1.1. **AUTHORITY**

This Permit is issued pursuant to the authority of the Secretary of the New Mexico Environment Department (Secretary) under the New Mexico Hazardous Waste Act (HWA), NMSA 1978, §§74-4-1 through 74-4-14, in accordance with the New Mexico Hazardous Waste Management Regulations (HWMR), 20.4.1 NMAC.

Pursuant to the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§6901 to 6992k, and 40 CFR Part 271 and Part 272 Subpart GG, the State of New Mexico, through the Secretary, is authorized to administer and enforce the state hazardous waste management program under the HWA in lieu of the federal program.

This Permit contains terms and conditions that the Secretary has determined are necessary to protect human health and the environment, pursuant to 20.4.1.900 NMAC (incorporating 40 CFR §270.32(b)(2)).

Any violation of a condition in this Permit may subject the Permittees or their officers, employees, successors, and assigns to:

1) A compliance order under §74-4-10 of the HWA or §3008(a) of RCRA (42 U.S.C. §6928(a));

2) An injunction under §74-4-10 of the HWA or §3008(a) of RCRA (42 U.S.C. §6928(a)), or §7002(a) of RCRA (42 U.S.C. §6972(a));

3) Civil penalties under §§74-4-10 and 74-4-10.1 of the HWA or §§3008(a) and (g) of RCRA (42 U.S.C. §§6928(a) and (g)), or §7002(a) of RCRA (42 U.S.C. §6972(a));

4) Criminal penalties under §74-4-11 of the HWA or §§3008(d), (e), and (f) of RCRA (42 U.S.C. §§6928(d), (e), and (f)); or

5) Some combination of the foregoing.

The list of authorities in this paragraph is not exhaustive and the Secretary reserves the right to take any action authorized by law to enforce the requirements of this Permit.

1.2. **EFFECT OF PERMIT**

The Secretary issues this Permit to the United States Department of Energy (DOE), the owner and co-operator of the Waste Isolation Pilot Plant (WIPP) (EPA I.D. Number NM4890139088), and Nuclear Waste Partnership LLC, Management and Operating Contractor (MOC), the co-operator of WIPP. This Permit authorizes DOE and MOC (the Permittees) to manage, store, and dispose contact-handled (CH) and remote-handled (RH) transuranic (TRU) mixed waste at WIPP, and establishes the general and specific standards for these activities, pursuant to the HWA and HWMR.
As to those activities specifically authorized or otherwise specifically addressed under this Permit, compliance with this Permit during its term shall constitute compliance, for purposes of enforcement, with Subtitle C of RCRA and the HWA, and the implementing regulations at 40 CFR Parts 264, 266, and 268 except for those requirements that become effective by statute after the Permit has been issued [20 4.1.900 NMAC (incorporating 40 CFR §270.4)]

Compliance with this Permit shall not constitute a defense to any order issued or any action brought under Sections 74-4-10.E or 74-4-13 of the HWA; Sections 3008(a), 3008(h), 3013, or 7003 of RCRA; the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. §9601 et seq., commonly known as CERCLA) Sections 106(a), 104, or 107; or any other federal, state, or local law providing for protection of public health or the environment. This Permit does not convey any property rights of any sort or any exclusive privilege, nor authorize any injury to persons or property, any invasion of other private rights, or any infringement of State or local laws or regulations. [20.4.1.900 NMAC (incorporating 40 CFR §§270.4, 270.30(g), and 270.32(b)(1))]

1.3. PERMIT ACTIONS

1.3.1. Permit Modification, Suspension, and Revocation

This Permit may be modified, suspended, and/or revoked for cause as specified in Section 74-4-4.2 of the HWA and 20.4.1.900 NMAC (incorporating 40 CFR §§270.41, 270.42, and 270.43). The filing of a request by the Permittees for a permit modification, suspension, or revocation, or the notification of planned changes or anticipated noncompliance, shall not stay any permit condition. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(f))]

1.3.2. Permit Renewal

The Permittees may renew this Permit by submitting an application for a new Permit at least 180 calendar days before the expiration date of this Permit. In reviewing any application for a Permit renewal, the Secretary shall consider improvements in the state of control and measurement technology and changes in applicable regulations. [20.4.1.900 NMAC (incorporating 40 CFR §§270.10(h) and 270.30(b))]

1.3.3. Permit Review

The Secretary shall review this Permit no later than five (5) years after the effective date of this Permit, and shall modify this Permit as necessary pursuant to Section 74-4-4.2 of the HWA and 20.4.1.900 NMAC (incorporating 40 CFR §270.41). Such modification(s) shall not extend the effective term of this Permit specified in Permit Section 1.7.2. [20.4.1.900 NMAC (incorporating 40 CFR §§270.41 and 270.50(b) and (d))]

1.4. SEVERABILITY

The provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstance is held invalid, the application of such provision to
other circumstances and the remainder of this Permit shall not be affected thereby. [40 CFR §124.16(a)(1) and (2)]

1.5. DEFINITIONS

Unless otherwise expressly provided herein, the terms used in this Permit shall have the meaning set forth in RCRA, HWA, and/or their implementing regulations.

1.5.1. Contact-handled Transuranic Mixed Waste

“Contact-handled transuranic mixed waste” means transuranic mixed waste with a surface dose rate not greater than 200 millirem per hour. [Pub. L. 102-579 (1992)]

1.5.2. Remote-handled Transuranic Mixed Waste

“Remote-handled transuranic mixed waste” means transuranic mixed waste with a surface dose rate of 200 millirem per hour or greater. For WIPP, the surface dose rate shall not exceed 1,000 rems per hour. [Pub. L. 102-579 (1992)]

1.5.3. Facility

“Facility” or “permitted facility” means the Waste Isolation Pilot Plant (WIPP) owned by the DOE and located approximately twenty six (26) miles east of Carlsbad, New Mexico, EPA I.D. Number NM4890139088. The WIPP facility comprises the entire complex within the WIPP Site Boundary as specified in the WIPP Land Withdrawal Act of 1992, Pub. L. 102-579 (1992), including all contiguous land, and structures, other appurtenances, and improvements on the Permittees' land, used for management, storage, or disposal of TRU mixed waste.

1.5.4. Permittees

“Permittees” means the United States Department of Energy (DOE), an agency of the Federal government, and the owner and co-operator of the WIPP facility; and Nuclear Waste Partnership LLC, Management and Operating Contractor (MOC), the co-operator of the WIPP facility. References to actions taken by “the Permittees” indicate actions that may be taken by either co-Permittee.

1.5.5. Secretary

“Secretary” means the Secretary of the New Mexico Environment Department (NMED), or designee.

1.5.6. TRU Waste

“TRU Waste” means waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for (A) high-level radioactive waste; (B) waste that the DOE Secretary has determined, with the
concurrence of the EPA Administrator, does not need the degree of isolation required by the disposal regulations; or (C) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with part 61 of title 10, Code of Federal Regulations. [Pub. L. 102-579 (1992)]

1.5.7. **TRU Mixed Waste**

“TRU Mixed Waste” means TRU waste that is also a hazardous waste as defined by the HWA and 20.4.1.200 NMAC (incorporating 40 CFR §261.3).

1.5.8. **Contact Handled Packages**

“Contact Handled Packages” means TRUPACT-II, HalfPACT, and TRUPACT-III shipping containers and their contents.

1.5.9. **Remote-Handled Packages**

“Remote-Handled Packages” means both CNS 10-160B and RH-TRU 72-B shipping containers and their contents.

1.5.10. **Containment Pallet**

“Containment pallet” means a device capable of holding a minimum of one 55-gallon drum, or 85-gallon drum, or 100-gallon drum or a standard waste box, or a ten-drum overpack and that has internal containment for up to ten percent of the volume of the containers on the containment pallet.

1.5.11. **Waste Characterization**

“Waste characterization” or “characterization” means the activities performed by or on behalf of the waste generator/storage sites (sites) to obtain information used by the Permittees to satisfy the general waste analysis requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.13(a)). Characterization occurs before waste containers have been certified for disposal at WIPP.

1.5.12. **Waste Confirmation**

“Waste confirmation” or “confirmation” means the activities performed by the Permittees or the co-Permittee DOE, pursuant to Permit Attachment C7 (TRU Waste Confirmation), to satisfy the requirements specified in Section 310 of Pub. L. 108-447. Confirmation occurs after waste containers have been certified for disposal at WIPP.

1.5.13. **Substantial Barrier**

“Substantial barrier” means salt or other non-combustible material installed between the waste face and the bulkhead to protect the waste from events such as ground movement or
vehicle impacts. The substantial barrier incorporates the chain link and brattice cloth room closure specified in Permit Attachment A2.

1.5.14. **Bulkhead**

“Bulkhead” means a steel structure, with flexible flashing, that is used to block ventilation as specified in Permit Attachment A2 (Geologic Repository).

1.5.15. **Explosion-Isolation Wall**

“Explosion-isolation wall” means the 12-foot wall intended as an explosion isolation device that has been constructed in Panels 1, 2, and 5 and is incorporated into the panel closure design as is part of the approved panel closure system (Detailed Design Report for an Operation Phase Panel Closure System).

1.5.16. **Filled Panel**

“Filled panel” means an Underground Hazardous Waste Disposal Unit specified in Permit Part 4 that will no longer receive waste for emplacement.

1.5.17. **Internal Container**

“Internal container” means a container inside the outermost container examined during radiography or visual examination (VE). Drum liners, liner bags, plastic bags used for contamination control, capillary-type labware, and debris not designed to hold liquid at the time of original waste packaging are not internal containers.

1.5.18. **Observable Liquid**

“Observable liquid” means liquid that is observable using radiography or VE as specified in Permit Attachment C (Waste Analysis Plan).

1.5.19. **Filled Room**

“Filled Room” means a room in an Underground Hazardous Waste Disposal Unit as specified in Permit Part 4 that will no longer receive waste for emplacement.

1.5.20. **Active Room**

“Active Room” means a room in an Underground Hazardous Waste Disposal Unit as specified in Permit Part 4 that contains emplaced TRU waste and is not a filled room.
1.6. **EFFECT OF INACCURACIES IN PERMIT APPLICATION**

This Permit is based on the assumption that all information contained in the permit application and the administrative record is accurate and that the Facility will be constructed and operated as specified in the application. The permit application consists of information submitted in September 2009 and supplementary technical documents.

Any inaccuracies found in the submitted information may be grounds for the termination or modification of this Permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.41, §270.42, and §270.43) and for potential enforcement action.

1.7. **DUTIES AND REQUIREMENTS**

1.7.1. **Duty to Comply**

The Permittees shall comply with all conditions of this Permit, except to the extent and for the duration such noncompliance is authorized in an emergency permit specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.61). Any Permit noncompliance, except under the terms of an emergency permit, constitutes a violation of RCRA and/or HWA and is grounds for enforcement action; for Permit modification, suspension, or revocation; or for denial of a Permit modification or renewal application. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(a))]

1.7.2. **Permit Term**

This Permit shall be effective for a fixed term not to exceed ten years from the effective date. The effective date of this Permit shall be 30 days after notice of the Secretary’s decision has been served on the Permittees or such later time as the Secretary may specify. [20.4.1.900 NMAC (incorporating 40 CFR §270.50(a))]

1.7.3. **Duty to Reapply**

If the Permittees wish to continue an activity regulated by this Permit after the expiration date of this Permit, the Permittees shall apply for and obtain a new Permit. The Permittees shall submit an application for a new Permit at least 180 calendar days before the expiration date of this Permit. [20.4.1.900 NMAC (incorporating 40 CFR §§270.10(h), 270.30(b))]

1.7.4. **Continuation of Expiring Permits**

If the Permittees have submitted a timely and complete application for renewal of this Permit as specified in 20.4.1.900 NMAC (incorporating 40 CFR §§270.10, 270.13 through 270.29), this Permit shall remain in effect until the effective date of the new Permit if, through no fault of the Permittees, the Secretary has not issued a new Permit on or before the expiration date of this Permit. [20.4.1.900 NMAC (incorporating 40 CFR §270.51)]
1.7.5.  **Need to Halt or Reduce Activity Not a Defense**

It shall not be a defense for the Permittees in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(c))]

1.7.6.  **Duty to Mitigate**

In the event of noncompliance with this Permit, the Permittees shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(d))]

1.7.7.  **Proper Operation and Maintenance**

The Permittees shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittees to achieve compliance with the conditions of this Permit. Proper operation and maintenance shall include effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance/quality control procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this Permit. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(e))]

1.7.8.  **Duty to Provide Information**

The Permittees shall furnish to the Secretary, within a reasonable time frame as specified by the Secretary, any relevant information which the Secretary may request to determine whether cause exists for modifying, suspending, or revoking this Permit, or to determine compliance with this Permit. The Permittees shall also furnish to the Secretary, upon request, copies of records required to be kept by this Permit. Information and records requested by the Secretary pursuant to this condition shall be provided in a paper or an electronic format acceptable to the Secretary. [20.4.1.500 and .900 NMAC (incorporating 40 CFR §§264.74(a) and 270.30(h))]

1.7.9.  **Inspection and Entry**

The Permittees shall allow the Secretary, or authorized representatives, upon the presentation of credentials and other documents as may be required by law and at reasonable times, the following inspection and entry privileges specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.30(i)):

1.7.9.1.  **Entrance to Premises**

To enter upon the Permittees' premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Permit;
1.7.9.2. **Access to Records**

To have access to and copy any records that must be kept under the conditions of this Permit;

1.7.9.3. **Inspection**

To have access to, inspect, and obtain photographs of any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

1.7.9.4. **Sampling**

To sample or monitor, for the purposes of assuring Permit compliance or as otherwise authorized by RCRA and/or HWA, any substances or parameters at any location. If the Secretary obtains any sample, prior to leaving the premises the Secretary shall give the Permittees a receipt describing the sample obtained and, if requested, a portion of each sample of equal weight or volume to the portion retained. If any analysis is made of the sample, the Secretary shall promptly furnish a copy of the results of the analysis to the Permittees.

Permit Section 1.7.9 shall not be construed to limit, in any manner, the Secretary's authority under Section 74-4-4.3 of the HWA.

1.7.10. **Monitoring and Records**

1.7.10.1. **Representative Sampling**

For the purposes of monitoring, the Permittees shall take samples and measurements representative of the monitored activity. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(j)(1))]

1.7.10.2. **Record Retention**

Beginning with the effective date of this Permit, the Permittees shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, and copies of all reports and records required by this Permit until closure. If original strip chart recordings are more than three years old, copies are acceptable. The Permittees shall retain the waste minimization certification required by 20.4.1.500 NMAC (incorporating 40 CFR §264.73(b)(9)), and records of all data used to complete the application for this Permit for a period of at least 3 years from the date of certification or application. The Secretary may extend these periods at any time, and these periods shall be automatically extended during the course of any unresolved enforcement action.
regarding this facility. The Permittees shall maintain records from all
ground-water monitoring wells and associated ground-water surface
elevations, during the active life of the facility and the post-closure
period. [20.4.1.500 NMAC (incorporating 40 CFR §264.74(b)),
20.4.1.501 NMAC, and 20.4.1.900 (incorporating §270.30(j)(2))]

1.7.10.3. Monitoring Records Contents

As specified by 20.4.1.900 NMAC (incorporating 40 CFR §270.30(j)(3)),
records of monitoring information shall include:

i. The dates, exact place, and times of sampling or measurements;

ii. The names of individuals who performed the sampling or
measurements;

iii. The dates analyses were performed;

iv. The names of individuals who performed the analyses;

v. The names of analytical techniques or methods used; and

vi. The results of such analyses.

1.7.11. Reporting Requirements

1.7.11.1. Reporting Planned Changes

The Permittees shall give notice to the Secretary, as soon as possible, of
any planned physical alterations or additions to the permitted facility. The
Permittees shall post a link to the planned change notice transmittal letter
on the WIPP Home Page and inform those on the e-mail notification list
as specified in Permit Section 1.11. [20.4.1.900 NMAC (incorporating 40
CFR §270.30(l)(1))]

1.7.11.2. Reporting Anticipated Noncompliance

The Permittees shall give advance notice to the Secretary of any planned
changes in the permitted facility or activity which may result in
noncompliance with permit requirements. The Permittees shall post a link
to the planned change notice transmittal letter on the WIPP Home Page
and inform those on the e-mail notification list as specified in Permit
Section 1.11. The Permittees shall not store or dispose TRU mixed waste
in any modified portion of the facility (except as provided in 20.4.1.900
NMAC (incorporating 40 CFR §270.42)) until the following conditions
specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.30(l)(2)) are
satisfied:
i. The Permittees have submitted to the Secretary, by certified mail or hand delivery, a letter signed by the Permittees and a New Mexico registered professional engineer stating that the facility has been constructed or modified in compliance with this Permit, and:

ii. The Secretary has either inspected the modified portion of the facility and finds it is in compliance with the conditions of this Permit; or waived the inspection or, within 15 calendar days of the date of submission of the letter required above, has not notified the Permittees of his intent to inspect.

1.7.12. Transfer of Permits

The Permittees shall not transfer this Permit to any person, unless the Secretary has approved a permit modification request for such transfer in writing. The Secretary shall require modification or revocation and reissuance of this Permit as specified by 20.4.1.900 NMAC (incorporating 40 CFR §§270.40 and 270.41(b)(2)) to identify the new Permittees and incorporate other applicable requirements under the HWA, RCRA, and their implementing regulations. The prospective new Permittee shall file a disclosure statement with the Secretary, if applicable and as specified at §74-4-4.7 of the HWA, prior to modification or revocation and re-issuance of the Permit.

Before transferring ownership or operation of the facility during its active life or post-closure care period, the Permittees shall notify the new owner or operator in writing as required by 20.4.1.500 and .900 NMAC (incorporating 40 CFR §§264.12(c) and 270.30(l)(3)).

1.7.13. 24 Hour and Subsequent Reporting

1.7.13.1. Oral Report

As required by 20.4.1.900 NMAC (incorporating 40 CFR §270.30(l)(6)(i)), within 24 hours from the time the Permittees become aware of the circumstances, the Permittees shall report orally to the Secretary any noncompliance which may endanger human health or the environment, including:

i. Information concerning release of any TRU mixed or hazardous waste that may cause an endangerment to public drinking water supplies; and

ii. Any information of a release or discharge of TRU mixed or hazardous waste, or of a fire or explosion from the facility, which could threaten the environment or human health outside the facility.
The oral report shall be made by calling the Hazardous Waste Bureau’s main telephone number during regular business hours, or by calling the New Mexico Department of Public Safety dispatch telephone number during non-business hours, and requesting that the report be forwarded to the NMED spill number.

1.7.13.2. **Description of Occurrence**

The description of the occurrence and its cause shall include:

i. Name, address, and telephone number of the Permittees;

ii. Name, address, and telephone number of the facility;

iii. Date, time, and type of incident;

iv. Name and quantity of materials involved;

v. The extent of injuries, if any;

vi. An assessment of actual or potential hazards to the environment and human health outside the facility, where this is applicable; and

vii. Estimated quantity and disposition of recovered material that resulted from the incident. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(l)(6)(ii))]

1.7.13.3. **Written Notice**

As required by 20.4.1.900 NMAC (incorporating 40 CFR §270.30(l)(6)(iii)), the Permittees shall submit a written notice within five calendar days of the time the Permittees become aware of the circumstances. The written notice shall contain the information required in Permit Section 1.7.13.2 and the following information:

i. A description of the noncompliance and its cause;

ii. The period(s) of the noncompliance including exact dates and times and, if the noncompliance has not been corrected, the anticipated time it is expected to continue; and

iii. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

The Secretary may waive the five-day written notice requirement in favor of a written report within 15 calendar days if justifiable cause is provided in advance. The Permittees shall post a link to the written notice or report...
transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

1.7.13.4. **Contingency Plan Implementation**

If the Contingency Plan is implemented, the Permittees shall comply with the reporting requirements specified in Permit Attachment D (RCRA Contingency Plan). [20.4.1.500 NMAC (incorporating 40 CFR §264.56(j))]

1.7.14. **Other Noncompliance**

The Permittees shall report to the Secretary all other instances of noncompliance not otherwise required to be reported above, in Permit Sections 1.7.10 through 1.7.13, at the time monitoring reports are submitted annually in October. The reports shall contain the information specified in Permit Section 1.7.13 and 20.4.1.900 NMAC (incorporating 40 CFR §270.30(l)(10)).

1.7.15. **Other Information**

Whenever the Permittees become aware that they failed to submit any relevant facts in the Permit application, or submitted incorrect information in the Permit application or in any report to the Secretary, the Permittees shall promptly submit such facts or information in writing to the Secretary. The Permittees shall post a link to the transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(l)(11))]

1.8. **ADMISSIBILITY OF DATA**

The Permittees waive any objection to the admissibility as evidence of any data required by this Permit in any administrative or judicial action to enforce a condition of this Permit.

1.9. **SIGNATORY REQUIREMENT**

The Permittees shall sign and certify, as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.11) all applications, reports required by this Permit, or information submitted to or requested by the Secretary. [20.4.1.900 NMAC (incorporating 40 CFR §270.30(k))]

1.10. **SUBMITTAL OF REPORTS, NOTIFICATIONS, AND INFORMATION TO THE SECRETARY**

1.10.1. **Information Submittal**

The Permittees shall submit, by certified mail or hand delivery or by electronic transmittal with a subsequent hard copy, all reports, notifications, or other submissions which are submitted to or requested by the Secretary or required by this Permit, to:
1.10.2. **Approval of Submittals**

All documents prepared by the Permittees under the terms of this Permit and submitted to the Secretary that are subject to the provisions of 20.4.2 NMAC shall be subject to the procedures set forth therein. Documents requiring the Secretary’s approval that are not subject to the provisions of 20.4.2 NMAC may be reviewed and approved, approved with modifications or directions, disapproved, denied, or rejected by the Secretary.

Submittals and associated schedules, upon the Secretary’s written approval, shall become enforceable as part of this Permit in accordance with the terms of the Secretary’s written approval, and such documents, as approved, shall control over any contrary or conflicting requirements of this Permit. This provision does not affect any public process that is otherwise required by this Permit, the HWA, or its implementing regulations, including 40 CFR §270.42 and 20.4.1.901 NMAC.

1.10.3. **Extension of Time**

The Permittees may seek an extension of time in which to perform a requirement of this Permit, for good cause, by sending a written request for extension of time and proposed revised schedule to the Secretary. The request shall state the length of the requested extension and describe the basis for the request. The Secretary will respond in writing to any request for extension following receipt of the request. If the Secretary denies the request for extension, reasons for the denial will be stated.

1.11. **PUBLIC E-MAIL NOTIFICATION LIST**

The Permittees shall develop and maintain an e-mail list to notify members of the public concerning actions identified in this Permit requiring e-mail notification. The Permittees shall send e-mail notifications required by this Permit to the e-mail list within seven days of the submittal date to the Secretary and shall include in the e-mail a direct link to the specific document to which it relates. The Permittees shall provide a link on the WIPP Home Page <http://www.wipp.energy.gov> whereby members of the public may review the actions requiring e-mail notification and submit a request to be placed on this list.

