2B -- 2B (AIR EXHAUST) (AS SHOWN & NOTED)

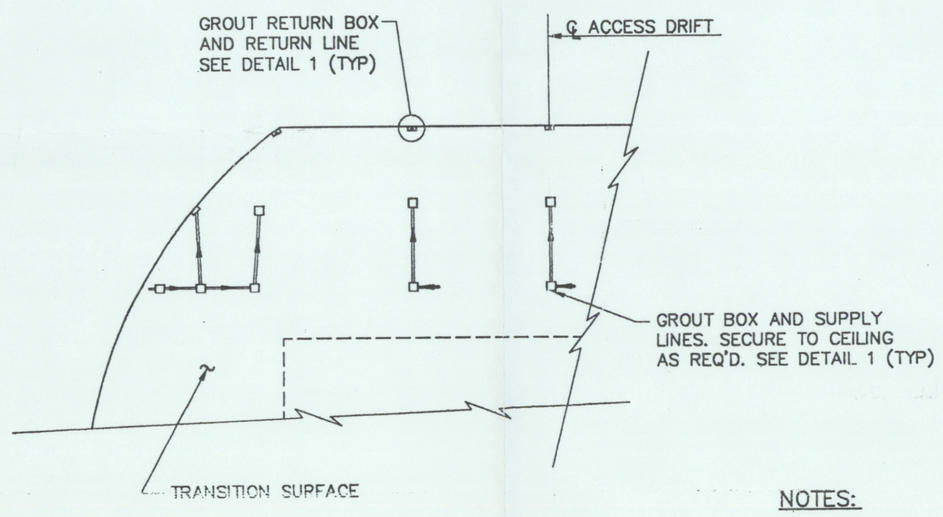
(FOR SECTION LOCATION SEE DWG. 762447–E4)

SCALE: 1/4" = 1'–0"



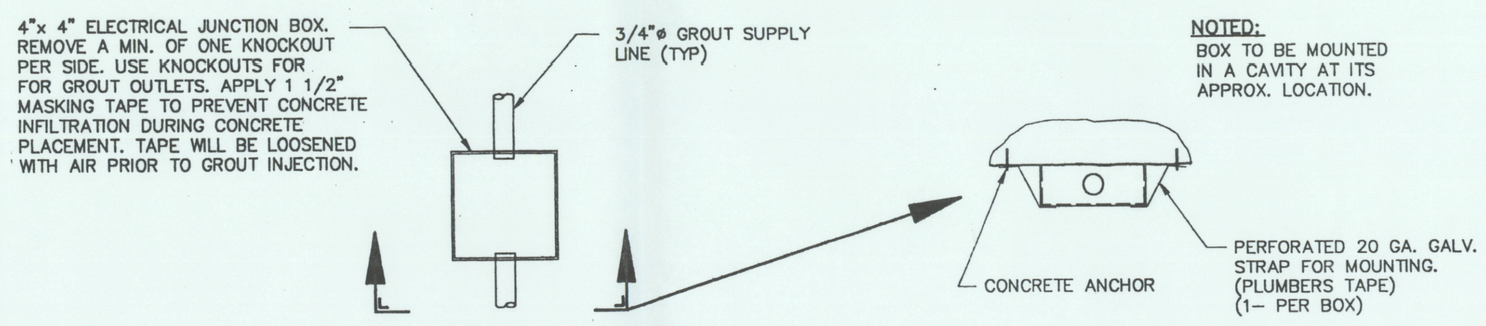
SECTION 1 – 1

SCALE: 1/4" = 1'–0"



SECTION 2 – 2

SCALE: 1/4" = 1'–0"



NOTED:
BOX TO BE MOUNTED IN A CAVITY AT ITS APPROX. LOCATION.