1.12. **CONFIDENTIAL INFORMATION**

The Permittees may claim confidentiality for any information submitted to or requested by the Secretary or required by this Permit. Any such claim must be asserted at the time of submittal in the manner prescribed on the application form, or in the case of other submittals, by stamping the words
“confidential business information” on each page containing such information. If no claim is made, the Secretary may make the information available to the public without further notice. If a claim is asserted, the information will be treated in accordance with the procedures in 40 CFR Part 2 (Public Information), to the extent authorized by Section 74-4-4.3(D) and (F) of the HWA and 20.4.1.100 and .900 NMAC (incorporating 40 CFR §260.2 and §270.12).

1.13. DOCUMENTS TO BE MAINTAINED AT THE FACILITY

The Permittees shall comply with the recordkeeping and reporting requirements specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.73(a)) and elsewhere in this Permit.

The Permittees shall maintain at the facility, until closed as specified in Part 6, the following documents and all amendments, revisions and modifications to these documents:

1. Waste Analysis Plan, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.13(b)) and this Permit, and records and results of waste analyses performed as specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.13).

2. Inspection schedules, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(2)) and this Permit, and records and results of inspections as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.15(d)).

3. Personnel training documents and records, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.16(d)) and this Permit.

4. Contingency Plan, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.53(a)) and this Permit, including summary reports and details of all incidents that require implementation of the contingency plan as specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.56(j)).

5. Operating record, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.73) and this Permit.

6. Closure Plan, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.112(a)) and this Permit.

7. Post-Closure Plan as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.118(a)) and this Permit.

8. Procedures for limiting air emissions, as required by 20.4.1.500 and .900 NMAC (incorporating 40 CFR §§264.601(c) and 270.23(a)(2)) and this Permit.

9. All other documents required by Part 1, Permit Section 1.7.10, and Part 2.
1.14. INFORMATION REPOSITORY

1.14.1. Requirement for Information Repository

The Permittees shall establish and maintain an electronic Information Repository (IR) in accordance with the requirements of 20.4.1.1102 NMAC (incorporating 40 CFR §§124.33(c) through (f)) and 20.4.1.900 NMAC (incorporating 40 §270.30(m)). The documents contained in the IR shall be accessible to the public from the WIPP Home Page.

The Permittees shall establish the IR no later than the effective date of this Permit.

1.14.2. Contents of Information Repository

The Permittees shall ensure that the IR contains the following documents:

1. The Permittees’ Part A and Part B Permit Applications associated with the permit renewal;
2. A complete copy of this Permit, as it may be modified;
3. Permit modification notifications and requests associated with this Permit submitted pursuant to 20.4.1. 900 NMAC (incorporating 40 CFR §270.42) and any associated responses from the Secretary;
4. The Waste Minimization Report submitted pursuant to Permit Section 2.4;
5. Requests for extensions of time submitted pursuant to Permit Section 1.10.3;
6. Corrective action documents submitted pursuant to Permit Part 8;
7. Each report submitted pursuant to Permit Sections 1.7.11 and 1.7.13 if such report is required to be submitted in writing;
8. Notices of deficiency or disapproval (NODs), NOD responses, final approval letters, and directives from the Secretary associated with the documents identified in paragraphs 1, 3, and 6 above;
9. Notices of violation, administrative compliance orders, responses to these documents required by the Secretary, and directives from the Secretary associated with the Permit;

1.14.3. Index of Information Repository

The Permittees shall ensure that the IR includes an index of the documents contained in the IR identifying all document titles, publications dates, and authors. This index shall be
accessible on the internet through the WIPP Home Page. The Permittees shall ensure that all documents are searchable and printable.

The Permittees shall add new documents to the IR within ten days after the new documents are submitted to, or received from, the Secretary.

1.14.4. Notification to Public of Information Repository

The Permittees shall inform the public of the existence of the IR and how it may be accessed by the following methods:

1. Written notice to all individuals on the facility mailing list 30 days after the IR becomes operational;
2. Public notice in area newspapers, including the Carlsbad Current-Argus, Albuquerque Journal, and Santa Fe New Mexican, when the IR becomes operational;
3. Continuous notice on the WIPP Home Page of the existence of the IR; and
4. In the public notice related to any permit modification notification or request submitted by the Permittees, including permit renewals.

1.15. COMMUNITY RELATIONS PLAN

1.15.1. Requirement for Community Relations Plan

The Permittees shall establish and implement a Community Relations Plan (CRP) to describe how the Permittees will keep communities and interested members of the public informed of Permit-related activities, including waste management, closure, post-closure, and corrective action, as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.32(b)(2)). The CRP shall explain how communities and interested members of the public can participate in Permit-related activities.

The Permittees shall implement and post the CRP on the WIPP Home Page within 180 days of the effective date of this Permit. The Permittees shall maintain the CRP until the termination of this Permit.

1.15.2. Contents of Community Relations Plan

The CRP must describe how the Permittees will accomplish the following elements:

1. Identify and establish an open working relationship with communities and interested members of the public;
2. Establish a productive government-to-government relationship between the Permittee DOE and affected tribes and pueblos;
3. Keep communities and interested members of the public informed of permit actions of interest (e.g., implementation of the Contingency Plan, Permit modification requests, Permit compliance issues);

4. Minimize disputes and resolve differences with communities and interested members of the public;

5. Provide a mechanism for the timely dissemination of information in response to individual requests; and

6. Provide a mechanism for communities and interested members of the public to provide feedback and input to the Permittees.

1.15.3. **Government to Government Consultation**

DOE shall consult on a government-to-government basis with affected tribes and pueblos in New Mexico when developing the CRP in an effort to ensure the program is responsive to their needs. DOE shall document in the operating record of this Permit and post on the WIPP Home Page all consultations, communications, agreements, and disagreements between DOE and affected tribes and pueblos in New Mexico only with the express approval of those entities, regarding the development of the CRP. The CRP shall specify how DOE will consult on a government-to-government basis with affected tribes and pueblos annually concerning how they may be made better informed of the issues related to this Permit.

1.15.4. **Initial Consultation on Community Relations Plan**

The Permittees shall communicate with and solicit comments from communities and interested members of the public when developing the CRP in an effort to ensure the program is responsive to their needs. The Permittees shall document in the operating record of this Permit all consultations, communications, agreements, and disagreements between the Permittees and all participating entities, with the approval of those entities, regarding the development of the CRP.

1.15.5. **Annual Compilation of Comments on Community Relations Plan**

The CRP shall specify how the Permittees will solicit comments from communities and interested members of the public annually concerning how they may be made better informed of the issues related to this Permit. The CRP shall specify that the Permittees will annually post on the WIPP Home Page a compilation of all such comments, including any statements of disagreement, with the approval of those entities in a manner set forth in the CRP.
1.16. **DISPUTE RESOLUTION**

1.16.1. **Applicability**

In the event DOE disagrees, in whole or in part, with either an action on a final audit report by NMED (as specified in Permit Section 2.3.2.4) or an evaluation by NMED of DOE’s provisional approval of an AK Sufficiency Determination Request for a particular waste stream (as specified in Permit Attachment C), DOE may seek dispute resolution. The dispute resolution procedure in this Permit Section shall be the exclusive mechanism for resolving disputes related to NMED’s final audit report action or a determination that DOE’s provisional approval for a particular waste stream is inadequate.

1.16.2. **Notice to NMED**

To invoke dispute resolution, DOE shall notify NMED in writing within seven calendar days of receipt of the action or determination in dispute. Such notice shall be sent to the Hazardous Waste Bureau Chief and must set forth the specific matters in dispute, the position DOE asserts should be adopted, a detailed explanation for DOE’s position, and any other matters considered necessary for the dispute resolution. For AK Sufficiency Determination disputes, DOE shall also submit all factual data, analysis, opinion, and other documentation upon which they relied for their provisional approval, and any other information that supports their position. NMED shall acknowledge receipt of notification by e-mail sent to DOE’s representative as designated in their written notification.

1.16.3. **Tier I - Informal Negotiations**

DOE and NMED shall make all reasonable, good faith efforts to informally resolve disputes related to NMED’s determination. DOE and NMED shall meet or teleconference within 15 calendar days from NMED’s receipt of notice to commence negotiations to resolve the dispute. DOE and NMED shall have 30 calendar days from NMED’s receipt of notice to resolve the dispute. If an agreement is reached, NMED shall promptly inform DOE of the terms of the agreement in writing. DOE shall comply with the terms of such agreement or, if appropriate, submit a revised submittal and implement the same in accordance with such agreement. If an agreement is not reached, NMED shall promptly inform DOE in writing that an agreement has not been reached.

1.16.4. **Tier II - Final Decision of the Secretary**

In the event agreement is not reached within the 30 calendar day period, DOE may submit a written Request for Final Decision to the Secretary. The Request must be submitted within seven calendar days after receipt of notification from NMED that an agreement under Tier I was not reached. The Secretary will notify the Permittees in writing of the decision on the dispute, and the Permittees shall comply with the terms and conditions of the decision. Such decision shall be the final resolution of the dispute and shall be enforceable under this Permit.
1.16.5. Actions Not Affected by Dispute

With the exception of those matters under dispute, the Permittees shall proceed to take any action required by those portions of the submission and of this Permit that NMED determines are not affected by the dispute.

1.16.6. E-Mail Notifications

If DOE submits a notice to NMED pursuant to Permit Section 1.16.2, the Permittees shall post a link to the notice on the WIPP Home Page, and inform those on the e-mail notification list as specified in Permit Section 1.11. After receipt of NMED’s letter concerning the conclusion of any Tier I negotiations, the Permittees shall post a link to the NMED letter on the WIPP Home Page, and shall inform those on the e-mail notification list as specified in Permit Section 1.11. If a Tier I agreement is not reached and DOE submits a Tier II request for final decision to the Secretary, the Permittees shall post a link to the request on the WIPP Home Page, and shall inform those on the e-mail notification list as specified in Permit Section 1.11. After receiving notice of the final action by the Secretary, the Permittees shall post a link to the final action on the WIPP Home Page and shall inform those on the e-mail notification list as specified in Permit Section 1.11.
PERMIT ATTACHMENTS

Permit Attachment A2 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Geologic Repository” - Appendix M2).

Permit Attachment C (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Waste Analysis Plan” - Chapter B).

Permit Attachment C7 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Permittee Level TRU Waste Confirmation Processes” - Appendix B7).

Permit Attachment D (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “RCRA Contingency Plan” - Chapter F).

Permit Attachment G1, “WIPP Panel Closure (WPC) Description and Specifications.” (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Detailed Design Report for an Operation Phase Panel Closure System”—Appendix I1)
PART 1 - GENERAL PERMIT CONDITIONS

1.1. AUTHORITY ................................................................. 1
1.2. EFFECT OF PERMIT .................................................. 1
1.3. PERMIT ACTIONS ...................................................... 2
1.3.1. Permit Modification, Suspension, and Revocation ........... 2
1.3.2. Permit Renewal ...................................................... 2
1.3.3. Permit Review ...................................................... 2
1.4. SEVERABILITY ......................................................... 2
1.5. DEFINITIONS .......................................................... 3
1.5.1. Contact-handled Transuranic Mixed Waste ................. 3
1.5.2. Remote-handled Transuranic Mixed Waste ................. 3
1.5.3. Facility ................................................................. 3
1.5.4. Permittees ........................................................... 3
1.5.5. Secretary ............................................................. 3
1.5.6. TRU Waste .......................................................... 3
1.5.7. TRU Mixed Waste ................................................ 4
1.5.8. Contact Handled Packages .................................... 4
1.5.9. Remote-Handled Packages ..................................... 4
1.5.10. Containment Pallet ................................................. 4
1.5.11. Waste Characterization ......................................... 4
1.5.12. Waste Confirmation .............................................. 4
1.5.13. Substantial Barrier ............................................... 4
1.5.14. Bulkhead ............................................................. 5
1.5.15. Explosion-Isolation Wall ....................................... 5
1.5.16. Filled Panel .......................................................... 5
1.5.17. Internal Container ................................................ 5
1.5.18. Observable Liquid ................................................ 5
1.6. EFFECT OF INACCURACIES IN PERMIT APPLICATION .... 6
1.7. DUTIES AND REQUIREMENTS ................................ 6
1.7.1. Duty to Comply ................................................... 6
1.7.2. Permit Term ........................................................ 6
1.7.3. Duty to Reapply ................................................... 6
1.7.4. Continuation of Expiring Permits ............................. 6
1.7.5. Need to Halt or Reduce Activity Not a Defense ........... 7
1.7.6. Duty to Mitigate ................................................... 7
1.7.7. Proper Operation and Maintenance .......................... 7
1.7.8. Duty to Provide Information ................................... 7
1.7.9. Inspection and Entry .............................................. 7
1.7.9.1. Entrance to Premises ........................................ 7
1.7.9.2. Access to Records ............................................ 8
1.7.9.3. Inspection ........................................................ 8
1.7.9.4. Sampling ........................................................ 8
1.7.10. Monitoring and Records ........................................ 8
1.7.10.1. Representative Sampling ................................... 8
1.7.10.2. Record Retention .......................................... 8
1.7.10.3. Monitoring Records Contents ............................ 9
1.7.11. Reporting Requirements ................................................................. 9
  1.7.11.1. Reporting Planned Changes .................................................. 9
  1.7.11.2. Reporting Anticipated Noncompliance ............................... 9
1.7.12. Transfer of Permits ....................................................................... 10
1.7.13. 24 Hour and Subsequent Reporting .............................................. 10
  1.7.13.1. Oral Report ........................................................................ 10
  1.7.13.2. Description of Occurrence ................................................... 11
  1.7.13.3. Written Notice .................................................................... 11
  1.7.13.4. Contingency Plan Implementation ...................................... 12
1.7.14. Other Noncompliance ................................................................. 12
1.7.15. Other Information ........................................................................ 12
1.8. ADMISSIBILITY OF DATA ................................................................. 12
1.9. SIGNATORY REQUIREMENT .............................................................. 12
1.10. SUBMITTAL OF REPORTS, NOTIFICATIONS, AND INFORMATION
     TO THE SECRETARY ........................................................................... 12
  1.10.1. Information Submittal ............................................................... 12
  1.10.2. Approval of Submittals ............................................................. 13
  1.10.3. Extension of Time ...................................................................... 13
1.11. PUBLIC E-MAIL NOTIFICATION LIST ............................................. 13
1.12. CONFIDENTIAL INFORMATION ...................................................... 13
1.13. DOCUMENTS TO BE MAINTAINED AT THE FACILITY .................. 14
1.14. INFORMATION REPOSITORY .......................................................... 15
  1.14.1. Requirement for Information Repository ................................. 15
  1.14.2. Contents of Information Repository ......................................... 15
  1.14.3. Index of Information Repository ................................................ 15
  1.14.4. Notification to Public of Information Repository ....................... 16
1.15. COMMUNITY RELATIONS PLAN ..................................................... 16
  1.15.1. Requirement for Community Relations Plan ............................... 16
  1.15.2. Contents of Community Relations Plan ...................................... 16
  1.15.3. Government to Government Consultation ................................ 17
  1.15.4. Initial Consultation on Community Relations Plan .................. 17
  1.15.5. Annual Compilation of Comments on Community Relations Plan . 17
1.16. DISPUTE RESOLUTION ...................................................................... 18
  1.16.1. Applicability ........................................................................... 18
  1.16.2. Notice to NMED ...................................................................... 18
  1.16.3. Tier I - Informal Negotiations ................................................... 18
  1.16.4. Tier II - Final Decision of the Secretary ................................... 18
  1.16.5. Actions Not Affected by Dispute .............................................. 19
  1.16.6. E-Mail Notifications ................................................................. 19

PERMIT PART 1
PART 4 - GEOLOGIC REPOSITORY DISPOSAL

4.1. DESIGNATED DISPOSAL UNITS

This Part authorizes the management and disposal of contact-handled (CH) and remote-handled (RH) transuranic (TRU) mixed waste containers in the Underground Hazardous Waste Disposal Units (Underground HWDUs) identified herein. Specific facility and process information for the management and disposal of CH and RH TRU mixed waste in the Underground HWDUs is incorporated in Permit Attachment A2 (Geologic Repository).

4.1.1. Underground Hazardous Waste Disposal Units

The Underground HWDUs are located at the WIPP facility approximately 2150 feet (665 meters) below the ground surface within the Salado formation. An Underground HWDU is a single excavated panel, consisting of seven rooms and two access drifts, designated for disposal of TRU mixed waste containers.

The Permittees may dispose TRU mixed waste in the Underground HWDUs, provided the Permittees comply with the following conditions:

4.1.1.1. Disposal Containers

The Permittees shall dispose TRU mixed waste in containers specified in Permit Section 4.3.1.

4.1.1.2. Disposal Locations and Quantities

The Permittees shall dispose TRU mixed waste containers in eight Underground HWDUs, as specified in Table 4.1.1 below and depicted in Permit Attachment A2, Figure A2-1. The Permittees may dispose quantities of TRU mixed waste containers in these locations not to exceed the maximum capacities specified in Table 4.1.1 below. The Permittees may increase these capacities subject to the following conditions:

i. The Permittees may submit a Class 1 permit modification requiring prior approval of the Secretary in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.42(a)) to increase the CH TRU mixed waste capacity by 35,300 ft³ (1,000 m³) or less, and the RH TRU mixed waste capacities in Panels 5 and 6 to a maximum of 22,950 ft³ (650 m³).

At least 15 calendar days before submittal to NMED, the Permittees shall post a link to the Class 1 permit modification on the WIPP Home Page and inform those on the e-mail notification list.
ii. Notwithstanding Permit Section 4.1.1.2.i, any Underground HWDU CH TRU waste capacity may be increased by up to 25 percent of the total maximum capacity in Table 4.1.1 by submitting a Class 2 permit modification request in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)).

<table>
<thead>
<tr>
<th>Description</th>
<th>Waste Type</th>
<th>Maximum Disposal Unit Capacity^2</th>
<th>Final Waste Volume Disposed^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel 1</td>
<td>CH TRU</td>
<td>636,000 ft^3 (18,000 m^3)</td>
<td>370,800 ft^3 (10,500 m^3)</td>
</tr>
<tr>
<td>Panel 2</td>
<td>CH TRU</td>
<td>636,000 ft^3 (18,000 m^3)</td>
<td>635,600 ft^3 (17,998 m^3)</td>
</tr>
<tr>
<td>Panel 3</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td>603,600 ft^3 (17,092 m^3)</td>
</tr>
<tr>
<td>Panel 4</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td>503,500 ft^3 (14,258 m^3)</td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>12,570 ft^3 (356 m^3)</td>
<td>6,200 ft^3 (176 m^3)</td>
</tr>
<tr>
<td>Panel 5</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td>562,500 ft^3 (15,927 m^3)</td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>15,720 ft^3 (445 m^3)</td>
<td>8,300 ft^3 (235 m^3)</td>
</tr>
<tr>
<td>Panel 6</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td>510,900 ft^3 (14,468 m^3)</td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>18,860 ft^3 (534 m^3)</td>
<td>7,500 ft^3 (214 m^3)</td>
</tr>
<tr>
<td>Panel 7</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft^3 (650 m^3)</td>
<td></td>
</tr>
<tr>
<td>Panel 8</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft^3 (650 m^3)</td>
<td></td>
</tr>
<tr>
<td>Panel 9A</td>
<td>CH TRU</td>
<td>662,150 ft^3 (18,750 m^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft^3 (650 m^3)</td>
<td></td>
</tr>
<tr>
<td>Panel 10A</td>
<td>CH TRU</td>
<td>662,150 ft^3</td>
<td></td>
</tr>
</tbody>
</table>
### PERMITTED AND PROHIBITED WASTE IDENTIFICATION

#### 4.2. Permitted Waste

The Permittees may dispose TRU mixed waste in the Underground HWDUs, provided the Permittees comply with the following conditions:

<table>
<thead>
<tr>
<th></th>
<th>CH TRU</th>
<th>RH TRU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Disposed in Filled Panels</strong></td>
<td>5,244,900 ft³ (148,500 m³)</td>
<td>93,050 ft³ (2,635 m³)</td>
</tr>
<tr>
<td><strong>Total Disposed in Filled Panels</strong></td>
<td>2,676,000 ft³ (75,775 m³)</td>
<td>14,500 ft³ (411 m³)</td>
</tr>
</tbody>
</table>

1. The area of each panel is approximately 124,150 ft² (11,533 m²).
2. “Maximum Disposal Unit Capacity” is the maximum volume of TRU mixed waste that may be emplaced in each panel. The maximum repository capacity of “6.2 million cubic feet of transuranic waste” is specified in the WIPP Land Withdrawal Act (Pub. L. 102-579, as amended).
3. The total final waste volume disposed cannot exceed the maximum repository capacity (final waste volume disposed) of “6.2 million cubic feet of transuranic waste” is specified in the WIPP Land Withdrawal Act (Pub. L. 102-579, as amended).
4. This total is a summation of the listed disposal unit capacity and is for information purposes only and is not a limit or condition.

#### 4.2.1. Waste Analysis Plan

The TRU mixed waste shall be characterized to comply with the waste analysis plan specified in Permit Section 2.3.1.

#### 4.2.1.2. TSDF Waste Acceptance Criteria

The TRU mixed waste shall comply with the treatment, storage, and disposal facility (TSDF) waste acceptance criteria specified in Permit Section 2.3.3.

#### 4.2.1.3. Hazardous Waste Numbers

The TRU mixed waste shall contain only hazardous waste numbers specified in Permit Section 2.3.4.

Derived waste may be disposed in the Underground HWDUs as specified in Permit Section 2.3.5.
4.2.2. **Prohibited Waste**

4.2.2.1. **General Prohibition**

The Permittees shall not dispose any TRU mixed waste that fails to comply with Permit Section 4.2.1.

4.2.2.2. **Specific Prohibition**

After this Permit becomes effective, the Permittees shall not dispose non-mixed TRU waste in any Underground HWDU unless such waste is characterized in accordance with the requirements of the WAP specified in Permit Section 2.3.1. The Permittees shall not dispose TRU mixed waste in any Underground HWDU if the Underground HWDU contains non-mixed TRU waste which was disposed of after this Permit became effective and was not characterized in accordance with the requirements of the WAP.

4.3. **DISPOSAL CONTAINERS**

4.3.1. **Acceptable Disposal Containers**

The Permittees shall use containers that comply with the requirements for U.S. Department of Transportation shipping container regulations (49 CFR §173 - Shippers - General Requirements for Shipment and Packaging, and 49 CFR §178 - Specifications for Packaging) for disposal of TRU mixed waste at WIPP. The Permittees are prohibited from disposing TRU mixed waste in any container not specified in Permit Attachment A1 (Container Storage), Section A1-1b, as set forth below:

4.3.1.1. **Standard 55-gallon (208-liter) Drum**

Standard 55-gallon drums are configured as a 7-pack or as an individual unit.

4.3.1.2. **Standard Waste Box (SWB)**

An SWB is configured as an individual unit.

4.3.1.3. **Ten-drum Overpack (TDOP)**

A TDOP is configured as an individual unit.

4.3.1.4. **85-gallon (322-liter) Drum**

85-gallon drums are configured as a 4-pack or as an individual unit.
4.3.1.5. **100 gallon (379-liter) Drum**

100-gallon drums are configured as a 3-pack or as an individual unit.

4.3.1.6. **RH TRU Canister**

An RH TRU canister is configured as an individual unit.

4.3.1.7. **Standard Large Box 2 (SLB2)**

An SLB2 is configured as an individual unit.

4.3.1.8. **Shielded Container**

Shielded containers are configured as a three-pack.

4.3.2. **Condition of Containers**

If a container holding TRU mixed waste is not in good condition (e.g., severe rusting, apparent structural defects) or if it begins to leak prior to disposal in an Underground HWDU, the Permittees shall manage the TRU mixed waste containers specified in Permit Section 4.3.1 as specified in Permit Attachment A1 and in compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.171).

4.4. **VOLATILE ORGANIC COMPOUND LIMITS**

The Permittees shall limit releases to the air of volatile organic compound waste constituents (VOCs) as specified by the following conditions, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601(c)):

4.4.1. **Room-Based Limits**

The measured concentration of VOCs in any open (active) room and in the immediately adjacent each closed room in active panels within an Underground HWDU shall not exceed the limits specified in Table 4.4.1 below:

<table>
<thead>
<tr>
<th>Compound</th>
<th>VOC Room-Based Concentration Limit (PPMV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Tetrachloride</td>
<td>9,625</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>13000</td>
</tr>
<tr>
<td>Chloroform</td>
<td>9,930</td>
</tr>
</tbody>
</table>
There are no maximum concentration limits for other VOCs.

4.4.2. Determination of VOC Room-Based Limits

The Permittees shall confirm the VOC concentration and emission rate limits identified in Permit Section 4.4.1 using the VOC Monitoring Plan specified in Permit Attachment N (Volatile Organic Compound Monitoring Plan). The Permittees shall conduct monitoring of VOCs as specified in Permit Sections 4.6.2 and 4.6.3.

4.4.3. Ongoing Disposal Room VOC Monitoring in Panels 3 Through 8

The Permittees shall continue disposal room VOC monitoring in Room 1 of a filled panel Panels 3 through 8 after completion of waste emplacement—until final panel closure unless the explosion-isolation wall specified in Permit Attachment G1 (Detailed Design Report for an Operation Phase Panel Closure System) is installed in the panel.

4.5. DESIGN, CONSTRUCTION, AND OPERATION REQUIREMENTS

The Permittees shall design, construct, and operate the Underground HWDUs as specified by the following conditions and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601):

4.5.1. Repository Design

The Permittees shall construct each Underground HWDU in conformance with the requirements specified in Permit Attachment A2 and Permit Attachment A3 (Drawing Number 51-W-214-W, “Underground Facilities Typical Disposal Panel”).

4.5.2. Repository Construction

4.5.2.1. Construction Requirements

Subject to Permit Section 4.5.1, the Permittees may excavate the following Underground HWDUs, as depicted in Permit Attachment A2, Figure A2-1, “Repository Horizon”, and specified in Section A2-2a(3),
“Subsurface Structures (Underground Hazardous Waste Disposal Units (HWDUs))”:

- Panel 10 (Disposal area access drift)
- Panel 2
- Panel 9 (Disposal area access drift)
- Panel 3
- Panel 4
- Panel 5
- Panel 6
- Panel 7
- Panel 8
- Panel 9A
- Panel 10A

Prior to disposal of TRU mixed waste in a newly constructed Underground HWDU, the Permittees shall comply with the certification requirements specified in Permit Section 1.7.11.2.

4.5.2.2. Notification Requirements

At least 30 calendar days prior to the projected start date of excavation of each Underground HWDU, the Permittees shall provide written notification to the Secretary stating the projected start date of excavation, along with supporting rationale (e.g., projected waste receipt rate, etc.). The Permittees shall post a link to the notification transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

Prior to disposal of TRU mixed waste in a newly constructed Underground HWDU, the Permittees shall comply with the certification requirements specified in Permit Section 1.5.11.

4.5.3. Repository Operation

4.5.3.1. Underground Traffic Flow

The Permittees shall manage underground traffic in accordance with Permit Attachment A4, “Traffic Patterns,” Section A4-4, “Underground Traffic,” in order to provide adequate separation of traffic and ventilation air when waste is being transported in the underground. The Permittees shall restrict and separate the ventilation and traffic flow areas in the underground TRU mixed waste handling and disposal areas from the ventilation and traffic flow areas for mining and construction.
equipment, except that during waste transport in W-30, ventilation need not be separated north of S-1600.

The Permittees shall designate routes for the traffic flow of TRU mixed waste handling equipment and construction equipment as required by Permit Attachment A4 (Traffic Patterns), Section A4-4, “Underground Traffic.” These routes will be recorded on a mine map that is posted in a location where persons entering the underground can read it. Whenever the routes are changed, the map will be updated. Maps will be available in facility files until facility closure.

4.5.3.2. **Ventilation**

The Permittees shall maintain a minimum running annual average mine ventilation exhaust rate of 260,000 standard ft³/min and a minimum active room ventilation rate of 35,000 standard ft³/min in each active room when waste disposal is taking place and workers are present in the room, as specified in Permit Attachment A2, Section A2-2a(3), “Subsurface Structures (Underground Ventilation System Description)” and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601(c)).

4.5.3.3. **Ventilation Barriers**

The Permittees shall construct ventilation barricades in active Underground HWDUs to restrict the flow of mine ventilation air through full disposal rooms, as specified in Permit Attachment A2, Section A2-2a(3), “Subsurface Structures (Underground Ventilation System Description)” and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601(c)).

4.6. **MAINTENANCE AND MONITORING REQUIREMENTS**

The Permittees shall maintain and monitor the Underground HWDUs as specified by the following conditions and as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.601 and 264.602):

4.6.1. **Geomechanical Monitoring**

4.6.1.1. **Implementation of Geomechanical Monitoring Program**

The Permittees shall implement a geomechanical monitoring program in each Underground HWU as specified in Permit Attachment A2, Section A2-5b(2), “Geomechanical Monitoring” and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.602).
4.6.1.2. Reporting Requirements

The Permittees shall submit to the Secretary an annual report in October evaluating the geomechanical monitoring program and shall include geomechanical data collected from each Underground HWDU during the previous year, as specified in Permit Attachment A2, Section A2-5b(2), “Geomechanical Monitoring”, and shall also include a map showing the current status of HWDU mining. The Permittees shall also submit at that time an annual certification by a registered professional engineer certifying the stability of any explosion-isolation walls. The Permittees shall post a link to the geomechanical monitoring report transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

4.6.1.3. Notification of Adverse Conditions

When evaluation of the geomechanical monitoring system data identifies a trend towards unstable conditions which requires a decision whether to terminate waste disposal activities in any Underground HWDU, the Permittees shall provide the Secretary with the same report provided to the WIPP Operations Manager within seven calendar days of its issuance, as specified in Permit Attachment A2, Section A2-5b(2)(a), “Description of the Geomechanical Monitoring System”. The Permittees shall post a link to the adverse condition notice transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

4.6.2. Repository Volatile Organic Compound Monitoring

4.6.2.1. Implementation of Repository VOC Monitoring

The Permittees shall implement repository VOC monitoring as specified in Permit Attachment N (Volatile Organic Compound Monitoring Plan) and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.602 and §264.601(c)). The Permittees shall implement repository VOC monitoring until the certified closure of all Underground HWDUs.

4.6.2.2. Reporting Requirements

The Permittees shall report to the Secretary semi-annually in April and October the data and analysis of the VOC Monitoring Plan as specified in Permit Attachment N, Sections N-3b, N-3e, and N-5d.
4.6.2.3. Notification Requirements

The Permittees shall calculate the total carcinogenic and the total non-carcinogenic risk to the surface worker using the methodology in Attachment N after each sampling event for the compounds in Table 4.6.2.3 using the approved EPA risk factors listed in Table 4.6.2.3.

The Permittees shall notify the Secretary in writing, within seven calendar days of obtaining validated analytical results, whenever the total carcinogenic risk to the surface worker exceeds $10^{-5}$ or the total non-carcinogenic risk as measured by the hazard index exceeds 1.0 concentration of any VOC specified in Table 4.4.1 exceeds the concentration of concern specified in Table 4.6.2.3 below.

The Permittees shall calculate the running annual average carcinogenic and non-carcinogenic risk to the surface worker using the methodology in Attachment N after each sampling event for the compounds in Table 4.6.2.3 using the approved EPA risk factors listed in Table 4.6.2.3.

The Permittees shall notify the Secretary in writing, within seven calendar days of obtaining validated analytical results, whenever the running annual average concentration (calculated after each sampling event) total carcinogenic risk to the surface worker exceeds $10^{-5}$ or the total non-carcinogenic risk as measured by the hazard index exceeds 1.0 for any VOC specified in Table 4.4.1 exceeds the concentration of concern specified in Table 4.6.2.3 below.

The Permittees shall post a link to any exceedance notice transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

The Permittees shall review EPA risk factors and the tentatively identified compound list annually and update Tables 4.4.1, 4.6.2.3 and 4.6.3.2 as needed as a Class 1 permit modification notification whenever new analytes are identified to be added to the target analyte list through the tentatively identified compound process in Attachment N or whenever the EPA updates the risk factors shown in update Table 4.6.2.3 whenever the EPA updates the risk factors.
### Table 4.6.2.3 - VOC Toxicity Values

<table>
<thead>
<tr>
<th>Compound</th>
<th>Recommended EPA Risk Factors</th>
<th>Drift E-300 Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carcinogenic IUR (ug/m$^3$)</td>
<td>Non-carcinogenic RfC (mg/m$^3$)ppbv</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>$6.0 \times 10^{-6}$</td>
<td>$1.0 \times 10^{-1}$</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>1015</td>
<td>220</td>
</tr>
<tr>
<td>Chloroform</td>
<td>$2.3 \times 10^{-5}$</td>
<td>$9.8 \times 10^{-2}$</td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>410</td>
<td>400</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>$2.6 \times 10^{-5}$</td>
<td>$7.0 \times 10^{-2}$</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>6700</td>
<td>1930</td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>$5.8 \times 10^{-5}$</td>
<td>400</td>
</tr>
<tr>
<td>Toluene</td>
<td>715</td>
<td>190</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>N/A</td>
<td>5000</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>$4.1 \times 10^{-6}$</td>
<td>$2.0 \times 10^{-3}$</td>
</tr>
</tbody>
</table>

IUR = Inhalation Unit Risk (EPA recommended value)
RfC = Reference Concentration (EPA recommended value)
N/A = not applicable (No EPA recommended value available)

### 4.6.2.4. Remedial Action

If the running annual average for the total carcinogenic risk due to releases of concentration for a VOCs specified in Table 4.6.2.3 exceeds $10^{-5}$ or if the running annual average for the total non-carcinogenic hazard index due to releases of VOCs specified in Table 4.6.2.3 exceeds 1.0, the Permittees shall cease disposal in the active CH disposal room and install ventilation barriers as specified in Permit Section 4.5.3.3. Alternatively, prior to reaching the action level, the Permittees may propose an alternative remedial action to the Secretary for ensuring no individuals are exposed to concentrations in excess of the limits. The Permittees may implement such plans in lieu of closing the active room only after approval by the Secretary.

If the running annual average for the total carcinogenic risk due to releases of concentration for a VOCs specified in Table 4.6.2.3 exceeds $10^{-5}$ or if the running annual average for the total non-carcinogenic hazard index due to releases of VOCs specified in Table...
4.6.2.3 exceeds 1.0 the concentration of concern specified in Table 4.6.2.3 for six consecutive months, the Permittees shall close the affected Underground HWDU as specified in Permit Section 4.9.1. Alternatively, prior to reaching the action level, the Permittees may propose an alternative remedial action to the Secretary for ensuring no individuals are exposed to concentrations in excess of the limits. The Permittees may implement such plans in lieu of closing the active HWDU only after approval by the Secretary.

For any remedial action taken under this Permit Section, the Permittees shall submit to the Secretary written quarterly status reports, beginning 30 calendar days after the Permittees submit the initial notification in Permit Section 4.6.2.3 which resulted in the remedial action. The quarterly status report shall analyze the cause of exceedance, describe the implementation and results of the remedial action, and describe measures taken to prevent future exceedances. The Permittees shall submit such reports until the Secretary determines the remedial action has been completed in accordance with all applicable requirements of this Permit.

4.6.3. Disposal Room Volatile Organic Compound Monitoring

4.6.3.1. Implementation of Disposal Room VOC Monitoring

The Permittees shall implement disposal room VOC monitoring as specified in Permit Attachment N and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.602 and §264.601(c)).

4.6.3.2. Notification Requirements

The Permittees shall notify the Secretary in accordance with Permit Attachment N, Section N-3e(2) writing, within seven calendar days of obtaining validated analytical results, whenever the concentration of any VOC specified in Table 4.4.1 in any closed room in an active panel or in any active open room or in the immediately adjacent closed room exceeds the action levels specified in Table 4.6.3.2 below. The Permittees shall post a link to the exceedance notice transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.
<table>
<thead>
<tr>
<th>Compound</th>
<th>50% Action Level for VOC Constituents of Concern in Active Open or Immediately Adjacent Any-Closed Room, ppmv</th>
<th>95% Action Level for VOC Constituents of Concern in Active Open or Immediately Adjacent Closed Room, ppmv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Tetrachloride</td>
<td>4,813</td>
<td>9,145</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>6,500</td>
<td>12,350</td>
</tr>
<tr>
<td>Chloroform</td>
<td>4,965</td>
<td>9,433</td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>2,745</td>
<td>5,215</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>1,200</td>
<td>2,280</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>50,000</td>
<td>95,000</td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>1,480</td>
<td>2,812</td>
</tr>
<tr>
<td>Toluene</td>
<td>5,500</td>
<td>10,450</td>
</tr>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>16,850</td>
<td>32,015</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>24,000</td>
<td>45,600</td>
</tr>
</tbody>
</table>

4.6.3.3. Remedial Action

Upon receiving validated analytical results that indicate one or more of the VOCs specified in Table 4.4.1 in any active open room or the immediately adjacent closed room of the closed rooms in an active panel has reached the “50% Action Level” in Table 4.6.3.2, the sampling frequency for such closed rooms will increase to once per week. The once per week sampling will continue either until the concentrations in the closed room(s) fall below the “50% Action Level” in Table 4.6.3.2, or until closure of Room 1 of the panel, whichever occurs first. If one or more of the VOCs in Table 4.4.1 in any active open room or immediately adjacent closed room reaches the “95% Action Level” in Table 4.6.3.2, another sample will be taken to confirm the existence of such a condition. If the second sample confirms that one or more of the VOCs in any active open room or the immediately adjacent closed room have reached the “95% Action Level” in Table 4.6.3.2, the active open room will be abandoned, ventilation barriers will be installed as specified in Permit Section 4.5.3.3, waste emplacement will proceed in the next open room, and monitoring of the subject closed room will continue at a frequency of once per week until commencement of panel closure. Prior to reaching the 95% Action Level in any active open room or the
immediately adjacent disposal room, the Permittees may propose an alternative remedial action to implement in the event the 95% Action Level is reached. This alternative remedial action must be approved by the Secretary prior to implementation.

4.6.4. **Mine Ventilation Rate Monitoring**

4.6.4.1. **Implementation of Mine Ventilation Rate Monitoring Plan**

The Permittees shall implement the Mine Ventilation Rate Monitoring Plan specified in Permit Attachment O (WIPP Mine Ventilation Rate Monitoring Plan) until the certified closure of all Underground HWDUs and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.602 and §264.601(c)).

4.6.4.2. **Reporting Requirements**

The Permittees shall report to the Secretary annually in October the results of the data and analysis of the Mine Ventilation Rate Monitoring Plan.

4.6.4.3. **Notification Requirements**

The Permittees shall calculate the running annual average mine ventilation exhaust rate on a monthly basis. In addition, the Permittees shall evaluate compliance with the minimum active room ventilation rate specified in Permit Section 4.5.3.2 on a monthly basis. The Permittees shall report to the Secretary in the annual report specified in Permit Section 4.6.4.2 whenever the evaluation of the mine ventilation monitoring program data identifies that the ventilation rates specified in the Permit Section 4.5.3.2 have not been achieved.

4.6.5. **Hydrogen and Methane Monitoring**

4.6.5.1. **Implementation of Hydrogen and Methane Monitoring Plan**

The Permittees shall implement the Hydrogen and Methane Monitoring Plan specified in Permit Attachment N1 (Hydrogen and Methane Monitoring Plan).

4.6.5.2. **Reporting Requirements**

The Permittees shall report to the Secretary semi-annually in April and October the data and analysis of the Hydrogen and Methane Monitoring Plan.
4.6.5.3. **Notification Requirements**

The Permittees shall notify the Secretary in writing, within seven calendar days of obtaining validated analytical results, whenever the concentration of hydrogen or methane in a filled panel exceeds the action levels specified in Table 4.6.5.3 below.

The Permittees shall post a link to the notification letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Action Level 1</th>
<th>Action Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>4,000 ppm</td>
<td>8,000 ppm</td>
</tr>
<tr>
<td>Methane</td>
<td>5,000 ppm</td>
<td>10,000 ppm</td>
</tr>
</tbody>
</table>

4.6.5.4. **Remedial Action**

Upon receiving validated analytical results that indicate at least one compound exceeded “Action Level 1” in Table 4.6.5.3, the sampling frequency in that filled panel will increase to once per week. Upon receiving validated analytical results that indicate at least one compound exceeded “Action Level 2” in Table 4.6.5.3 in two consecutive weekly samples, the Permittees shall install in that panel the explosion-isolation wall specified in Permit Attachment G1.

4.6.5.5. **Sampling Line Loss**

The Permittees shall notify the Secretary in writing within seven calendar days of the discovery of loss of sampling line(s). The Permittees shall evaluate any loss of sampling lines as described in Permit Attachment N1, Section N1-5b, “Sample Tubing”, and shall notify the Secretary in writing within seven calendar days the results of such evaluation. The Permittees shall also post a link to such notification letters on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

4.7. **INSPECTION SCHEDULES AND PROCEDURES**

The Permittees shall inspect the Underground HWDUs at least weekly, as specified in Permit Attachment E (Inspection Schedule, Process and Forms), Tables E-1 and E-1a, and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.15). The Permittees shall perform these inspections to detect malfunctions, signs of deterioration, operator errors, discharges, or any other factors which
have caused or may cause a release of hazardous wastes or hazardous waste constituents to the
environment or which may compromise the ability of any Underground HWUD to comply with the

4.8. **RECORDKEEPING**

4.8.1. **Underground HWUD Location Map**

The Permittees shall maintain, in the operating record, a map containing the exact location
and dimensions of each Underground HWUD with respect to permanently surveyed
benchmarks.

4.8.2. **Disposal Waste Type and Location**

The Permittees shall maintain, in the operating record, a record identifying the types and
quantities of TRU mixed waste in each Underground HWUD and the disposal location of
each container or container assembly (e.g., a 7-pack of standard 55-gallons drums) within
each Underground HWUD, using the following fields from the WWIS data dictionary:

1. Panel Number
2. Room Number or Drift Number
3. Row Number (for CH TRU mixed waste) or Borehole Number (for RH TRU
mixed waste)
4. Column Number (for CH TRU mixed waste)
5. Column Height (for CH TRU mixed waste)
6. Container Type Code
7. Container Identification Number
8. Manifest Document Number
9. Disposal Date

The Permittees shall also maintain, in the operating record, a map or diagram depicting the
location and quantity of each waste. The map or diagram shall include a cross reference to
specific manifest document numbers, if the waste was accompanied by a manifest, as
required by 20.4.1.500 NMAC (incorporating 40 CFR §264.73(b)(2)).

4.8.3. **Ventilation Rates**

The Permittees shall maintain, in the operating record, a record identifying any non-
conformance to the ventilation rates specified in Permit Section 4.5.3.2.
PERMIT ATTACHMENTS

Permit Attachment A1 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Container Storage” – Appendix M1).

Permit Attachment A2 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Geologic Repository” – Appendix M2).


Permit Attachment A4 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Traffic Patterns” – Chapter G).

Permit Attachment E (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Inspection Schedule, Process and Forms” - Chapter D).


Permit Attachment N (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Volatile Organic Compound Monitoring Plan” - Chapter N).

Permit Attachment N1 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Hydrogen and Methane Monitoring Plan” – Appendix N1).