DETAIL 1 (GROUT BOX)

SCALE: 3" = 1'–0"

"Do Not Scale This Drawing"

NOTES:

1. EACH CELL SHALL BE GROUTED BEFORE THE NEXT CELL IS FORMED AND CONCRETE PLACED. PRIOR TO INITIATION OF GROUTING, CONCRETE SHALL BE PERMITTED TO BE CURED FOR A MINIMUM OF 7 DAYS.
2. THE EXACT NUMBER AND LOCATION OF GROUT BOXES FOR INTERFACE GROUTING SHALL BE DETERMINED IN THE FIELD. HOWEVER, THE HIGHEST LOCATION SHALL BE USED FOR RETURN. ADDITIONAL BOXES AND LINES MAY BE INSTALLED AS NEEDED AND/OR DIRECTED BY THE WESTINGHOUSE WID. ALL BOXES AND LINES SHALL BE INSTALLED PRIOR TO PLACEMENT OF CONCRETE.
3. IF GROUT IS NOT RETURNED THROUGH THE RETURN LINE, THEN GROUT SHALL BE INJECTED THROUGH THAT RETURN LINE. AS DIRECTED BY THE WESTINGHOUSE WID, THE CONTRACTOR SHALL DRILL HOLES THROUGH THE CONCRETE TO PERFORM CONTACT GROUTING AS SPECIFIED. THE HOLES SHALL BE DRILLED AT A MINIMUN TO THE INTERFACE OF THE BACK WALL AND CONCRETE BARRIER OR TO THE DEPTH DETERMINED BY THE WESTINGHOUSE WID. TWO HOLES SHALL BE DRILLED AT A MINIMUM FOR EACH LOCATION, I.E. ONE FOR THE GROUT LINE AND ONE FOR THE RETURN LINE. THE EXACT NUMBER AND LOCATION OF HOLES WILL BE DETERMINED IN THE FIELD BY THE WESTINGHOUSE WID.
4. THE OPEN END OF GROUT AND RETURN LINES SHALL BE INDIVIDUALLY TAGGED, LABELED OR COLOR CODED TO DENOTE THEIR PROPER FUNCTION PRIOR TO INSTALLATION OF FORMWORK.
5. GROUTING AND RETURN CONDUITS SHALL BE INSTALLED TO FIT THE EXCAVATION AS REQUIRED AND TO AVOID ANY KINKS.
6. THE DIMENSIONS OF THE JUNCTION BOXES AND DIAMETER OF THE GROUT AND RETURN LINES ARE NOMINAL.

REFERENCE DWG'S.

762447–E2	PANEL CLOSURE SYSTEM UNDERGROUND WASTE DISPOSAL PANEL – PLAN AND GENERAL NOTES
762447–E3	PANEL CLOSURE SYSTEM – AIR INTAKE DRIFT – CONSTRUCTION DETAILS
762447–E4	PANEL CLOSURE SYSTEM AIR EXHAUST DRIFT CONSTRUCTION DETAILS
762447–E5	PANEL CLOSURE SYSTEM – CONSTRUCTION & EXPLOSION WALLS – CONSTRUCTION DETAILS

I.T. DRAWING NUMBER	762447–E6
DRAWN BY	STRIT 09-12-95
CHECKED BY	DCH 10/12/95
APPROVED BY	ARC 11/7/95

REVISION	DATE	BY	CHK'D	APR'VD	DESCRIPTION
A	10/12/95	JES	DCH	ARC	FOR CLIENT REVIEW

NAME	DATE	THIS DRAWING CREATED BY ENGINEERING CHANGE ORDER (ECO):	PWR: N/A
DFTR:		U.S. DEPARTMENT OF ENERGY	
CHKR:		Westinghouse Waste Isolation Division AND IT CORPORATION	
COG:		Waste Isolation Pilot Plant CARLSBAD, NEW MEXICO	
CM:		PANEL CLOSURE SYSTEM AIR INTAKE & EXHAUST DRIFT GROUTING & MISC. DETAILS	
QA:			
SFTY:			
APPD:			
APPD:			
DM:			
DOE:		SIZE E / SYS AU00 / DWG NO 762447–E6 / REV NEW	
		SCALE: AS NOTED / INTERPRET DWG PER ANSI Y14 / DWG: 6 OF 6	

THIS DRAWING TAKEN FROM: N/A
VENDOR: N/A

INDEX CODE NUMBER				
SYSTEM	WBE	DWG TYPE	CL	VENDOR
AU00				