Permit Attachment O (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “WIPP Mine Ventilation Rate Monitoring Plan” - Chapter Q).
PART 4 - GEOLOGIC REPOSITORY DISPOSAL .................................................................1
  4.1. DESIGNATED DISPOSAL UNITS .................................................................1
    4.1.1. Underground Hazardous Waste Disposal Units ...............................1
      4.1.1.1. Disposal Containers ...............................................................1
      4.1.1.2. Disposal Locations and Quantities ...........................................1
  4.2. PERMITTED AND PROHIBITED WASTE IDENTIFICATION ............3
    4.2.1. Permitted Waste ..................................................................................3
      4.2.1.1. Waste Analysis Plan .................................................................3
      4.2.1.2. TSDF Waste Acceptance Criteria ............................................3
      4.2.1.3. Hazardous Waste Numbers .......................................................3
    4.2.2. Prohibited Waste ..............................................................................4
      4.2.2.1. General Prohibition .................................................................4
      4.2.2.2. Specific Prohibition .................................................................4
  4.3. DISPOSAL CONTAINERS .............................................................................4
    4.3.1. Acceptable Disposal Containers .....................................................4
      4.3.1.1. Standard 55-gallon (208-liter) Drum ........................................4
      4.3.1.2. Standard Waste Box (SWB) .....................................................4
      4.3.1.3. Ten-drum Overpack (TDOP) ....................................................4
      4.3.1.4. 85-gallon (322-liter) Drum ......................................................4
      4.3.1.5. 100 gallon (379-liter) Drum ....................................................5
      4.3.1.6. RH TRU Canister .................................................................5
      4.3.1.7. Standard Large Box 2 (SLB2) ..................................................5
      4.3.1.8. Shielded Container ...............................................................5
    4.3.2. Condition of Containers ....................................................................5
  4.4. VOLATILE ORGANIC COMPOUND LIMITS .............................................5
    4.4.1. Room-Based Limits .........................................................................5
    4.4.2. Determination of VOC Room-Based Limits ....................................6
    4.4.3. Ongoing Disposal Room VOC Monitoring in Panels 3 Through 8 ......6
  4.5. DESIGN, CONSTRUCTION, AND OPERATION REQUIREMENTS ........6
    4.5.1. Repository Design ..........................................................................6
    4.5.2. Repository Construction .................................................................6
      4.5.2.1. Construction Requirements ....................................................6
      4.5.2.2. Notification Requirements .....................................................7
    4.5.3. Repository Operation .......................................................................7
      4.5.3.1. Underground Traffic Flow .....................................................7
      4.5.3.2. Ventilation ..........................................................................8
      4.5.3.3. Ventilation Barriers .............................................................8
  4.6. MAINTENANCE AND MONITORING REQUIREMENTS ......................8
    4.6.1. Geomechanical Monitoring ............................................................8
      4.6.1.1. Implementation of Geomechanical Monitoring Program ..........8
      4.6.1.2. Reporting Requirements .......................................................9
      4.6.1.3. Notification of Adverse Conditions .......................................9
    4.6.2. Repository Volatile Organic Compound Monitoring .....................9
      4.6.2.1. Implementation of Repository VOC Monitoring ........................9
      4.6.2.2. Reporting Requirements .......................................................9
      4.6.2.3. Notification Requirements ...................................................10

PERMIT PART 4
4.6.2.4. Remedial Action ................................................................. 11
4.6.3. Disposal Room Volatile Organic Compound Monitoring .......... 12
  4.6.3.1. Implementation of Disposal Room VOC Monitoring .......... 12
  4.6.3.2. Notification Requirements .............................................. 12
  4.6.3.3. Remedial Action ............................................................... 13
4.6.4. Mine Ventilation Rate Monitoring ........................................... 14
  4.6.4.1. Implementation of Mine Ventilation Rate Monitoring Plan .......... 14
  4.6.4.2. Reporting Requirements .................................................. 14
  4.6.4.3. Notification Requirements .............................................. 14
  4.6.5. Hydrogen and Methane Monitoring ........................................ 14
    4.6.5.1. Implementation of Hydrogen and Methane Monitoring .......... 14
    4.6.5.2. Reporting Requirements ................................................ 14
    4.6.5.3. Notification Requirements ............................................. 15
    4.6.5.4. Remedial Action ............................................................ 15
    4.6.5.5. Sampling Line Loss ....................................................... 15
4.7. INSPECTION SCHEDULES AND PROCEDURES ......................... 15
4.8. RECORDKEEPING .................................................................. 16
  4.8.1. Underground HWDU Location Map ....................................... 16
  4.8.2. Disposal Waste Type and Location ....................................... 16
  4.8.3. Ventilation Rates ............................................................... 16
PART 6 – CLOSURE REQUIREMENTS

6.1. **OVERVIEW**

This Part specifies the closure requirements for the WIPP facility. The Permittees shall close the permitted Container Storage Units and Underground Hazardous Waste Disposal Units (Underground HWDUs) in accordance with the requirements in 20.4.1.500 NMAC (incorporating 40 CFR §§264.110 through 264.116 and §264.178), this Permit Part, and the procedures described in Permit Attachment G (Closure Plan).

6.2. **PERFORMANCE STANDARD**

The Permittees shall close the facility as specified in Permit Attachment G and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.111).

6.3. **AMENDMENT TO CLOSURE PLAN**

The Permittees shall amend Permit Attachment G, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.112(c)), whenever necessary.

6.4. **NOTIFICATION OF CLOSURE**

The Permittees shall notify the Secretary in writing at least 60 calendar days prior to the date on which they expect to begin partial closure, i.e., closure of an Underground Hazardous Waste Disposal Unit (Underground HWDU), or final closure of the facility as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.112(d) and 264.601). The Permittees shall post a link to the closure notice transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

6.5. **TIME ALLOWED FOR CLOSURE**

6.5.1. **Partial Closure**

Upon completion of disposal operations in an Underground HWDU, the Permittees shall complete partial closure activities as specified in Permit Attachment G, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.113).

6.5.2. **Final Facility Closure**

After receiving the final volume of TRU mixed waste, the Permittees shall remove from the facility all non-mixed hazardous waste, dispose in the Underground HWDUs all TRU-mixed hazardous waste and derived waste, and complete closure activities as specified in Permit Attachment G and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.113).
6.6. **DISPOSAL OR DECONTAMINATION OF EQUIPMENT, STRUCTURES, AND SOILS**

The Permittees shall decontaminate or dispose of all contaminated equipment, structures, and soils, as specified in Permit Attachment G and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.114).

6.7. **CERTIFICATION OF CLOSURE**

Within 60 calendar days of completion of closure of each Underground HWDU, and within 60 calendar days of completion of final closure, the Permittees shall certify in writing to the Secretary that the Underground HWDUs and/or facility have been closed as specified in Permit Attachment G and as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.115 and 264.601).

6.8. **SURVEY PLAT**

No later than the submission of the certification of closure of each Underground HWDU, the Permittees shall submit a survey plat detailing the location and dimensions of each Underground HWDU with respect to permanently surveyed benchmarks, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.116).

6.9. **CLOSURE OF PERMITTED CONTAINER STORAGE UNITS**

At closure of the WHB Unit and Parking Area Unit, the Permittees shall remove all hazardous waste and hazardous waste residues from the containment system, in accordance with the procedures in Permit Attachment G, as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.178).

6.10. **CLOSURE OF PERMITTED DISPOSAL UNITS**

6.10.1. **Panel Closure**

Upon completion of disposal in an Underground HWDU, the Permittees shall provide written notification to the Secretary stating the final volume of TRU mixed waste emplaced in the Underground HWDU. The Permittees shall also close the Underground HWDU as specified in Permit Attachment G and Permit Attachment G1 (Detailed Design Report for an Operation Phase Panel Closure System). The Permittees shall post a link to the final panel volume notice transmittal letter on the WIPP Home Page and inform those on the e-mail notification list as specified in Permit Section 1.11.

6.10.2. **Repository Closure**

Upon completion of disposal in the repository and closure of all Underground HWDUs, the Permittees shall close the repository as specified in Permit Attachment G and Permit Attachment G2 (Shaft Sealing System Compliance Submittal Design Report).
6.10.3. **Repository Post-Closure**

Upon completion of repository closure as specified in Permit Section 6.10.2, the Permittees shall comply with all post-closure requirements as specified in Permit Part 7, Post-Closure Care.
PERMIT ATTACHMENTS


Permit Attachment G1, “WIPP Panel Closure (WPC) Description and Specifications” (as modified from WIPP RCRA Part B Permit Application, “Detailed Design Report for an Operation Phase Panel Closure System” - Appendix I1).

Permit Attachment G2 (as modified from WIPP RCRA Part B Permit Application, “Shaft Sealing System Compliance Submittal Design Report” - Appendix I2).
PART 6 – CLOSURE REQUIREMENTS........................................................................................................1
6.1. OVERVIEW ........................................................................................................................................1
6.2. PERFORMANCE STANDARD ............................................................................................................1
6.3. AMENDMENT TO CLOSURE PLAN .................................................................................................1
6.4. NOTIFICATION OF CLOSURE ...........................................................................................................1
6.5. TIME ALLOWED FOR CLOSURE .......................................................................................................1
   6.5.1. Partial Closure ..........................................................................................................................1
   6.5.2. Final Facility Closure ...............................................................................................................1
6.6. DISPOSAL OR DECONTAMINATION OF EQUIPMENT, STRUCTURES, AND SOILS ...............2
6.7. CERTIFICATION OF CLOSURE ........................................................................................................2
6.8. SURVEY PLAT ...................................................................................................................................2
6.9. CLOSURE OF PERMITTED CONTAINER STORAGE UNITS ..........................................................2
6.10. CLOSURE OF PERMITTED DISPOSAL UNITS ........................................................................2
   6.10.1. Panel Closure ..........................................................................................................................2
   6.10.2. Repository Closure ..................................................................................................................2
   6.10.3. Repository Post-Closure .........................................................................................................3
PART 7 - POST-CLOSURE CARE PLAN

7.1. OVERVIEW

This Part specifies the post-closure care requirements for the WIPP facility. Post-closure care requirements are applicable to Underground Hazardous Waste Disposal Units (Underground HWDUs) and include requirements for routine inspection and maintenance of the closed panel entry drifts, and air monitoring as required. Post-closure care requirements apply immediately after certification of closure of each Underground HWU and continue for 30 years after final closure of the facility. Post-closure care requires active institutional controls including fencing and warning signs, inspections, maintenance, monitoring of ground water, and control and cleanup of releases.

7.2. UNIT IDENTIFICATION

The Permittees shall provide post-closure care for the closed Underground HWDUs (eight panels and two access drifts), and for the facility after final closure, as specified in Permit Attachment H (Post-Closure Plan) and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.110(b)).

7.3. POST-CLOSURE PROCEDURES AND USE OF PROPERTY

The Permittees shall conduct post-closure care after completion of closure of each Underground HWU identified in Permit Section 7.2 and shall continue post-closure care for thirty (30) years after the date of certification of final closure of the facility, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(a)(1)). The Permittees may request, at any time during the post-closure care period, a Permit modification to shorten the applicable post-closure care period. The Secretary may shorten the post-closure care period if the Secretary finds the reduced period is sufficient to protect human health and the environment, as provided by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(a)(2)(i)). The Secretary may extend the applicable post-closure care period if the Secretary finds an extension is necessary to protect human health and the environment, as provided by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(a)(2)(ii)).

7.3.1. Post-Closure Plan

The Permittees shall implement the Post-Closure Plan in Permit Attachment H and Permit Attachment H1 (Active Institutional Controls During Post-closure), as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(d), §264.118(b) and §264.603).

7.3.2. Post-Closure Care and Monitoring

7.3.2.1. General Monitoring, Inspection, and Maintenance Requirements

The Permittees shall monitor and perform inspections of the Underground HWU closures, and perform maintenance of the accessible bulkheads of the closures, as necessary. Closed Underground HWU access drifts after construction of each HWU closure system, as specified in Permit Attachment A2 (Geologic Repository). The Permittees shall monitor and
maintain the components, structures and equipment of the waste containment systems at the facility as specified in Permit Attachments H and H1, and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(a)(1)(ii)).

7.3.2.2. **Air Monitoring Requirements**

The Permittees shall maintain ventilation and perform daily monitoring of the mine ventilation air downstream from closed Underground HWDUs at the beginning of days when work is to be performed downstream from the closed Underground HWDUs. The Permittees shall implement the Volatile Organic Compound Monitoring Plan in Permit Attachment N (Volatile Organic Compound Monitoring Plan) during the post-closure care period for closed Underground HWDUs, until six (6) months after the certification of closure of all Underground HWDUs, as specified in Permit Section 4.6.2. [20.4.1.500 NMAC (incorporating 40 CFR §264.117(a), §264.601 and §264.603)]

7.3.2.3. **Detection Monitoring Program**

The Permittees shall maintain and implement the Detection Monitoring Program during the post-closure care period as specified in Part 5 and Permit Attachment L (WIPP Ground-water Detection Monitoring Program Plan), and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart F and §264.117(a)(1)).

7.3.3. **Security**

The Permittees shall comply with the applicable post-closure security requirements as specified in Permit Attachments H and H1 and as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(b)(2)).

7.3.4. **Post-Closure Disturbance**

The Permittees shall not allow any use of the facility surface area above the Underground HWDUs designated in Permit Section 7.2 which could disturb the integrity of the shaft sealing systems or any components of the waste containment system, or the function of the facility monitoring systems during the post-closure care period, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.117(c)), except as allowed under 20.4.1.500 NMAC (incorporating 40 CFR §264.117(c)(1) or (2)).

7.4. **NOTICES AND CERTIFICATION**

7.4.1. **Disposal Unit Records**

No later than 60 calendar days after certification of closure of each Underground HWDU, the Permittees shall submit to the Secretary and the local zoning authority, or the authority
with jurisdiction over local land use, a record of the type, location, and quantity of TRU mixed waste disposed in each Underground HWDU, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.119(a)).

7.4.2.  Deed Notice

Within 60 calendar days of certification of closure of the first Underground HWDU and within 60 calendar days of certification of the last Underground HWDU, the Permittees shall comply with the following conditions, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.119(b)):

7.4.2.1.  Deed Recordation

The Permittees shall record, in accordance with New Mexico law, a notation on the deed to the facility property, or on some other instrument that is normally examined during a title search, that will in perpetuity notify any potential purchaser of the property that:

(i) The land has been used to manage TRU mixed waste; and
(ii) Its use is restricted under 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart G) regulations; and
(iii) The survey plat and record of the type, location, and quantity of TRU mixed waste disposed in each Underground HWDU have been filed with the Secretary and the local zoning authority or the authority with jurisdiction over local land use.

7.4.2.2.  Certification

The Permittees shall submit a certification to the Secretary, signed by the Permittees, stating the Permittees have recorded the notation specified in Permit Section 7.4.2.1, including a copy of the document(s) in which the notation has been placed, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.119(b)).

7.4.3.  Removal of Wastes or Contaminated Soils

If the Permittees, or any subsequent owner or operator of the land upon which the Underground HWDUs are located, wishes to remove TRU mixed wastes, TRU mixed waste residues, or contaminated soils, they shall request a modification to this permit in accordance with the applicable requirements in 20.4.1.900 NMAC (incorporating 40 CFR Part 270) and 4.1.901. The Permittees or any subsequent owner or operator of the land shall demonstrate the removal of TRU mixed wastes will satisfy the criteria of 20.4.1.500 NMAC (incorporating 40 CFR §264.117(c) and §264.119(c)).
7.4.4. **Completion of Post-Closure Care**

No later than 60 calendar days after completion of the post-closure care period for each Underground HWDU, the Permittees shall submit to the Secretary, by registered mail, a certification that the post-closure care for the Underground HWDU was performed in accordance with the specifications in the approved Post-Closure Plan, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.120). The Permittees and an independent New Mexico registered professional engineer shall sign the certification. The Permittees shall provide to the Secretary upon request the documentation supporting the professional engineer's certification, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.145(i) and §264.120).

7.5. **POST-CLOSURE PERMIT MODIFICATIONS**

The Permittees shall submit a written notification of or request for a permit modification to amend the approved Post-Closure Plan at any time during the active life of the facility or during the post-closure care period, as required by 20.4.1.500, .900, and .901 NMAC (incorporating 40 CFR §§264.118(d) and 270). The Permittees shall include a copy of the proposed amended Post-Closure Plan for approval by the Secretary, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)).

7.5.1. **Changes Requiring a Permit Modification**

Changes to the approved Post-Closure Plan which require a permit modification include, but are not limited to, the following circumstances specified in 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)(2)):

7.5.1.1. **Operating Plans**

Whenever changes in operating plans or facility design affect the approved Post-Closure Plan; or

7.5.1.2. **Timing of Closure**

Whenever there is a change in the expected year of final closure; or

7.5.1.3. **Other Events**

Whenever other events occur during the active life of the facility, including partial or final closure, that affect the approved Post-Closure Plan.

7.5.2. **Timing of Permit Modification**

The Permittees shall submit a written request for a permit modification at least 60 calendar days prior to the proposed change in facility design or operation, or no later than 60 calendar days after the change.
days after an unexpected event has occurred which affects the Post-Closure Plan, as required by 20.4.1.500 NMAC (incorporating §264.118(d)(3)).
PERMIT ATTACHMENTS

Permit Attachment A2 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Geologic Repository” - Appendix M2).

Permit Attachment H (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Post-Closure Plan” - Chapter J).

Permit Attachment H1 (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Active Institutional Controls During Post-Closure” - Appendix J1).

Permit Attachment L (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “WIPP Ground-water Detection Monitoring Program Plan” – Chapter L).

Permit Attachment N (as modified from WIPP Hazardous Waste Facility Permit Amended Renewal Application, “Volatile Organic Compound Monitoring Plan” - Chapter N)
PART 7 - POST-CLOSURE CARE PLAN

7.1. OVERVIEW

7.2. UNIT IDENTIFICATION

7.3. POST-CLOSURE PROCEDURES AND USE OF PROPERTY

7.3.1. Post-Closure Plan

7.3.2. Post-Closure Care and Monitoring

7.3.2.1. General Monitoring, Inspection, and Maintenance Requirements

7.3.2.2. Air Monitoring Requirements

7.3.2.3. Detection Monitoring Program

7.3.3. Security

7.3.4. Post-Closure Disturbance

7.4. NOTICES AND CERTIFICATION

7.4.1. Disposal Unit Records

7.4.2. Deed Notice

7.4.2.1. Deed Recordation

7.4.2.2. Certification

7.4.3. Removal of Wastes or Contaminated Soils

7.4.4. Completion of Post-Closure Care

7.5. POST-CLOSURE PERMIT MODIFICATIONS

7.5.1. Changes Requiring a Permit Modification

7.5.1.1. Operating Plans

7.5.1.2. Timing of Closure

7.5.1.3. Other Events

7.5.2. Timing of Permit Modification
## ATTACHMENT A

### GENERAL FACILITY DESCRIPTION AND PROCESS INFORMATION

**TABLE OF CONTENTS**

| A-1  | Facility Description                                                                 | 1 |
| A-2  | Description of Activities                                                            | 2 |
| A-3  | Property Description                                                                 | 2 |
| A-4  | Facility Type                                                                         | 2 |
| A-5  | Waste Description                                                                     | 3 |
| A-6  | Chronology of Events Relevant to Changes in Ownership or Operational Control          | 4 |
ATTACHMENT A

GENERAL FACILITY DESCRIPTION AND PROCESS INFORMATION

A-1 Facility Description

Abstract

NAME OF FACILITY: Waste Isolation Pilot Plant

OWNER and CO-OPERATOR: U.S. Department of Energy

P.O. Box 3090
Carlsbad, NM 88221

CO-OPERATOR: Nuclear Waste Partnership LLC

P.O. Box 2078
Carlsbad, NM 88221

RESPONSIBLE OFFICIALS: Jose R. Franco

Manager, DOE/Carlsbad Field Office

Farok Sharif, Project Manager

Nuclear Waste Partnership LLC

FACILITY MAILING ADDRESS: U.S. Department of Energy

P.O. Box 3090
Carlsbad, NM 88221

FACILITY LOCATION: 30 miles east of Carlsbad on the Jal Highway, in Eddy County.

TELEPHONE NUMBER: 575/234-7300

U.S. EPA I.D. NUMBER: NM4890139088

GEOGRAPHIC LOCATION: 32° 22’ 30" N
103° 47’ 30" W

DATE OPERATIONS BEGAN: November 26, 1999
A-2 Description of Activities

The Waste Isolation Pilot Plant (WIPP) is a facility for the management, storage, and disposal of transuranic (TRU) mixed waste subject to regulation under 20.4.1.500 NMAC. Both contact-handled (CH) and remote-handled (RH) TRU mixed wastes are permitted for storage and disposal at the WIPP facility.

A-3 Property Description

The WIPP property has been divided into functional areas. The Property Protection Area (PPA), surrounded by a chain-link security fence, encompasses 34.16 acres and provides security and protection for all major surface structures. The DOE Off Limits Area encloses the PPA, and is approximately 1,454 acres. These areas define the DOE exclusion zone within which certain items and material are prohibited. The final zone is marked by the WIPP Site Boundary (WIPP Land Withdrawal Area), a 16-section Federal land area under the jurisdiction of the DOE.

A-4 Facility Type

There are three basic groups of structures associated with the WIPP facility: surface structures, shafts and underground structures. The surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of TRU mixed waste from the surface to the underground. There are two surface locations where TRU mixed waste is managed and stored. The first area is the Waste Handling Building (WHB) Container Storage Unit (WHB Unit) for TRU mixed waste management and storage. The WHB Unit consists of the WHB contact-handled (CH) Bay and the remote-handled (RH) Complex. The second area designated for managing and storing TRU mixed waste is the Parking Area Container Storage Unit (Parking Area Unit), an outside container storage area which extends south from the WHB to the rail siding. The Parking Area Unit provides storage space for up to 50 loaded Contact-Handled Packages and 14 loaded Remote-Handled Packages on an asphalt and concrete surface. Part 3 of the permit authorizes the storage and management of CH and RH TRU mixed waste containers in these two surface locations. The technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §§264.170 to 264.178) are applied to the operation of the WHB Unit and the Parking Area Unit. Permit Attachment A1 describes the container storage units, the TRU mixed waste management facilities and operations, and compliance with the technical requirements of 20.4.1.500 NMAC.

Four vertical shafts connect the surface facility to the underground. These are the Waste Shaft, the Salt Handling Shaft, the Exhaust Shaft and the Air Intake Shaft. The Waste Shaft is the only shaft used to transport TRU mixed waste to the underground. The WIPP underground structures are located in a mined salt bed 2,150 feet below the surface.

The WIPP is a geologic repository mined within a bedded salt formation, which is defined in 20.4.1.100 NMAC (incorporating 40 CFR §260.10) as a miscellaneous unit. As such, hazardous waste management units within the repository are subject to permitting according to 20.4.1.900 and .901 NMAC (incorporating 40 CFR §270), and are regulated under 20.4.1.500 NMAC, Miscellaneous Units.

The underground structures include the underground Hazardous Waste Disposal Units (HWDUs), an area for future underground HWDUs, the shaft pillar area, interconnecting drifts and other areas unrelated to the Hazardous Waste Facility Permit. The underground HWDUs
are defined as waste panels, each consisting of seven rooms and two access drifts. The WIPP underground area is designated as Panels 1 through 10A, although only Panels 1 through 8 will be used under the terms of this permit. Each of the seven rooms is approximately 300 feet long, 33 feet wide and 13 feet high. Part 4 of the permit authorizes the management and disposal of CH and RH TRU mixed waste containers in underground HWDUs. The Disposal Phase consists of receiving CH and RH TRU mixed waste shipping containers, unloading and transporting the waste containers to the underground HWDUs, emplacing the waste in the underground HWDUs, and subsequently achieving closure of the underground HWDUs in compliance with applicable State and Federal regulations. As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees shall ensure that the environmental performance standards for a miscellaneous unit, which are applied to the underground HWDUs in the geologic repository, will be met. Permit Attachment A2 describes the underground HWDUs, the TRU mixed waste management facilities and operations, and compliance with the technical requirements of 20.4.1.500 NMAC.

A-5 Waste Description

Wastes destined for WIPP are byproducts of nuclear 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 [20.4.1.800 NMAC, (incorporating 40 CFR §268.2(g) and (h))]. Solid process residues include inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Waste Summary Category based on the specific waste stream types and final waste form. This category includes wastes that are at least 50 percent by volume solid process residues.

**S4000—Soils/Gravel**
This waste summary category includes waste streams that are at least 50 percent by volume soil. Soils are further categorized by the amount of debris included in the matrix.

**S5000—Debris Wastes**
This waste summary category includes waste that is at least 50 percent by volume materials that meet the NMAC criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2)). 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.

The S5000 Waste Summary Category includes metal debris, metal debris containing lead, inorganic nonmetal debris, asbestos debris, combustible debris, graphite debris, heterogeneous debris, and composite filters, as well as other minor waste streams. Particles smaller than 2.36 inches in size may be considered debris if the debris is a manufactured object and if it is not a particle of S3000 or S4000 material.
If a waste does not include at least 50 percent of any given category by volume, characterization shall be performed using the waste characterization process required for the category constituting the greatest volume of waste for that waste stream.

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 waste may be generated in either the WHB or the underground. This waste is referred to as “derived waste.” All such derived waste will be placed in the rooms in HWDUs along with the TRU mixed waste for disposal.

Non-mixed hazardous wastes generated at the WIPP, through activities where contact with TRU mixed waste does not occur, are characterized, placed in containers, and stored (for periods not exceeding the limits specified in 20.4.1.300 NMAC (incorporating 40 CFR §262.34)) until they are transported off site for treatment and/or disposal at a permitted facility. This waste generation and accumulation activity, when performed in compliance with 20.4.1.300 NMAC (incorporating 40 CFR §262), is not subject to RCRA permitting requirements and, as such, is not addressed in the permit.

Chronology of Events Relevant to Changes in Ownership or Operational Control

December 19, 1997
NMED received notification of a change of name/ownership from Westinghouse Electric Corporation to CBS Corporation. The WIPP Management and Operating Contractor (MOC), Westinghouse Waste Isolation Division (WID), became a division of Westinghouse Electric Company, which in turn was a division of CBS Corporation. Notification to NMED was made by the permit applicant in a letter dated December 18, 1997. The permit application was under review, but a draft permit was not yet issued.

September 22, 1998
NMED received notification of a pending transfer of ownership for the MOC, Westinghouse WID, from CBS Corporation to an as-yet-to-be-named limited liability company owned jointly by British Nuclear Fuels, plc and Morrison-Knudsen Corporation. The transfer of ownership was scheduled to occur on or about December 15, 1998. Notification to NMED was made by the permit applicant in a letter dated September 17, 1998. The draft permit had been issued for public comment, but the final permit was not yet issued.

March 9, 1999
NMED again received notification of the pending divestiture of the MOC, Westinghouse WID, by CBS Corporation to the limited liability company owned jointly by British Nuclear Fuels, plc and Morrison-Knudsen Corporation known as MK/BNFL GESCO LLC. The new MOC would be renamed to Westinghouse Government Environmental Services Company LLC. Notification to NMED was made by the permit applicant in a letter dated March 2, 1999. The public hearing on the permit was underway, but the final permit was not yet issued.

March 26, 1999
NMED received official notification of the divestiture of Westinghouse Electric Company by CBS Corporation to MK/BNFL GESCO LLC effective March 22, 1999. The MOC was renamed Westinghouse Government Environmental Services Company LLC (WGES), of which
Westinghouse Waste Isolation Division was a division. This transaction constituted a change of operational control under 20.4.1.900 NMAC (incorporating 40 CFR §270.40). Notification to NMED was made by the permit applicant in a letter dated March 24, 1999. The public hearing on the permit was nearly concluded, but the final permit was not yet issued.

April 28, 1999
NMED received a revised Part A Permit Application in a letter dated April 21, 1999, reflecting that the Westinghouse Waste Isolation Division, cooperator of the WIPP hazardous waste facility, was now a part of WGES. However, the final permit, issued October 27, 1999, did not reflect the change in ownership.

July 25, 2000
NMED received a Class 1 permit modification in a letter dated July 21, 2000, changing the name in the Permit from Westinghouse Electric Corporation to Westinghouse Government Environmental Services Company LLC (WGES), Waste Isolation Division (WID). However, this notification did not constitute the required permit modification under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) necessary to reflect the transfer of the permit to a new operator.

December 15, 2000
DOE announced that it had awarded a five-year contract for management and operation of WIPP to Westinghouse TRU Solutions LLC, a limited liability company owned jointly by WGES LLC and Roy F. Weston, Inc. The announcement further stated that, following a brief transition period, the new contractor would assume MOC responsibilities on February 1, 2001. This transaction constituted a change of operational control under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) requiring a Class 1 permit modification with prior written approval of NMED.

February 5, 2001
NMED received a Class 1 permit modification in a letter dated February 2, 2001, which notified NMED of an organizational name change of the MOC from Westinghouse Government Environmental Services Company LLC Waste Isolation Division to Westinghouse TRU Solutions LLC. However, this notification did not constitute the required permit modification under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) necessary to reflect the transfer of the permit to a new operator.

December 31, 2002
NMED received a Class 1 permit modification in a letter dated December 27, 2002, which changed the name of the MOC from Westinghouse TRU Solutions LLC to Washington TRU Solutions LLC. Again, this notification did not constitute the required permit modification under 20.4.1.900 NMAC (incorporating 40 CFR §270.40) necessary to reflect the transfer of the permit to a new operator.

February 28, 2003
NMED received a Class 1 permit modification requiring prior agency approval in a letter dated February 28, 2003, to satisfy the requirements specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.40) to reflect the transfer of the permit to a new operator.
NMED received a Class 1 permit modification requiring prior agency approval in a letter dated September 16, 2004, describing a change of ownership of Washington TRU Solutions LLC (WTS). WTS is owned jointly by WGES, managing member, and Weston Solutions, Inc. WGES had been owned jointly by Washington Group International, Inc. (WGI), and BNFL Nuclear Services, Inc. However, WGI has acquired BNFL’s prior interest in the former Westinghouse government services businesses, which includes BNFL’s prior interest in WGES.

NMED received notification in a letter dated August 2, 2007 of the pending acquisition of WGI by URS Corporation at an unknown future date. This acquisition would be related to operational control, because WGI is the sole owner of WGES, managing member of the joint venture, along with Weston Solutions, Inc., that owns WTS, the WIPP MOC. This notification was submitted to assure compliance with 20.4.1.900 NMAC (incorporating 40 CFR §270.40(b)).

NMED received a Class 1 permit modification requiring prior agency approval in a letter dated November 19, 2007, describing a change of ownership of WTS. On November 15, 2007, WGI was acquired by URS Corporation. WTS is owned jointly by WGES, managing member, and Weston Solutions, Inc. WGES, formerly owned by WGI, is now owned by URS Corporation.

NMED received a Class 1 permit modification requiring prior agency approval in a letter dated June 25, 2012 describing a change in the MOC for the WIPP facility. The new MOC for the WIPP facility will be Nuclear Waste Partnership LLC. The new MOC is comprised of URS Energy and Construction, Inc. and Babcock and Wilcox Technical Services Group, Inc.
ATTACHMENT A2

GEOLOGIC REPOSITORY
# ATTACHMENT A2

## GEOLOGIC REPOSITORY

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2-1</td>
<td>Description of the Geologic Repository</td>
<td>1</td>
</tr>
<tr>
<td>A2-2</td>
<td>Geologic Repository Design and Process Description</td>
<td>2</td>
</tr>
<tr>
<td>A2-2a(1)</td>
<td>CH TRU Mixed Waste Handling Equipment</td>
<td>3</td>
</tr>
<tr>
<td>A2-2a(2)</td>
<td>Shafts</td>
<td>4</td>
</tr>
<tr>
<td>A2-2a(3)</td>
<td>Subsurface Structures</td>
<td>6</td>
</tr>
<tr>
<td>A2-2a(4)</td>
<td>RH TRU Mixed Waste Handling Equipment</td>
<td>10</td>
</tr>
<tr>
<td>A2-2b</td>
<td>Geologic Repository Process Description</td>
<td>11</td>
</tr>
<tr>
<td>A2-3</td>
<td>Waste Characterization</td>
<td>13</td>
</tr>
<tr>
<td>A2-4</td>
<td>Treatment Effectiveness</td>
<td>13</td>
</tr>
<tr>
<td>A2-5</td>
<td>Maintenance, Monitoring, and Inspection</td>
<td>14</td>
</tr>
<tr>
<td>A2-5a(1)</td>
<td>Ground-Control Program</td>
<td>14</td>
</tr>
<tr>
<td>A2-5b</td>
<td>Monitoring</td>
<td>14</td>
</tr>
<tr>
<td>A2-5b(1)</td>
<td>Groundwater Monitoring</td>
<td>14</td>
</tr>
<tr>
<td>A2-5b(2)</td>
<td>Geomechanical Monitoring</td>
<td>14</td>
</tr>
<tr>
<td>A2-5b(2)(a)</td>
<td>Description of the Geomechanical Monitoring System</td>
<td>14</td>
</tr>
<tr>
<td>A2-5b(2)(b)</td>
<td>System Experience</td>
<td>15</td>
</tr>
<tr>
<td>A2-5b(3)</td>
<td>Volatile Organic Compound Monitoring</td>
<td>16</td>
</tr>
<tr>
<td>A2-5c</td>
<td>Inspection</td>
<td>16</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table A2-1</td>
<td>CH TRU Mixed Waste Handling Equipment Capacities</td>
</tr>
<tr>
<td>Table A2-2</td>
<td>Instrumentation Used in Support of the Geomechanical Monitoring System</td>
</tr>
<tr>
<td>Table A2-3</td>
<td>RH TRU Mixed Waste Handling Equipment Capacities</td>
</tr>
</tbody>
</table>

LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure A2-1</td>
<td>Repository Horizon</td>
</tr>
<tr>
<td>Figure A2-2</td>
<td>Spatial View of the Miscellaneous Unit and Waste Handling Facility</td>
</tr>
<tr>
<td>Figure A2-3</td>
<td>Facility Pallet for Seven-Pack of Drums</td>
</tr>
<tr>
<td>Figure A2-5</td>
<td>Typical Backfill Sacks Emplaced on Drum Stacks</td>
</tr>
<tr>
<td>Figure A2-5a</td>
<td>Potential MgO Emplacement Configurations</td>
</tr>
<tr>
<td>Figure A2-6</td>
<td>Waste Transfer Cage to Transporter</td>
</tr>
<tr>
<td>Figure A2-7</td>
<td>Push-Pull Attachment to Forklift to Allow Handling of Waste Containers</td>
</tr>
<tr>
<td>Figure A2-8</td>
<td>Typical RH and CH Transuranic Mixed Waste Container Disposal Configuration</td>
</tr>
<tr>
<td>Figure A2-9</td>
<td>Underground Ventilation System Airflow</td>
</tr>
<tr>
<td>Figure A2-10</td>
<td>Typical Room Barricade</td>
</tr>
<tr>
<td>Figure A2-11</td>
<td>Typical Bulkhead</td>
</tr>
<tr>
<td>Figure A2-12</td>
<td>WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram</td>
</tr>
<tr>
<td>Figure A2-12a</td>
<td>WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram (Continued)</td>
</tr>
<tr>
<td>Figure A2-13</td>
<td>Layout and Instrumentation - As of 1/96</td>
</tr>
<tr>
<td>Figure A2-14</td>
<td>Facility Cask Transfer Car (Side View)</td>
</tr>
<tr>
<td>Figure A2-15</td>
<td>Typical Horizontal Emplacement Equipment</td>
</tr>
<tr>
<td>Figure A2-15a</td>
<td>Typical Horizontal Emplacement Equipment</td>
</tr>
<tr>
<td>Figure A2-16</td>
<td>RH TRU Waste Facility Cask Unloading from Waste Shaft Conveyance</td>
</tr>
<tr>
<td>Figure A2-17</td>
<td>Facility Cask Installed on the Typical Emplacement Equipment</td>
</tr>
<tr>
<td>Figure A2-18</td>
<td>Installing Shield Plug</td>
</tr>
<tr>
<td>Figure A2-19</td>
<td>Shield Plug Supplemental Shielding Plate(s)</td>
</tr>
<tr>
<td>Figure A2-20</td>
<td>Shielding Layers to Supplement RH Borehole Shield Plugs</td>
</tr>
<tr>
<td>Figure A2-21</td>
<td>Shield Plug Configuration</td>
</tr>
</tbody>
</table>
GEOLOGIC REPOSITORY

A2-1 Description of the Geologic Repository

Management, storage, and disposal of transuranic (TRU) mixed waste in the Waste Isolation Pilot Plant (WIPP) geologic repository is subject to regulation under 20.4.1.500 NMAC. The WIPP is a geologic repository mined within a bedded salt formation, which is defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10) as a miscellaneous unit. As such, HWMUs within the repository are eligible for permitting according to 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and are regulated under 20.4.1.500 NMAC, Miscellaneous Units.

As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees shall ensure that the environmental performance standards for a miscellaneous unit, which are applied to the Underground Hazardous Waste Disposal Units (HWDUs) in the geologic repository, will be met.

The Disposal Phase will consist of receiving contact-handled (CH) and remote-handled (RH) TRU mixed waste shipping containers, unloading and transporting the waste containers to the Underground HWDUs, emplacing the waste in the Underground HWDUs, and subsequently achieving closure of the Underground HWDUs in compliance with applicable State and Federal regulations.

The WIPP geologic repository is mined within a 2,000-feet (ft) (610-meters (m))-thick bedded-salt formation called the Salado Formation. The Underground HWDUs (miscellaneous units) are located 2,150 ft (655 m) beneath the ground surface. TRU mixed waste management activities underground will be confined to the southern portion of the 120-acre (48.6 hectares) mined area during the Disposal Phase. During the term of this Permit, disposal of TRU mixed waste will occur only in the HWDUs designated as Panels 15 through 10A8 and in any currently active panel (See Figure A2-1). RH TRU mixed waste disposal began in Panel 4. The Permittees may also request in the future a Permit to allow disposal of containers of TRU mixed waste in the areas designated as Panels 9 and 10 in Figure A2-1. This Permit, during its 10-year term, authorizes the excavation of and disposal of waste in Panels 6 through 10A and the disposal of waste in Panels 1 through 8.

Panels 1 through 10A8 will consist of seven rooms and two access drifts each. Panels 9 and 10 have yet to be designed. Access drifts connect the rooms and have the same cross section (see Section A2-2a(3)). The closure system installed in each HWDU after it is filled will prevent anyone from entering the HWDU and will restrict ventilation airflow. The point of compliance for air emissions from the Underground is Sampling Station VOC-A, as defined in Permit Attachment N (Volatile Organic Compound Monitoring Plan). Sampling Station VOC-A is the location where the concentration of volatile organic compounds (VOCs) in the air emissions from the Underground HWDUs will be measured and then compared to the VOC limits concentration of concern as required by Permit Part 4.

Four shafts connect the underground area with the surface. The Waste Shaft Conveyance headframe and hoist are located within the Waste Handling Building (WHB) and will be used to transport containers of TRU mixed waste, equipment, and materials to the repository horizon. The waste hoist can also be used to transport personnel. The Air Intake Shaft and the Salt
Handling Shaft provide ventilation to all areas of the mine except for the Waste Shaft Station. This area is ventilated by the Waste Shaft itself. The Salt Handling Shaft is also used to hoist mined salt to the surface and serves as the principal personnel transport shaft. The Exhaust Shaft serves as a common exhaust air duct for all areas of the mine. The relationship between the WIPP surface facility, the four shafts, and the geologic repository horizon is shown on Figure A2-2.

The HWDUs identified as Panels 1 through 10A8 (Figure A2-1) provide room for up to 6,200,000 cubic feet (ft³) (175,564 cubic meters (m³)) of CH TRU mixed waste. The CH TRU mixed waste containers may be stacked up to three high across the width of the room or emplaced in holes in the walls of the panels in up to 730 boreholes per panel, subject to the limitations in Permit Part 4, Section 4.1.1.2.ii. These boreholes shall be drilled on nominal eight-foot centers, horizontally, about mid-height in the ribs of a disposal room. The thermal loading from RH TRU mixed waste shall not exceed 10 kilowatts per acre when averaged over the area of a panel, as shown in Permit Attachment A3, plus 100 feet of each of a panel’s adjoining barrier pillars.

Panels 4 through 8 provide room for up to 93,050 ft³ (2,635 m³) of RH TRU mixed waste. RH TRU mixed waste may be disposed of in up to 730 boreholes per panel, subject to the limitations in Permit Part 4, Section 4.1.1.2.ii. These boreholes shall be drilled on nominal eight-foot centers, horizontally, about mid-height in the ribs of a disposal room. The thermal loading from RH TRU mixed waste shall not exceed 10 kilowatts per acre when averaged over the area of a panel, as shown in Permit Attachment A3, plus 100 feet of each of a panel’s adjoining barrier pillars.

The WIPP facility is located in a sparsely populated area with site conditions favorable to isolation of TRU mixed waste from the biosphere. Geologic and hydrologic characteristics of the site related to its TRU mixed waste isolation capabilities are discussed in Addendum L1 of the WIPP Hazardous Waste Facility Permit Amended Renewal Application (DOE, 2009). Hazard prevention programs are described in this Permit Attachment. Contingency and emergency response actions to minimize impacts of unanticipated events, such as spills, are described in Permit Attachment D. The closure plan for the WIPP facility is described in Permit Attachment G.

A2-2 Geologic Repository Design and Process Description

A2-2a Geologic Repository Design and Construction

The WIPP facility, when operated in compliance with the Permit, will ensure safe operations and be protective of human health and the environment.

As a part of the design validation process, geomechanical tests were conducted in SPDV test rooms. During the tests, salt creep rates were measured. Separation of bedding planes and fracturing were also observed. Consequently, a ground-control strategy was implemented. The ground-control program at the WIPP facility mitigates the potential for roof or rib falls and maintains normal excavation dimensions, as long as access to the excavation is possible.
A2-2a(1) CH TRU Mixed Waste Handling Equipment

The following are the major pieces of equipment used to manage CH TRU waste in the geologic repository. A summary of equipment capacities, as required by 20.4.1.500 NMAC is included in Table A2-1.

Facility Pallets

The facility pallet is a fabricated steel unit designed to support 7-packs, 3-packs, or 4-packs of drums, standard waste boxes (SWBs), ten-drum overpacks (TDOPs), or a standard large box (SLB2), and has a rated load of 25,000 pounds (lbs.) (11,430 kilograms (kg)). The facility pallet will accommodate up to four 7-packs, four 3-packs, two 3-packs of shielded containers, four 4-packs of drums, four SWBs (in two stacks of two units), two TDOPs, or one SLB2. Loads are secured to the facility pallet during transport to the emplacement area. Facility pallets are shown in Figure A2-3. Fork pockets in the side of the pallet allow the facility pallet to be lifted and transferred by forklift to prevent direct contact between TRU mixed waste containers and forklift tines. This arrangement reduces the potential for puncture accidents. WIPP facility operational documents define the operational load of the facility pallet to ensure that the rated load of a facility pallet is not exceeded.

Backfill

Magnesium oxide (MgO) will be used as a backfill in order to provide chemical control over the solubility of radionuclides in order to comply with the requirements of 40 CFR §191.13. The MgO backfill will be purchased prepackaged in the proper containers for emplacement in the underground. Purchasing prepackaged backfill eliminates handling and placement problems associated with bulk materials, such as dust creation. In addition, prepackaged materials will be easier to emplace, thus reducing potential worker exposure to radiation. Should a backfill container be breached, MgO is benign and cleanup is simple. No hazardous waste would result from a spill of backfill.

The MgO backfill will be managed in accordance with Specification D-0101 (MgO Backfill Specification) and WP05-WH1025 (CH Waste Downloading and Emplacement). These documents are kept on file at the WIPP facility by the Permittees.

Backfill will be handled in accordance with standard operating procedures. Typical emplacement configurations are shown in Figures A2-5 and A2-5a. Some emplacement configurations may include the use of MgO emplacement racks, as shown in Figure A2-5a.

Quality control will be provided within standard operating procedures to record that the correct number of sacks are placed and that the condition of the sacks is acceptable.

Backfill placed in this manner is protected until exposed when sacks are broken during creep closure of the room and compaction of the backfill and waste. Backfill in sacks utilizes existing techniques and equipment and eliminates operational problems such as dust creation and introducing additional equipment and operations into waste handling areas. There are no mine operational considerations (e.g. ventilation flow and control) when backfill is placed in this manner.
The Waste Shaft Conveyance

The hoist systems in the shafts and all shaft furnishings are designed to resist the dynamic forces of the hoisting system and to withstand a design-basis earthquake of 0.1 g. Appendix D2 of the WIPP RCRA Part B Permit Application (DOE, 1997) provided engineering design-basis earthquake report which provides the basis for seismic design of WIPP facility structures. The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system (such as overtravel, overspeed, power loss, circuitry failure, or starting in a wrong direction) and will trigger an alarm that automatically shuts down the hoist.

The waste hoist moves the Waste Shaft Conveyance and is a multirope, friction-type hoist. A counterweight is used to balance the waste shaft conveyance. The waste shaft conveyance (outside dimensions) is 30 ft (9 m) high by 10 ft (3 m) wide by 15 ft (4.5 m) deep and can carry a payload of 45 tons (40,824 kg). During loading and unloading operations, it is steadied by fixed guides. The hoist’s maximum rope speed is 500 ft (152.4 m) per min.

The Waste Shaft hoist system has two sets of brakes, with two units per set, plus a motor that is normally used to stop the hoist. The brakes are designed so that either set, acting alone, can stop a fully loaded conveyance under all emergency conditions.

The Underground Waste Transporter

The underground waste transporter is a commercially available diesel-powered tractor. The trailer was designed specifically for the WIPP for transporting facility pallets from the waste shaft conveyance to the Underground HWDU in use. This transporter is shown in Figure A2-6.

Underground Forklifts

CH TRU mixed waste containers loaded on slipsheets will be removed from the facility pallets using forklifts with a push-pull attachment (Figure A2-7) attached to the forklift-truck front carriage. The push-pull attachment grips the edge of the slipsheet (on which the waste containers sit) to pull the containers onto the platen. After the forklift moves the waste containers to the emplacement location, the push-pull attachment pushes the containers into position. The use of the push-pull attachment prevents direct contact between waste containers and forklift tines. SWBs and TDOPs may also be removed from the facility pallet by using forklifts equipped with special adapters for these containers. These special adapters will prevent direct contact between SWBs or TDOPs and forklift tines. In addition, the low clearance forklift that is used to emplace MgO may be used to emplace waste if necessary.

A forklift will be used to offload the SLB2 from the underground transporter and emplace the waste container in the waste stack.

A2-2a(2) Shafts

The WIPP facility uses four shafts: the Waste Shaft, the Salt Handling Shaft, the Air Intake Shaft, and the Exhaust Shaft. These shafts are vertical openings that extend from the surface to the repository level.

The Waste Shaft is located beneath the WHB and is 19 to 20 ft (5.8 to 6.1 m) in diameter. The Salt Handling Shaft, located north of the Waste Shaft beneath the salt handling headframe, is
10 to 12 ft (3 to 3.6 m) in diameter. Salt mined from the repository horizon is removed through the Salt Handling Shaft. The Salt Handling Shaft is the main personnel and materials hoist and also serves as a secondary-supply air duct for the underground areas. The Air Intake Shaft, northwest of the WHB, varies in diameter from 16 ft 7 in. (4.51 m) to 20 ft 3 in. (6.19 m) and is the primary source of fresh air underground. The Exhaust Shaft, east of the WHB, is 14 to 15 ft (4.3 to 4.6 m) in diameter and serves as the exhaust duct for the underground air.

Openings excavated in salt experience closure because of salt creep (or time-dependent deformation at constant load). The closure affects the design of all of the openings discussed in this section. Underground excavation dimensions, therefore, are nominal, because they change with time. The unlined portions of the shafts have larger diameters than the lined portions, which allows for closure caused by salt creep. Each shaft includes a shaft collar, a shaft lining, and a shaft key section. The Final Design Validation Report in Appendix D1 of the WIPP RCRA Part B Permit Application (DOE, 1997) discusses the shafts and shaft components in greater detail.

The reinforced-concrete shaft collars extend from the surface to the top of the underlying consolidated sediments. Each collar serves to retain adjacent unconsolidated sands and soils and to prevent surface runoff from entering the shafts. The shaft linings extend from the base of the collar to the top of the salt beds approximately 850 ft (259 m) below the surface. Grout injected behind the shaft lining retards water seeping into the shafts from water-bearing formations, and the liner is designed to withstand the natural water pressure associated with these formations. The shaft liners are concrete, except in the Salt Handling Shaft, where a steel shaft liner has been grouted in place.

The shaft key is a circular reinforced concrete section emplaced in each shaft below the liner in the base of the Rustler and extending about 50 ft (15 m) into the Salado. The key functions to resist lateral pressures and assures that the liner will not separate from the host rocks or fail under tension. This design feature also aids in preventing the shaft from becoming a route for groundwater flow into the underground facility.

On the inside surface of each shaft, excluding the Salt Handling Shaft, there are three water-collection rings: one just below the Magenta, one just below the Culebra, and one at the lowermost part of the key section. These collection rings will collect water that may seep into the shaft through the liner. The Salt Handling Shaft has a single water collection ring in the lower part of the key section. Water collection rings are drained by tubes to the base of the shafts where the water is accumulated.

WIPP shafts and other underground facilities are, for all practical purposes, dry. Minor quantities of water (which accumulate in some shaft sumps) are insufficient to affect the waste disposal area. This water is collected, brought to the surface, and disposed of in accordance with current standards and regulations.

The Waste Shaft is protected from precipitation by the roof of the waste shaft conveyance headframe tower. The Exhaust Shaft is configured at the top with a 14 ft- (4.3 m-) diameter duct that diverts air into the exhaust filtration system or to the atmosphere, as appropriate. The Salt Handling and Air Intake Shaft collars are open except for the headframes. Rainfall into the shafts is evaporated by ventilation air.

The waste hoist system in the Waste Shaft and all Waste Shaft furnishings are designed to resist the dynamic forces of the hoisting system, which are greater than the seismic forces on
the underground facilities. In addition the Waste Shaft conveyance headframe is designed to withstand the design-basis earthquake (DBE). Maximum operating speed of the hoist is 500 ft (152.4 m) per minute. During loading and unloading operations, the waste hoist is steadied by fixed guides. The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system, such as overtravel, overspeed, power loss, or circuitry failure. The control response is to annunciate the condition and shut the hoist down. Operator response is required to recover from the automatic shutdown. Waste hoist operation is continuously monitored by the CMS. A battery powered FM transmitter/receiver allows communication between the hoist conveyance and the hoist house.

The waste hoist has two pairs of brake calipers acting on independent brake paths. The hoist motor is normally used for braking action of the hoist. The brakes are used to hold the hoist in position during normal operations and to stop the hoist under emergency conditions. Each pair of brake calipers is capable of holding the hoist in position during normal operating conditions and stopping the hoist under emergency conditions. In the event of power failure, the brakes will set automatically.

The waste hoist is protected by a fixed automatic fire suppression system. Portable fire extinguishers are also provided on the hoist floor and in equipment areas.

### A2-2a(3) Subsurface Structures

The subsurface structures in the repository, located at 2,150 ft (655 m) below the surface, include the HWDUs, the northern experimental areas, and the support areas. Appendix D3 of the WIPP RCRA Part B Permit Application (DOE, 1997) provided details of the underground layout. Figure A2-8 shows the proposed waste emplacement configuration for the HWDUs.

The status of important underground equipment, including fixed fire-protection systems, the ventilation system, and contamination detection systems, will be monitored by a central monitoring system, located in the Support Building adjacent to the WHB. Backup power will be provided as discussed below. The subsurface support areas are constructed and maintained to conform to Federal mine safety codes.

### Underground Hazardous Waste Disposal Units (HWDUs)

During the terms of this and the preceding Permit, the volume of CH TRU mixed waste (CH and RH) emplaced in the repository will not exceed 6,200,000 ft$^3$ (175,564 m$^3$) and the volume of RH TRU mixed waste shall not exceed 250,000 ft$^3$ (7,079 m$^3$). CH TRU mixed waste will be disposed of in Undergound HWDUs identified as Panels 1 through 10A8. RH TRU mixed waste may be disposed of in Panels 4 through 10A8.

Main entries and cross cuts in the repository provide access and ventilation to the HWDUs. The main entries link the shaft pillar/service area with the TRU mixed waste management area and are separated by pillars. Each of the Underground HWDUs labeled Panels 1 through 10A8 will have seven rooms. The locations of these HWDUs are shown in Figure A2-1. The rooms will have nominal dimensions of 13 ft (4.0 m) high by 33 ft (10 m) wide by 300 ft (91 m) long and will be supported by 100 ft- (30 m-) wide pillars.

As currently planned, future Permits may allow disposal of TRU mixed waste containers in two additional panels, identified as Panels 9 and 10. Disposal of TRU mixed waste in Panels 9 and
10 is prohibited under this Permit. If waste volumes disposed of in the eight panels fail to reach
the stated design capacity, the Permittees may request a Permit to allow disposal of TRU mixed
waste in the four main entries and crosscuts adjacent to the waste panels (referred to as the
disposal area access drifts). These areas are labeled Panels 9 and 10 in Figure A2-1. A permit
modification or future permit would be submitted describing the condition of those drifts and the
controls exercised for personnel safety and environmental protection while disposing of waste in
these areas. These areas have the following nominal dimensions:

   The E-140 waste transport route south of the Waste Shaft Station is mined to be 25 ft wide
   nominally and its height ranges from about 14 ft to 20 ft.

   The W-30 waste transport route south of S-700 is mined to be 20 ft wide nominally and its
   height will be mined to at least 14 ft.

   All other drifts that are part of the waste transport route will be at least 20 ft wide and 14 ft
   high to accommodate waste transport equipment.

   Other drifts (i.e. mains and cross-cuts) vary in width and height according to their function
   typically ranging from 14 ft to 20 ft wide and 12 ft to 20 ft high.

The layout of these excavations is shown on Figure A2-1.

Underground Facilities Ventilation System

   The underground facilities ventilation system will provide a safe and suitable environment for
   underground operations during normal WIPP facility operations. The underground system is
   designed to provide control of potential airborne contaminants in the event of an accidental
   release or an underground fire.

   The main underground ventilation system is divided into four separate flows (Figure A2-9): one
   flow serving the mining areas, one serving the northern experimental areas, one serving the
   disposal areas, and one serving the Waste Shaft and station area. The four main airflows are
   recombined near the bottom of the Exhaust Shaft, which serves as a common exhaust route
   from the underground level to the surface.

Underground Ventilation System Description

   The underground ventilation system consists of six centrifugal exhaust fans, two identical
   HEPA-filter assemblies arranged in parallel, isolation dampers, a filter bypass arrangement, and
   associated ductwork. The six fans, connected by the ductwork to the underground exhaust shaft
   so that they can independently draw air through the Exhaust Shaft, are divided into two groups.
   One group consists of three main exhaust fans, two of which are utilized to provide the nominal
   air flow of 425,000 standard ft\(^3\) per min (SCFM) throughout the WIPP facility underground during
   normal operation. One main fan may be operated in the alternate mode to provide 260,000
   SCFM underground ventilation flow. These fans are located near the Exhaust Shaft. The
   second group consists of the remaining three filtration fans, and each can provide 60,000 SCFM
   of air flow. These fans, located at the Exhaust Filter Building, are capable of being employed
   during the filtration mode, where exhaust is diverted through HEPA filters, or in the reduced or
   minimum ventilation mode where air is not drawn through the HEPA filters. In order to ensure
the miscellaneous unit environmental performance standards are met, a minimum running annual average exhaust rate of 260,000 SCFM will be maintained.

The underground mine ventilation is designed to supply sufficient quantities of air to all areas of the repository. During normal operating mode (simultaneous mining and waste emplacement operations), approximately 140,000 actual ft³ (3,962 m³) per min can be supplied to the panel area. This quantity is necessary in order to support the level of activity and the pieces of diesel equipment that are expected to be in operation.

At any given time during waste emplacement activities, there may be significant activities in multiple rooms in a panel. For example, one room may be receiving CH TRU mixed waste containers, another room may be receiving RH TRU mixed waste canisters, and the drilling of RH TRU mixed waste emplacement boreholes may be occurring in another room. The remaining rooms in a panel will either be completely filled with waste; be idle, awaiting waste handling operations; or being prepared for waste receipt. A minimum ventilation rate of 35,000 ft³ (990 m³) per minute will be maintained in each active room when waste disposal is taking place and workers are present in the room. This quantity of air is required to support the numbers and types of diesel equipment that are expected to be in operation in the area, to support the underground personnel working in that area, and to exceed a minimum air velocity of 60 ft (18 m) per minute. The remainder of the air is needed in order to account for air leakage through inactive rooms.

Air will be routed into a panel from the intake side. Air is routed through the individual rooms within a panel using underground bulkheads and air regulators. Bulkheads are constructed by erecting framing of rectangular steel tubing and screwing galvanized sheet metal to the framing. Bulkhead members use telescoping extensions that are attached to framing and the salt which adjust to creep. Flexible flashing attached to the bulkhead on one side and the salt on the other completes the seal of the ventilation. Where controlled airflow is required, a louver-style damper on a slide-gate (sliding panel) regulator is installed on the bulkhead. Personnel access is available through most bulkheads, and vehicular access is possible through selected bulkheads. Vehicle roll-up doors in the panel areas are not equipped with warning bells or strobe lights since these doors are to be used for limited periodic maintenance activities in the return air path. Flow is also controlled using brattice cloth barricades. These consist of chain link fence that is bolted to the salt and covered with brattice cloth; and are used in instances where the only flow control requirement is to block the air. A brattice cloth air barricade is shown in Figure A2-11. Ventilation will be maintained only in all active rooms within a panel until waste emplacement activities are completed and the panel-closure system is installed. The air will be routed simultaneously through all the active rooms within the panel. The filled rooms will be isolated from the ventilation system, while the active rooms that are actively being filled will receive a minimum of 35,000 SCFM of air when workers are present to assure worker safety. After all rooms within a panel are filled, the panel will be closed using a closure system described Permit Attachment G and Permit Attachment G1.

Once a disposal room is filled and is no longer needed for emplacement activities, it will be barricaded against entry and isolated from the mine ventilation system by removing the air regulator bulkhead and constructing chain link/brattice cloth barricades and, if necessary, bulkheads at each end. A typical bulkhead is shown in Figure A2-11a. There is no requirement for air for these rooms since personnel and/or equipment will not be in these areas.
The ventilation flow split prior to passing S-1600 so that the flow that passes through the path for the waste disposal areas side is separated from the ventilation flow that passes through the mining side. This separation is established by means of air locks, bulkheads, and salt pillars. These flows are combined prior to exhausting the air from the underground. Under normal operations a pressure differential is maintained between the mining side and the waste disposal side to ensure that any leakage between these flow paths is towards the disposal side. The pressure differential is produced by the surface fans in conjunction with the underground air regulators.

Underground Ventilation Modes of Operation

The underground ventilation system is designed to perform under two types of operation: normal (the HEPA exhaust filtration system is bypassed), and filtered (the exhaust is filtered through the HEPA filtration system, if radioactive contaminants are detected or suspected. Overall, there are six possible modes of exhaust fan operation:

- 2 main fans in operation
- 1 main fan in operation
- 1 filtration fan in filtered operation
- 1 filtration fan in unfiltered operation
- 2 filtration fans in unfiltered operation
- 1 main and 1 filtration fan (unfiltered) in operation

Under some circumstances (such as power outages and maintenance activities, etc.), all mine ventilation may be discontinued for short periods of time.

In the normal mode, two main surface exhaust fans, located near the Exhaust Shaft, will provide continuous ventilation of the underground areas. All underground flows join at the bottom of the Exhaust Shaft before discharge to the atmosphere.

Outside air will be supplied to the mining areas and the waste disposal areas through the Air Intake Shaft, the Salt Handling Shaft, and access entries. A small quantity of outside air will flow down the Waste Shaft to ventilate the Waste Shaft station. The ventilation system is designed to operate with the Air Intake Shaft as the primary source of fresh air. Under these circumstances, sufficient air will be available to simultaneously conduct all underground operations (e.g., waste handling, mining, experimentation, and support). Ventilation may be supplied by operating fans in the configurations listed in the above description of the ventilation modes.

If the nominal flow of 425,000 cfm (12,028 m³/min) is not available (i.e., only one of the main ventilation fans is available) underground operations may proceed, but the number of activities that can be performed in parallel may be limited depending on the quantity of air available. Ventilation may be supplied by operating one or two of the filtration exhaust fans. To accomplish this, the isolation dampers will be opened, which will permit air to flow from the main exhaust duct to the filter outlet plenum. The filtration fans may also be operated to bypass the HEPA plenum. The isolation dampers of the filtration exhaust fan(s) to be employed will be opened, and the selected fan(s) will be switched on. In this mode, underground operations will be limited, because filtration exhaust fans cannot provide sufficient airflow to support the use of diesel equipment.
In the filtration mode, the exhaust air will pass through two identical filter assemblies, with only one of the three Exhaust Filter Building filtration fans operating (all other fans are stopped). This system provides a means for removing the airborne particulates that may contain radioactive and hazardous waste contaminants in the reduced exhaust flow before they are discharged through the exhaust stack to the atmosphere. The filtration mode is activated manually or automatically if the radiation monitoring system detects abnormally high concentrations of airborne radioactive particulates (an alarm is received from the continuous air monitor in the exhaust drift of the active waste panel) or a waste handling incident with the potential for a waste container breach is observed. The filtration mode is not initiated by the release of gases such as VOCs.

If utility power fails, the exhaust filter system goes into the fail-safe position, and the system high-efficiency particulate-air filter dampers are placed into filtration position. When power is restored by the diesel generators, a decision is made whether to remain in filtration mode and energize a filtration fan or to realign the dampers into the minimum exhaust mode. Without any indication of a radiological release, the decision is usually the latter. TRU mixed waste handling and related operations cease upon loss of utility power and are not resumed until normal utility power is returned. As specified in Part 2, all waste handling equipment will "fail safe," meaning that it will retain its load during a power outage.

**Underground Ventilation Normal Mode Redundancy**

The underground ventilation system has been provided redundancy in normal ventilation mode by the addition of a third main fan. Ductwork leading to that new fan ties into the existing main exhaust duct.

**Electrical System**

The WIPP facility uses electrical power (utility power) supplied by the regional electric utility company. If there is a loss of utility power, TRU mixed waste handling and related operations will cease.

Backup, alternating current power will be provided on site by two 1,100-kilowatt diesel generators. These units provide 480-volt power with a high degree of reliability. Each of the diesel generators can carry predetermined equipment loads while maintaining additional power reserves. Predetermined loads include lighting and ventilation for underground facilities, lighting and ventilation for the TRU mixed waste handling areas, and the Air Intake Shaft hoist. The diesel generator can be brought on line within 30 minutes either manually or from the control panel in the Central Monitoring Room (CMR).

Uninterruptible power supply (UPS) units are also on line providing power to predetermined monitoring systems. These systems ensure that the power to the radiation detection system for airborne contamination, the local processing units, the computer room, and the CMR will always be available, even during the interval between the loss of off-site power and initiation of backup diesel generator power.

**A2-2a(4) RH TRU Mixed Waste Handling Equipment**

The following are the major pieces of equipment used to manage RH TRU mixed waste in the geologic repository. A summary of equipment capacities is included in Table A2-3.
The Facility Cask Transfer Car

The Facility Cask Transfer Car is a self-propelled rail car (Figure A2-14) that operates between the Facility Cask Loading Room and the geologic repository. After the Facility Cask is loaded, the Facility Cask Transfer Car moves onto the waste shaft conveyance and is then transported underground. At the underground waste shaft station, the Facility Cask Transfer Car proceeds away from the waste shaft conveyance to provide forklift access to the Facility Cask.

Horizontal Emplacement and Retrieval Equipment or Functionally Equivalent Equipment

The Horizontal Emplacement and Retrieval Equipment (HERE) or functionally equivalent equipment (Figure A2-15) emplaces canisters into a borehole in a room wall of an Underground HWDU. Once the canisters have been emplaced, the HERE then fills the borehole opening with a shield plug.

A2-2b Geologic Repository Process Description

Prior to receipt of TRU mixed waste at the WIPP facility, waste operators will be thoroughly trained in the safe use of TRU mixed waste handling and transport equipment. The training will include both classroom training and on-the-job training.

RH TRU Mixed Waste Emplacement

The Facility Cask Transfer Car is loaded onto the waste shaft conveyance and is lowered to the waste shaft station underground. At the waste shaft station underground, the Facility Cask is moved from the waste shaft conveyance by the Facility Cask Transfer Car (Figure A2-16). A forklift is used to remove the Facility Cask from the Facility Cask Transfer Car and to transport the Facility Cask to the Underground HWDU. There, the Facility Cask is placed on the HERE (Figure A2-17). The HERE is used to emplace the RH TRU mixed waste canister into the borehole. The borehole will be visually inspected for obstructions prior to aligning the HERE and emplacement of the RH TRU mixed waste canister. The Facility Cask is moved forward to mate with the shield collar, and the transfer carriage is advanced to mate with the rear Facility Cask shield valve. The shield valves on the Facility Cask are opened, and the transfer mechanism advances to push the canister into the borehole. After retracting the transfer mechanism into the Facility Cask, the forward shield valve is closed, and the transfer mechanism is further retracted into its housing. The transfer mechanism is moved to the rear, and the shield plug carriage containing a shield plug is placed on the emplacement machine. The transfer mechanism is used to push the shield plug into the Facility Cask. The front shield valve is opened, and the shield plug is pushed into the borehole (Figure A2-18). The transfer mechanism is retracted, the shield valves close on the Facility Cask, and the Facility Cask is removed from the HERE.

A shield plug is a concrete filled cylindrical steel shell (Figure A2-21) approximately 61 in. long and 29 in. in diameter, made of concrete shielding material inside a 0.24 in. thick steel shell with a removable pintle at one end. Each shield plug has integral forklift pockets and weighs approximately 3,750 lbs. The shield plug is inserted with the pintle end closest to the HERE to provide the necessary shielding, limiting the borehole radiation dose rate at 30 cm to less than 10 mrem per hour for a canister surface dose rate of 100 rem/hr. Additional shielding is provided at the direction of the Radiological Control Technician based on dose rate surveys following shield plug emplacement. This additional shielding is provided by the manual
emplacement of one or more shield plug supplemental shielding plates and a retainer (Figures A2-19 and A2-20).

The amount of RH TRU mixed waste disposal in each panel is limited based on thermal and geomechanical considerations and shall not exceed 10 kilowatts per acre as described in Permit Attachment A2-1. RH TRU mixed waste emplacement boreholes shall be drilled in the ribs of the panels at a nominal spacing of 8 ft (2.4 m) center-to-center, horizontally.

Figures A1-26 and A1-27 are flow diagrams of the RH TRU mixed waste handling process for the RH-TRU 72-B and CNS 10-160B casks, respectively.

CH TRU Mixed Waste Emplacement

CH TRU mixed waste containers and shielded containers will arrive by tractor-trailer at the WIPP facility in sealed shipping containers. Prior to unloading the packages from the trailer, they will undergo security and radiological checks and shipping documentation reviews. The trailers carrying the shipping containers will be stored temporarily at the Parking Area Container Storage Unit (Parking Area Unit). A forklift will remove the Contact Handled Packages from the transport trailers and a forklift or Yard Transfer Vehicle will transport them into the Waste Handling Building Container Storage Unit for unloading of the waste containers. Each TRUPACT-II may hold up to two 7-packs, two 4-packs, two 3-packs, two SWBs, or one TDOP. Each HalfPACT may hold up to seven 55-gal (208 L) drums, one SWB, one three-pack of shielded containers or four 85-gal (322 L) drums. Each TRUPACT-III will hold one SLB2. An overhead bridge crane or Facility Transfer Vehicle with transfer table will be used to remove the waste containers from the Contact Handled Packaging and place them on a facility or containment pallet. Each facility pallet has two recessed pockets to accommodate two sets of 7-packs, two sets of 3-packs, two sets of 4-packs, two SWBs stacked two-high, two TDOPs, or one SLB2. Each stack of waste containers will be secured prior to transport underground (see Figure A2-3). A forklift or the facility transfer vehicle will transport the loaded facility pallet to the conveyance loading room adjacent to the Waste Shaft. The facility transfer vehicle will be driven onto the waste shaft conveyance deck, where the loaded facility pallet will be transferred to the waste shaft conveyance, and the facility transfer vehicle will be backed off. Containers of CH TRU mixed waste (55-gal (208 L) drums, SWBs, 85-gal (322 L) drums, 100-gal (379 L) drums, and TDOPs) or shielded containers can be handled individually, if needed, using the forklift and lifting attachments (i.e., drum handlers, parrot beaks).

The waste shaft conveyance will lower the loaded facility pallet to the underground. At the waste shaft station, the CH TRU underground transporter will back up to the waste shaft conveyance, and the facility pallet will be transferred from the waste shaft conveyance onto the transporter (see Figure A2-6). The transporter will then move the facility pallet to the appropriate Underground HWDU for emplacement. The underground waste transporter is equipped with a fire suppression system, rupture-resistant diesel fuel tanks, and reinforced fuel lines to minimize the potential for a fire involving the fuel system.

A forklift in the HWDU near the waste stack will be used to remove the waste containers from the facility pallets and to place them in the waste stack using a push-pull attachment or, in the case of an SLB2, the SLB2 will be lifted from the facility pallet and placed directly on the floor of the emplacement room. The waste will be emplaced room by room in Panels 1 through 8. Each panel will be closed off when filled. If a waste container is damaged during the Disposal Phase, it will be immediately overpacked or repaired. CH TRU mixed waste containers will be
continuously vented. The filter vents will allow aspiration, preventing internal pressurization of the container and minimizing the buildup of flammable gas concentrations.

Once a waste panel is mined and any initial ground control established, flow regulators will be constructed to assure adequate control over ventilation during waste emplacement activities. The first room to be filled with waste will be Room 7, which is the one that is farthest from the main access ways. A ventilation control point will be established for Room 7 just outside the exhaust side of Room 6. This ventilation control point will consist of a bulkhead with a ventilation regulator. When RH TRU mixed waste canister emplacement is completed in a room, CH TRU mixed waste emplacement can begin in that room. Stacking of CH waste will begin at the ventilation control point and proceed down the access drift, through the room and up the intake access drift until the entrance of Room 6 is reached. At that point, a brattice cloth and chain link barricade and, if necessary, bulkheads will be emplaced. This process will be repeated for Room 6, and so on until Room 1 is filled. At that point, the panel closure system will be constructed.

The emplacement of CH TRU mixed waste into the HWDUs will typically be in the order received and unloaded from the Contact Handled Packaging. There is no specification for the amount of space to be maintained between the waste containers themselves, or between the waste containers and the walls. Containers will be stacked in the best manner to provide stability for the stack (which is up to three containers high) and to make best use of available space. It is anticipated that the space between the wall and the container could be from 8 to 18 in. (20 to 46 cm). This space is a function of disposal room wall irregularities, container type, and sequence of emplacement. Bags of backfill will occupy some of this space. Space is required over the stacks of containers to assure adequate ventilation for waste handling operations. A minimum of 16 in. (41 cm) was specified in the Final Design Validation Report (Appendix D1, Chapter 12 of the WIPP RCRA Part B Permit Application (DOE, 1997)) to maintain air flow. Typically, the space above a stack of containers will be 36 to 48 in. (90 to 122 cm). However 18 in. (0.45 m) will contain backfill material consisting of bags of Magnesium Oxide (MgO). Figure A2-8 shows a typical container configuration, although this figure does not mix containers on any row. Such mixing, while inefficient, will be allowed to assure timely movement of waste into the underground. No aisle space will be maintained for personnel access to emplaced waste containers. No roof maintenance behind stacks of waste is planned.

The anticipated schedule for the filling of each of the Underground HWDUs known as Panels 1 through 8 is shown in Permit Attachment G, Table G-1. Panel closure in accordance with the Closure Plan in Permit Attachment G and Permit Attachment G1 is estimated to require an additional 150 days.

Figure A2-12 is a flow diagram of the CH TRU mixed waste handling process.

A2-3 Waste Characterization

TRU mixed waste characterization is described in Permit Attachment C.

A2-4 Treatment Effectiveness

TRU mixed waste treatment, as defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), for which a permit is required, will not be performed at the WIPP facility.
A2-5 Maintenance, Monitoring, and Inspection

A2-5a Maintenance

A2-5a(1) Ground-Control Program

The ground-control program at the WIPP facility will ensure that any room in an HWDU in which waste will be placed will be sufficiently supported to assure compliance with the applicable portions of the Land Withdrawal Act (LWA), which requires a regular review of roof-support plans and practices by the Mine Safety and Health Administration (MSHA). Support is installed to the requirements of 30 CFR §57, Subpart B.

A2-5b Monitoring

A2-5b(1) Groundwater Monitoring

Groundwater monitoring for the WIPP Underground HWDUs will be conducted in accordance with Part 5 and Permit Attachment L of this permit.

A2-5b(2) Geomechanical Monitoring

The geomechanical monitoring program at the WIPP facility is an integral part of the ground-control program (See Figure A2-13). HWDUs, drifts, and geomechanical test rooms will be monitored to provide confirmation of structural integrity. Geomechanical data on the performance of the repository shafts and excavated areas will be collected as part of the geotechnical field-monitoring program. The results of the geotechnical investigations will be reported annually. The report will describe monitoring programs and geomechanical data collected during the previous year.

A2-5b(2)(a) Description of the Geomechanical Monitoring System

The Geomechanical Monitoring System (GMS) provides in situ data to support the continuous assessment of the design for underground facilities. Specifically, the GMS provides for:

- Early detection of conditions that could affect operational safety
- Evaluation of disposal room closure that ensures adequate access
- Guidance for design modifications and remedial actions
- Data for interpreting the behavior of underground openings, in comparison with established design criteria

The instrumentation in Table A2-2 is available for use in support of the geomechanical program.

The minimum instrumentation for each of the eight panels will be one borehole extensometer installed in the roof at the center of each disposal room. The roof extensometers will monitor the dilation of the immediate salt roof beam and possible bed separations along clay seams. Additional instrumentation will be installed as conditions warrant.
Remote polling of the geomechanical instrumentation will be performed at least once every month. This frequency may be increased to accommodate any changes that may develop.

The results from the remotely read instrumentation will be evaluated after each scheduled polling. Documentation of the results will be provided annually in the Geotechnical Analysis Report.

Data from remotely read instrumentation will be maintained as part of a geotechnical instrumentation system. The instrumentation system provides for data maintenance, retrieval, and presentation. The Permittees will retrieve the data from the instrumentation system and verify data accuracy by confirming the measurements were taken in accordance with applicable instructions and equipment calibration is known. Next, the Permittees will review the data after each polling to assess the performance of the instrument and of the excavation. Anomalous data will be investigated to determine the cause (instrumentation problem, error in recording, changing rock conditions). The Permittees will calculate various parameters such as the change between successive readings and deformation rates. This assessment will be reported to the Permittees’ cognizant ground control engineer and operations personnel. The Permittees will investigate unexpected deformation to determine if remediation is needed.

The stability of an open panel excavation is generally determined by the rock deformation rate. The excavation may be unstable when there is a continuous increase in the deformation rate that cannot be controlled by the installed support system. The Permittees will evaluate the performance of the excavation. These evaluations assess the effectiveness of the roof support system and estimate the stand-up time of the excavation. If an open panel shows the trend is toward adverse (unstable) conditions, the results will be reported to determine if it is necessary to terminate waste disposal activities in the open panel. This report of the trend toward adverse conditions in an open HWDU will also be provided to the Secretary of the NMED within seven (7) calendar days of issuance of the report.

A2-5b(2)(b) System Experience

Much experience in the use of geomechanical instrumentation was gained as the result of performance monitoring of Panel 1, which began at the time of completion of the panel excavation in 1988. The monitoring system installed at that time involved simple measurements and observations (e.g., vertical and horizontal convergence rates, and visual inspections). Minimal maintenance of instrumentation is required, and the instrumentation is easily replaced if it malfunctions. Conditions throughout Panel 1 are well known. The monitoring program continues to provide data to compare the performance of Panel 1 with that established elsewhere in the underground. Panel 1 performance is characterized by the following:

The development of bed separations and lateral shifts at the interfaces of the salt and the clays underlying the anhydrites “a” and “b.”

Room closures. A closure due only to the roof movement will be separated from the total closure.

The behavior of the pillars.

Fracture development in the roof and floor.
Distribution of load on the support system.

Roof conditions are assessed from observation boreholes and extensometer measurements. Measurements of room closure, rock displacements, and observations of fracture development in the immediate roof beam are made and used to evaluate the performance of a panel. A description of the Panel 1 monitoring program was presented to the members of the Geotechnical Experts Panel (in 1991) who concurred that it was adequate to determine deterioration within the rooms and that it will provide early warning of deteriorating conditions.

The assessment and evaluation of the condition of WIPP excavations is an interactive, continuous process using the data from the monitoring programs. Criteria for corrective action are continually reevaluated and reassessed based on total performance to date. Actions taken are based on these analyses and planned utilization of the excavation. Because WIPP excavations are in a natural geologic medium, there is inherent variability from point to point. The principle adopted is to anticipate potential ground control requirements and implement them in a timely manner rather than to wait until a need arises.

A2-5b(3) Volatile Organic Compound Monitoring

The volatile organic compound monitoring for the WIPP Underground HWDUs will be conducted in accordance with Part 4 and Permit Attachment N of this permit.

A2-5c Inspection

The inspection of the WIPP Underground HWDUs will be conducted in accordance with Part 2 and Permit Attachment E of this permit.

References


### Table A2-1

**CH TRU Mixed Waste Handling Equipment Capacities**

<table>
<thead>
<tr>
<th>Capacities for Equipment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Pallet</td>
<td>25,000 lbs.</td>
</tr>
<tr>
<td>Facility Transfer Vehicle</td>
<td>26,000 lbs.</td>
</tr>
<tr>
<td>Underground transporter</td>
<td>28,000 lbs.</td>
</tr>
<tr>
<td>Underground forklift</td>
<td>12,000 lbs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Gross Weights of Containers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seven-pack of 55-gallon drums</td>
<td>7,000 lbs.</td>
</tr>
<tr>
<td>Four-pack of 85-gallon drums</td>
<td>4,500 lbs.</td>
</tr>
<tr>
<td>Three-pack of 100-gallon drums</td>
<td>3,000 lbs.</td>
</tr>
<tr>
<td>Ten-drum overpack</td>
<td>6,700 lbs.</td>
</tr>
<tr>
<td>Standard waste box</td>
<td>4,000 lbs.</td>
</tr>
<tr>
<td>Standard large box 2</td>
<td>10,500 lbs.</td>
</tr>
<tr>
<td>Shielded container</td>
<td>2,260 lbs.</td>
</tr>
<tr>
<td>Three-pack of shielded containers</td>
<td>7,000 lbs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Net Empty Weights of Equipment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TRUPACT-II</td>
<td>13,140 lbs.</td>
</tr>
<tr>
<td>HalfPACT</td>
<td>10,500 lbs.</td>
</tr>
<tr>
<td>TRUPACT-III</td>
<td>43,600 lbs.</td>
</tr>
<tr>
<td>Facility pallet</td>
<td>4,120 lbs.</td>
</tr>
</tbody>
</table>
**Table A2-2**

Instrumentation Used in Support of the Geomechanical Monitoring System

<table>
<thead>
<tr>
<th>Instrument Type</th>
<th>Features</th>
<th>Parameter Measured</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borehole Extensometer</td>
<td>The extensometer provides for monitoring the deformation parallel to the borehole axis. Units suitable for up to 5 measurements anchors in addition to the reference head. Maximum borehole depths shall be 50 feet.</td>
<td>Cumulative Deformation</td>
<td>0-2 inches</td>
</tr>
<tr>
<td>Borehole Television Camera</td>
<td>Closed circuit television may be used for monitoring areas otherwise inaccessible, such as boreholes or shafts.</td>
<td>Video Image</td>
<td>N/A</td>
</tr>
<tr>
<td>Convergence Points and Tape Extensometers</td>
<td>Mechanically anchored eyebolts to which a portable tape extensometer is attached.</td>
<td>Cumulative Deformation</td>
<td>2-50 feet</td>
</tr>
<tr>
<td>Convergence Meters</td>
<td>Includes wire and sonic meters. Mounted on rigid plates anchored to the rock surface.</td>
<td>Cumulative Deformation</td>
<td>2-50 feet</td>
</tr>
<tr>
<td>Inclinometers</td>
<td>Both vertical and horizontal inclinometers are used. Traversing type of system in which a probe is moved periodically through casing located in the borehole whose inclination is being measured.</td>
<td>Cumulative Deformation</td>
<td>0-30 degrees</td>
</tr>
<tr>
<td>Rock Bolt Load Cells</td>
<td>Spool type units suitable for use with rock bolts. Tensile stress is inferred from strain gauges mounted on the surface of the spool.</td>
<td>Load</td>
<td>0-300 kips</td>
</tr>
<tr>
<td>Earth Pressure Cells</td>
<td>Installed between concrete keys and rock. Preferred type is a hydraulic pressure plate connected to a vibrating wire transmitter.</td>
<td>Lithostatic Pressure</td>
<td>0-1000 psi</td>
</tr>
<tr>
<td>Piezometer Pressure Transducers</td>
<td>Located in shafts and of robust design and construction. Periodic checks on operability required.</td>
<td>Fluid Pressure</td>
<td>0-500 psi</td>
</tr>
<tr>
<td>Strain Gauges</td>
<td>Installed within the concrete shaft key. Suitably sealed for the environment. Two types used--surface mounted and embedded.</td>
<td>Cumulative Deformation</td>
<td>0-3000 µin/in (embedded) 0-2500 µin/in (surface)</td>
</tr>
</tbody>
</table>
### Table A2-3
RH TRU Mixed Waste Handling Equipment Capacities

<table>
<thead>
<tr>
<th>Capacities for Equipment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>41-Ton Forklift</td>
<td>82,000 lbs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Gross Weights of RH TRU Containers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RH TRU Facility Canister</td>
<td>10,000 lbs</td>
</tr>
<tr>
<td>55-Gallon Drum</td>
<td>1,000 lbs</td>
</tr>
<tr>
<td>RH TRU Canister</td>
<td>8,000 lbs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Net Empty Weights of Equipment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Cask</td>
<td>67,700 lbs</td>
</tr>
</tbody>
</table>
FIGURES

1

2
Figure A2-1
Repository Horizon
Figure A2-1
Repository Horizon
Figure A2-2
Spatial View of the Miscellaneous Unit and Waste Handling Facility
Figure A2-2
Spatial View of the Miscellaneous Unit and Waste Handling Facility
Figure A2-3
Facility Pallet for Seven-Pack of Drums
Figure A2-5
Typical Backfill Sacks Emplaced on Drum Stacks
Figure A2-5a
Potential MgO Emplacement Configurations
Figure A2-6
Waste Transfer Cage to Transporter
Figure A2-7
Push-Pull Attachment to Forklift to Allow Handling of Waste Containers
Figure A2-8
Typical RH and CH Transuranic Mixed Waste Container Disposal Configuration

NOTE: MgO will be emplaced as necessary
Figure A2-9
Underground Ventilation System Airflow
Figure A2-11
Typical Room Barricade

PERMIT ATTACHMENT A2
Page A2-36 of 47
Figure A2-11a
Typical Bulkhead
Figure A2-12
WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram
Figure A2-12
WIPP Facility Surface and Underground CH Transuranic Mixed Waste Process Flow Diagram (Continued)
Figure A2-13
Layout and Instrumentation - As of 1/96

PERMIT ATTACHMENT A2
Page A2-40 of 47
Figure A2-14
Facility Cask Transfer Car (Side View)
Figure A2-15
Typical Emplacement Equipment
Figure A2-15a
Typical Emplacement Equipment
Figure A2-16
RH TRU Waste Facility Cask Unloading from Waste Shaft Conveyance
Figure A2-17
Facility Cask Installed on the Typical Emplacement Equipment
Figure A2-18
Installing Shield Plug
Figure A2-20
Shielding Layers to Supplement RH Borehole Shield Plugs
Figure A2-21
Shield Plug Configuration

TYPICAL DIMENSION: APPROXIMATELY 20 INCHES DIAMETER X 81 INCHES SHIELDING LENGTH

Composition: Cylindrical steel shell filled with concrete
Weight: Approximately 3750 pounds
ATTACHMENT A4

TRAFFIC PATTERNS
## ATTACHMENT A4

### TRAFFIC PATTERNS

#### TABLE OF CONTENTS

| A4-1 Traffic Information and Traffic Patterns | ................................................................. | 1 |
| A4-2 Facility Access and Traffic | .................................................................................. | 1 |
| A4-3 Waste Handling Building Traffic | .................................................................................. | 3 |
| A4-4 Underground Traffic | .................................................................................. | 4 |
LIST OF TABLES

Table Title
Table A4-1 Waste Isolation Pilot Plant Site Designation Traffic Parameters

LIST OF FIGURES

Figure Title
Figure A4-1 General Location of the WIPP Facility
Figure A4-2 WIPP Traffic Flow Diagram
Figure A4-3 Waste Transport Routes in Waste Handling Building - Container Storage Unit
Figure A4-3a Typical Transport Route for TRUPACT-II and Standard Large Box 2
Figure A4-3b Typical Transport Route for TRUPACT-II and Standard Large Box 2 in Room 108
Figure A4-4 Typical Underground Transport Route Using E-140
Figure A4-4a Typical Underground Transport Route Using W-30
Figure A4-5 RH Bay Waste Transport Routes
Figure A4-6 RH Bay Cask Loading Room Waste Transport Route
Figure A4-7 RH Bay Canister Transfer Cell Waste Transport Route
ATTACHMENT A4

TRAFFIC PATTERN

A4-1 Traffic Information and Traffic Patterns

Access to the WIPP facility is provided by two access roads that connect with U.S. Highway 62/180, 13 mi (21 km) to the north, and NM Highway 128 (Jal Highway), 4 mi (6.4 km) to the south (Figure A4-1). These access roads were built for the Permittees to transport TRU mixed waste to the site. Both access roads are owned and maintained by the Department of Energy (DOE). Signs and pavement markings are located in accordance with the Uniform Traffic Control Devices Manual. Access-road design designation parameters, such as traffic volume, are presented in Table A4-1.

A4-2 Facility Access and Traffic

Access to the facility for personnel, visitors, and trucks carrying supplies and TRU mixed waste is provided through a security checkpoint (vehicle trap). After passing through the security checkpoint, TRU mixed waste transport trucks will normally turn right (south) before reaching the Support Building and then left (east) to park in the parking area HWMU just east of the air locks (Figure A4-2). Outgoing trucks depart the same way they arrived, normally out of the west end of the parking area, north through the fence gate and out through the vehicle trap. An alternate inbound route is to continue straight ahead from the security checkpoint to the second road and to turn south to enter the truck parking area. The alternate outbound route is the reverse of this route. Salt transport trucks, which remove mined salt from the Salt Handling Shaft area, will not cross paths with TRU mixed waste transporters; instead, they will proceed from the Salt Handling Shaft northward to the salt pile. Figure A4-2 shows surface traffic flow at the WIPP facility.

The site speed limit for motor vehicles is 10 mph (16 kph) and 5 mph (8 kph) for rail movements. Speed limits are clearly posted at the entrance to the site and enforced by security officers. There are no traffic signals. Stop signs are located at the major intersections of roadways with the main east-west road. Safety requirements are communicated to all site personnel via General Employee Training within 30 days of their employment. Employee access to on-site facilities requires an annual refresher course to reinforce the safety requirements. Security officers monitor vehicular traffic for compliance with site restrictions, and provide instructions to off-site delivery shipments. Vehicular traffic other than the waste transporters use the same roads, but there will be no interference because there are two lanes available on the primary and alternate routes for waste shipments. Pedestrian traffic is limited to the sidewalks and prominently marked crosswalks. Site traffic is composed mostly of pickup trucks and electric carts with a frequency of perhaps 10 per hour at peak periods. Emergency vehicles are exercised periodically for maintenance and personnel training, with an average frequency of one each per day. They are used for their intended purpose on an as-required basis.

The traffic circulation system is designed in accordance with American Association of State Highway and Transportation Officials (AASHTO) Site Planning Guides for lane widths, lateral clearance to fixed objects, minimum pavement edge radii, and other geometric features. Objects in or near the roadway are prominently marked.
On-site roads, sidewalks, and paved areas are used for the distribution and storage of vehicles and personnel and are designed to handle all traffic generated by employees, visitors, TRU mixed waste shipments, and movements of operational and maintenance vehicles. The facility entrance and TRU mixed waste haul roads are designed for AASHTO H20-S16 wheel loading. Service roads are designed for AASHTO H10 wheel loading. Access and on-site paved roads are designed to bear the anticipated maximum load of 115,000 lbs (52,163.1 kg), the maximum allowable weight of a truck/trailer carrying loaded Contact-Handled or Remote-Handled Packages. The facility is designed to handle approximately eight truck trailers per day, each carrying one or more Contact-Handled or Remote-Handled Packages. This is equivalent to 3,640 TRU mixed waste-carrying vehicles per year.

The calculations to support the anticipated maximum load of 115,000 lbs. are shown below:

Soil Resistance R (psi) - is taken directly from the WIPP Soil Report and Bechtel calculation because there is no change.

A. Pavement Thickness

The traffic frequency increase from 10 shipments per day to 10.15 shipments per day has only minimal impact on the Total Expanded Average Load (EAL) and the traffic index (TI) as shown below, both important parameters in pavement design.

Total EAL (TEAL):
13,780 ~ constant for 5 or more axles over 20 years, taken from Table 7-651.2A - Highway Design Manual (HDM).
TEAL = 13,780 x 25yr./20yr. = 17,225
Using 10.15 shipments per day ~ 17,225 x 10.15 = 174,834

Conversion of EAL to Traffic Index (TI).
For TEAL of 174,834 ~ TI = 7.5 - (from HDM, Table 7-651.2B)

Asphalt Concrete Thickness TAC:
GE = 0.0032 x TI x (100 - R)....R = 80
GE - Gravel Equivalent (Ft).
GE = 0.0032 x 7.5 x 20 = 0.48' ...GfAC = 2.01 ⇒ TAC = 0.48/2.01 = 0.24' ⇒ use 2½” AC
Surface Course.
(Actually used: 3”)
Gf - Gravel Equivalent Factor (constant from Table 7-651.2C from HDM).

B. Bituminous Treated Base

GE = 0.0032 x TI x (100 - R) .... R = 55 ~ caliche subbase ⇒ GE = 1.08’ GEBTB = 1.08 - 2.01 x 0.21 = 0.66’
TBTB = GEBTB/GfBTB = 0.66/1.2 = 0.55’ ⇒ Use 4” BTB
GfBTB ~ taken from table 7-651.2C

C. Caliche Subbase ~ TCSB

GE = 0.0032 x TI x (100 -R) .....R = 50 - prepared subgrade
GE = 1.2
GECSB = 1.2 - (0.21× 2.07) - (0.33 × 1.2) \Rightarrow 0.37''
TCBS = 0.37/1.0 = 0.37'' \sim 4\frac{1}{2}''

Based on the results of the above calculation, the site paved roads designated for waste transportation are safe to be used by the heavier truckloads carrying shipping casks used in RH TRU mixed waste transportation to the WIPP.

A4-3 Waste Handling Building Traffic

CH TRU mixed waste will arrive by tractor-trailer at the WIPP facility in sealed Contact Handled Packages. Prior to unloading the packages from the trailer, security checks, radiological surveys, and shipping documentation reviews will be performed. A forklift or Yard Transfer Vehicle will remove the Contact Handled Packages and transport them a short distance through an air lock that is designed to maintain differential pressure in the WHB. The forklift or Yard Transfer Vehicle will place the shipping containers at one of the two TRUPACT-II unloading docks (TRUDOCK) inside the WHB or, in the case of the TRUPACT-III, at the payload transfer station in Room 108.

The TRUPACT-II may hold up to two 55-gallon drum seven-packs, two 85-gallon drum four-packs, two 100-gallon drum three-packs, two standard waste boxes (SWB), or one ten-drum overpack (TDOP). A HalfPACT may hold seven 55-gallon drums, one SWB, or four 85-gallon drums. The TRUPACT-III holds a single SLB2. A six-ton overhead bridge crane or Facility Transfer Vehicle with a transfer table will be used to remove the contents of the Contact Handled Package. Waste containers will be surveyed for radioactive contamination and decontaminated or returned to the Contact Handled Package as necessary.

Each facility pallet will accommodate four 55-gallon drum seven-packs, four SWBs, four 85-gallon drum four-packs, four 100-gallon drum three-packs, two TDOPs, or an SLB2. Waste containers will be secured to the facility pallet prior to transfer. A forklift or facility transfer vehicle will transport the loaded facility pallet the air lock at the Waste Shaft (Figures A4-3, A4-3a, and A4-3b). The facility transfer vehicle will be driven onto the waste shaft conveyance deck, where the loaded facility pallet will be transferred to the waste shaft conveyance and downloaded for emplacement.

RH TRU mixed waste will arrive at the WIPP facility in a payload container contained in a shielded cask loaded on a tractor-trailer. Prior to unloading the cask from the trailer, radiological surveys, security checks, and shipping documentation reviews will be performed, and the trailer carrying the cask will be moved into the Parking Area or directly into the RH Bay of the Waste Handling Building Unit.

The cask is unloaded from the trailer in the RH Bay and is placed on the Cask Transfer Car. The Cask Transfer Car is used to move the cask to the Cask Unloading Room. At this point, a crane moves the waste to the Hot Cell or the Transfer Cell. Some RH TRU mixed waste may be moved to the Hot Cell for overpacking before being moved to the Transfer Cell. Once in the Transfer Cell, the Transfer Cell Shuttle Car moves the waste beneath the facility cask. A crane is used to move the waste from the Transfer Cell Shuttle Car into the facility cask. The Facility Cask Transfer Car then moves the facility cask to the underground. A more detailed description of waste handling in the WHB is included in Attachment M1. Figures A4-5, A4-6 and A4-7 show RH TRU mixed waste transport routes.
A4-4  Underground Traffic

The Permittees shall designate the traffic routes of TRU mixed waste handling equipment and construction equipment and record this designation on a map that is posted in a location where it can be examined by personnel entering the underground. The map will be updated whenever the routes are changed. Maps will be available in facility files until facility closure. The primary waste transportation pathway is E-140. The alternate waste transportation pathway is W-30. Construction equipment traffic is restricted and administratively separated from waste handling equipment traffic by WIPP SOPs while waste is being transported in either the primary or alternate waste transportation path. In general, the ventilation and traffic flow path in the TRU mixed waste handling areas underground are restricted and separate from those used for mining and haulage (construction) equipment, except that: However, there are two exceptions as follows. First, during waste transport in W-30, ventilation need not be separated north of S-1600 (Figures A4-4 and A4-4a). Second, where construction and waste transport routes cross at ventilation overcasts, traffic may temporarily enter into a different ventilation circuit. In general, the Permittees restrict waste traffic to the intake ventilation drift to maximize isolation of this activity from personnel. The waste disposal exhaust drifts in the waste disposal area will normally not be used for personnel access except, when necessary to conduct activities (e.g., geotechnical monitoring, ground control, ventilation adjustment, and calibration of continuous air monitoring equipment). Non-waste and non-construction traffic is generally comprised of escorted visitors only and is minimized during each of the respective operations.

Adequate clearances that exceed the mining regulations of 30 CFR §57 exist underground for safe passage of vehicles and pedestrians. Pedestrians/personnel are required to yield to vehicles in the WIPP underground facility. This condition is reinforced through the WIPP equipment operating procedures, the WIPP Safety Manual, the WIPP safety briefing required for all underground visitors, the General Employee Training annual refresher course, and the Underground annual refresher course that are mandated by 30 CFR §57, the New Mexico Mine Code, and DOE Order 5480.20A.

In addition, other physical means are utilized to safeguard pedestrians/personnel when underground such as:

- All equipment operators are required to sound the vehicle horn when approaching intersections.
- All airlock and bulkhead vehicle doors are equipped with warning bells or strobe lights to alert personnel when door opening is imminent.
- Hemispherical mirrors are used at blind intersections so that persons can see around corners.
- All heavy equipment is required to have operational back-up alarms.
- Heavily used intersections are well lighted.

Typically, the traffic routes during waste disposal in all Panels will use the same main access drifts.
All traffic safety is regulated and enforced by the Federal and State mine codes of regulations (30 CFR §57 and New Mexico State Mine Code). The agencies that administer these codes make regular inspection tours of the WIPP underground facilities for the purpose of enforcement.

All underground equipment is designed for off-road use since all driving surfaces are excavated in salt. No loads on the underground roadways will exceed the bearing strength of in situ halite.
Waste Isolation Pilot Plant
DRAFT Hazardous Waste Permit
February 2014
### Table A4-1
Waste Isolation Pilot Plant Site Designation Traffic Parameters

<table>
<thead>
<tr>
<th>Traffic Parameter</th>
<th>North Access Road (No. of Vehicles, unless otherwise stated)</th>
<th>South Access Road (No. of Vehicles, unless otherwise stated)</th>
<th>On-Site Waste Haul Roads Contact-Handled and Remote-Handled Package Traffic</th>
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<tr>
<td>Average Daily Traffic (ADT)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>800</td>
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<tr>
<td>Design Hourly Volume (DHV)&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>144</td>
<td>NA&lt;sup&gt;g&lt;/sup&gt;</td>
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<tr>
<td>Hourly Volume (Max. at Shift Change)</td>
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<td>250</td>
<td>NA</td>
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<tr>
<td>Distribution (D)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>67%</td>
<td>67%</td>
<td>NA</td>
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<tr>
<td>Trucks (T)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>2%</td>
<td>2%</td>
<td>100%</td>
</tr>
<tr>
<td>Design Speed&lt;sup&gt;h, i&lt;/sup&gt;</td>
<td>70 mph (113 kph)</td>
<td>60 mph (97 kph)</td>
<td>25 mph (40 kph)</td>
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<tr>
<td>Control of Access&lt;sup&gt;f&lt;/sup&gt;</td>
<td>None</td>
<td>None</td>
<td>Full</td>
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</tbody>
</table>

<sup>a</sup> For WIPP personnel and TRU mixed waste shipments only.

<sup>b</sup> ADT—Estimated number of vehicles traveling in both directions per day.

<sup>c</sup> DHV—A two-way traffic count with directional distribution.

<sup>d</sup> D—The percentage of DHV in the predominant direction of travel.

<sup>e</sup> T—The percentage of ADT comprised of trucks (excluding light delivery trucks).

<sup>f</sup> Control of Access—The extent of roadside interference or restriction of movement.

<sup>g</sup> NA—Not applicable.

<sup>h</sup> mph—miles per hour.

<sup>i</sup> kph—kilometers per hour.
Figure A4-1
General Location of the WIPP Facility
Figure A4-2
WIPP Traffic Flow Diagram
Figure A4-3
Waste Transport Routes in Waste Handling Building - Container Storage Unit
Figure A4-3a
Typical Transport Route for TRUPACT-III and Standard Large Box 2
Figure A4-3b
Typical Transport Route for TRUPACT-III and Standard Large Box 2 in Room 108
LEGEND:

--- EXISTING
--- PLANNED

NOTES:
1. VENTILATION CONTROL BULKHEADS
   NOT SHOWN FOR CLARITY
2. CONSTRUCTION EQUIPMENT TRAFFIC
   IS RESTRICTED AND SEPARATED FROM
   WASTE HANDLING EQUIPMENT WHILE
   WASTE IS BEING TRANSPORTED.
3. E-140 WASTE TRANSPORTATION ROUTE

Figure A4-4
Typical Underground Transport Route Using E-140
LEGEND:

- EXISTING
- PLANNED
- PLANNED CLOSURE AREAS

NOTES
1. VENTILATION CONTROL BULKHEADS NOT SHOWN FOR CLARITY.
2. CONSTRUCTION EQUIPMENT TRAFFIC IS RESTRICTED AND SEPARATED FROM WASTE HANDLING EQUIPMENT WHILE WASTE IS BEING TRANSPORTED.
3. E-140 WASTE TRANSPORTATION ROUTE ————

Figure A4-4
Typical Underground Transport Route Using E-140
Waste Isolation Pilot Plant
DRAFT Hazardous Waste Permit
February 2014

LEGEND:

--- EXISTING
--- PLANNED

NOTES
1. VENTILATION CONTROL BULKHEADS
   NOT SHOWN FOR CLARITY
2. CONSTRUCTION EQUIPMENT TRAFFIC
   IS RESTRICTED AND SEPARATED FROM
   WASTE HANDLING EQUIPMENT WHILE
   WASTE IS BEING TRANSPORTED.
3. W-30 WASTE TRANSPORTATION ROUTE
   ---------->

Figure A4-4a
Typical Underground Transport Route Using W-30
Figure A4-4a
Typical Underground Transport Route Using W-30
Figure A4-5
RH Bay Waste Transport Routes
Figure A4-6
RH Bay Cask Loading Room Waste Transport Route
Figure A4-7
RH Bay Canister Transfer Cell Waste Transport Route
ATTACHMENT B

HAZARDOUS WASTE PERMIT APPLICATION PART A
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## ATTACHMENT B

### HAZARDOUS WASTE PERMIT APPLICATION PART A

#### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART A - HAZARDOUS WASTE PERMIT APPLICATION</td>
<td>1</td>
</tr>
<tr>
<td>RCRA PART A APPLICATION CERTIFICATION</td>
<td>15</td>
</tr>
<tr>
<td>APPENDIX B1 OTHER ENVIRONMENTAL PERMITS</td>
<td>16</td>
</tr>
<tr>
<td>APPENDIX B2 MAPS</td>
<td>28</td>
</tr>
<tr>
<td>Figure B2-1 General Location of the WIPP Facility</td>
<td>30</td>
</tr>
<tr>
<td>Figure B2-2 Planimetric Map-WIPP Facility Boundaries</td>
<td>31</td>
</tr>
<tr>
<td>Figure B2-2a Legend to Figure B2-2</td>
<td>32</td>
</tr>
<tr>
<td>Figure B2-3 Topographic Map</td>
<td>33</td>
</tr>
<tr>
<td>APPENDIX B3 FACILITIES</td>
<td>34</td>
</tr>
<tr>
<td>Figure B3-1 Spatial View of the WIPP Facility</td>
<td>36</td>
</tr>
<tr>
<td>Figure B3-2 Repository Horizon</td>
<td>38</td>
</tr>
<tr>
<td>Figure B3-3 Waste Handling Building - CH TRU Mixed Waste Container Storage and Surge Areas</td>
<td>40</td>
</tr>
<tr>
<td>Figure B3-4 Parking Area-Container Storage and Surge Areas</td>
<td>41</td>
</tr>
<tr>
<td>APPENDIX B4 PHOTOGRAPHS</td>
<td>42</td>
</tr>
<tr>
<td>Figure B4-1 Aerial Photograph of the Waste Isolation Pilot Plant</td>
<td>44</td>
</tr>
<tr>
<td>Figure B4-2 Underground - Panel One - Waste Disposal Room</td>
<td>45</td>
</tr>
<tr>
<td>Figure B4-3 Aerial Photograph of the Waste Handling Building</td>
<td>46</td>
</tr>
<tr>
<td>Figure B4-4 TRUDOCKs in CH Bay of the Waste Handling Building</td>
<td>47</td>
</tr>
<tr>
<td>Figure B4-5 NE Corner of CH Bay of the Waste Handling Building</td>
<td>48</td>
</tr>
<tr>
<td>Figure B4-6 Westward View of CH Bay of the Waste Handling Building</td>
<td>49</td>
</tr>
<tr>
<td>Figure B4-7 Waste Shaft Conveyance - Loading Facility Pallet with CH Waste, Waste Handling Building</td>
<td>50</td>
</tr>
<tr>
<td>Figure B4-8 RH Bay (Photo Taken July 2000)</td>
<td>51</td>
</tr>
<tr>
<td>Figure B4-9 Cask Unloading Room and Bridge Crane</td>
<td>52</td>
</tr>
<tr>
<td>Figure B4-10 Hot Cell</td>
<td>53</td>
</tr>
<tr>
<td>Figure B4-11 Transfer Cell</td>
<td>54</td>
</tr>
<tr>
<td>Figure B4-12 Facility Cask Loading Room and Facility Cask Rotating Device</td>
<td>55</td>
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<tr>
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<td>Reason for Submittal</td>
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<td>Street Address</td>
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<tr>
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<td>Carlsbad</td>
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<td>County, State, Zip Code</td>
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<td>Site Contact Person</td>
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</tr>
<tr>
<td>Title</td>
<td>Manager, Carlsbad Field Office (CBFO)</td>
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<tr>
<td>Street or P.O. Box</td>
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EPA Form 8700-12, 8700-13 A/B, 8700-23 (Revised 12/2011)
### Hazardous Waste Activities; Complete all parts 1-10.

<table>
<thead>
<tr>
<th>Check</th>
<th>Description</th>
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</table>
| ☑ N | Generator of Hazardous Waste  
If "Yes", mark only one of the following – a, b, or c.  
   a. LGQ: Generates, in any calendar month, 1,000 kg/mo (2,200 lbs./mo.) or more of hazardous waste; or  
      Generates, in any calendar month, or accumulates at any time, more than 1 kg/mo (2.2 lbs./mo.) of acute hazardous waste; or  
      Generates, in any calendar month, or accumulates at any time, more than 100 kg/mo (220 lbs./mo.) of acute hazardous spill cleanup material.  
   b. SQG: 100 to 1,000 kg/mo (220 – 2,200 lbs./mo.) of non-acute hazardous waste.  
   c. CESQG: Less than 100 kg/mo (220 lbs./mo.) of non-acute hazardous waste.  
| ☑ N | If "Yes" above, indicate other generator activities in 2-4. |
| ☑ N | Short-Term Generator (generate from a short-term or one-time event and not from on-going processes). If "Yes", provide an explanation in the Comments section. |
| ☑ N | United States Importer of Hazardous Waste |
| ☑ N | Mixed Waste (hazardous and radioactive) Generator |

### Universal Waste Activities; Complete all parts 1-2.

<table>
<thead>
<tr>
<th>Check</th>
<th>Description</th>
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</table>
| ☑ N | Large Quantity Handler of Universal Waste (you accumulate 5,000 kg or more) [refer to your State regulations to determine what is regulated]. Indicate types of universal waste managed at your site. If "Yes", mark all that apply.  
   a. Batteries  
   b. Pesticides  
   c. Mercury containing equipment  
   d. Lamps  
   e. Other (specify)  
   f. Other (specify)  
   g. Other (specify) |
| ☑ N | Destination Facility for Universal Waste  
Note: A hazardous waste permit may be required for this activity. |

### Used Oil Activities; Complete all parts 1-4.

<table>
<thead>
<tr>
<th>Check</th>
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| ☑ N | Used Oil Transporter  
If "Yes", mark all that apply.  
   a. Transporter  
   b. Transfer Facility (at your site) |
| ☑ N | Used Oil Processor and/or Re-refiner  
If "Yes", mark all that apply.  
   a. Processor  
   b. Re-refiner |
| ☑ N | Off-Specification Used Oil Burner  
| ☑ N | Used Oil Fuel Marketer  
If "Yes", mark all that apply.  
   a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner  
   b. Marketer Who First Claims the Used Oil Meets the Specifications |

---

**EPA Form 8700-12, 8700-13 A/B, 8700-23 (Revised 12/2011)**

**Page 2 of 4**
D. Eligible Academic Entities with Laboratories—Notification for opting into or withdrawing from managing laboratory hazardous wastes pursuant to 40 CFR Part 262 Subpart K

- You can ONLY Opt into Subpart K if:
  - you are at least one of the following: a college or university; a teaching hospital that is owned by or has a formal affiliation agreement with a college or university; or a non-profit research institute that is owned by or has a formal affiliation agreement with a college or university; AND
  - you have checked with your State to determine if 40 CFR Part 262 Subpart K is effective in your state

Y ☐ N ☐ 1. Opting into or currently operating under 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories. See the item-by-item instructions for definitions of types of eligible academic entities. Mark all that apply:
   - [ ] a. College or University
   - [ ] b. Teaching Hospital that is owned by or has a formal written affiliation agreement with a college or university
   - [ ] c. Non-profit Institute that is owned by or has a formal written affiliation agreement with a college or university

Y ☐ N ☐ 2. Withdrawing from 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories

11. Description of Hazardous Waste

A. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g., D001, D003, F007, U112). Use an additional page if more spaces are needed.

<table>
<thead>
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<th>Code (P)</th>
<th>Code (U)</th>
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<tr>
<td>D012</td>
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</table>

B. Waste Codes for State-Regulated (i.e., non-Federal) Hazardous Wastes. Please list the waste codes of the State-Regulated hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed.
### EPA ID Number NM4890139088

| Additional Hazardous Waste Numbers from Section 10 |
|------------------|--------------------------------------------------|
| U209             |                                                  |
| U210             |                                                  |
| U220             |                                                  |
| U226             |                                                  |
| U228             |                                                  |
| U239             |                                                  |

☐ N  Are you notifying under 40 CFR 260.42 that you will begin managing, are managing, or will stop managing hazardous secondary material under 40 CFR 261.2(a)(2)(ii), 40 CFR 261.4(a)(23), (24), or (25)?

If "Yes" you must fill out the Addendum to the Site Identification Form: Notification for Managing Hazardous Secondary Material.

13. Comments


14. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. For the RCRA Hazardous Waste Part A Permit Application, all owner(s) and operator(s) must sign (see 40 CFR 270.10(b) and 270.11).

<table>
<thead>
<tr>
<th>Signature of legal owner, operator, or authorized representative</th>
<th>Name and Official Title (type or print)</th>
<th>Date Signed (mm/dd/yyyy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Signature on File</td>
<td>Jose R. Franco, Manager-CBFO</td>
<td>06/25/2012</td>
</tr>
<tr>
<td>Original Signature on File</td>
<td>Farok Sharif, Project Manager-NWP</td>
<td>06/25/2012</td>
</tr>
</tbody>
</table>
### Facility Permit Contact
- **First Name:** Jose
- **Middle Initial:** R.
- **Last Name:** Franco

**Contact Title:** Manager, Carlsbad Field Office

**Phone:** (575) 234-7300
**Ext.:**
**Email:** jose.franco@wipp.wy

### Facility Permit Mailing Address
- **Street or P.O. Box:** P.O. Box 3090
- **City, Town, or Village:** Carlsbad
- **State:** NM
- **Country:** USA
- **Zip Code:** 88221

### Operator Mailing Address and Telephone Number
- **Street or P.O. Box:** P.O. Box 3090
- **City, Town, or Village:** Carlsbad
- **State:** NM
- **Country:** USA
- **Phone:** (575) 234-7300
- **Zip Code:** 88221

### Facility Existence Date
- **Facility Existence Date (mm/dd/yyyy):** 05/18/1981

### Other Environmental Permits

<table>
<thead>
<tr>
<th>A. Facility Type (Enter code)</th>
<th>B. Permit Number</th>
<th>C. Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>See Permit Attachment B, Appendix B1</td>
</tr>
</tbody>
</table>

### Nature of Business:
The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy facility which entails receiving, unloading, and transferring radioactive-mixed waste from the surface of the site to the underground hazardous waste management units. Waste will be emplaced in an underground geologic repository horizon located in a deep-bedded salt formation approximately 2,150 feet beneath the surface.
### Process Codes and Design Capacities – Enter Information in the Section on Form Page 3

**A. PROCESS CODE** – Enter the code from the list of process codes below that best describes each process to be used at the facility. If more lines are needed, attach a separate sheet of paper with the additional information. For “other” processes (i.e., D99, S99, T94 and X92), describe the process (including its design capacity) in the space provided in item 8.

**B. PROCESS DESIGN CAPACITY** – For each code entered in item 7.A, enter the capacity of the process.

1. **AMOUNT** – Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action), enter the total amount of waste for that process.

2. **UNIT OF MEASURE** – For each amount entered in item 7.B(1), enter the code in item 7.B(2) from the list of unit of measure codes below that describes the unit of measure used. Select only from the units of measure in this list.

**C. PROCESS TOTAL NUMBER OF UNITS** – Enter the total number of units for each corresponding process code.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D79</td>
<td>Undergrond Injection Wall Disposal</td>
<td>Gallons; Liters; Gallons Per Day, or Liters Per Day</td>
<td>T81</td>
<td>Cement Kiln</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
</tr>
<tr>
<td>D80</td>
<td>Landfill</td>
<td>Acres-Sq; Hectares-Meter; Acres</td>
<td>T82</td>
<td>Lime Kiln</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
</tr>
<tr>
<td>D81</td>
<td>Land Treatment</td>
<td>Acres or Hectares</td>
<td>T83</td>
<td>Aggregate Kiln</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
</tr>
<tr>
<td>D82</td>
<td>Ocean Disposal</td>
<td>Gallons Per Day or Liters Per Day</td>
<td>T84</td>
<td>Phosphate Kiln</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
</tr>
<tr>
<td>D83</td>
<td>Surface Impoundment Gallons; Liters; Cubic Meters, or Cubic Yards</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>D84</td>
<td>Drip Pad Gallons; Liters; Cubic Meters, or Hectares, or Cubic Yards</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>D85</td>
<td>Containment Building Cubic Yards or Cubic Meters Storage</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<td></td>
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<tr>
<td>D86</td>
<td>Other Storage</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>S01</td>
<td>Container Gallons; Liters, Cubic Meters, or Cubic Yards</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>S02</td>
<td>Tank Storage Gallons; Liters, Cubic Meters, or Cubic Yards</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>S03</td>
<td>Waste Pile Cubic Yards or Cubic Meters</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>S04</td>
<td>Surfipoundment Gallons; Liters, Cubic Meters, or Cubic Yards</td>
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<tr>
<td>S05</td>
<td>Drip Pad Gallons; Liters; Cubic Meters, or Hectares, or Cubic Yards</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>S06</td>
<td>Containment Building Cubic Yards or Cubic Meters Storage</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>S09</td>
<td>Other Storage</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>T01</td>
<td>Tank Treatment Gallons Per Day, Liters Per Day</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>T02</td>
<td>Surface Impoundment Gallons Per Day, Liters Per Day</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>T03</td>
<td>Incinerator Short Tons Per Hour, Metric Tons Per Hour, Gallons Per Day, Liters Per Day, BTU Per Hour, Pounds Per Hour, Short Tons Per Day, Kilograms Per Hour, Gallons Per Day, Liters Per Day, Metric Tons Per Hour, or Million BTU Per Hour</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>T04</td>
<td>Other Treatment Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Day, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, or Million BTU Per Hour</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, or Million BTU Per Hour</td>
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<tr>
<td>T80</td>
<td>Boiler Gallons; Liters, Gallons Per Hour, Liters Per Hour, BTU Per Hour, or Million BTU Per Hour</td>
<td>Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, or Million BTU Per Hour</td>
<td></td>
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</tbody>
</table>

### Miscellaneous (Subpart X)

| X01          | Open Burning/Incineration | Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour |
| X02          | Mechanical Processing Short Tons Per Hour, Metric Tons Per Hour, Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Day, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, or Million BTU Per Hour |
| X03          | Thermal Unit Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Day, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, or Million BTU Per Hour |
| X04          | Geologic Repository Cubic Yards; Cubic Meters; Acres; Hectares | Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour |
| X09          | Other Subpart X | Gallons Per Day, Liters Per Day, Pounds Per Hour, Short Tons Per Hour, Kilograms Per Hour, Metric Tons Per Day, Metric Tons Per Hour, Short Tons Per Day, BTU Per Hour, Liters Per Hour, Kilograms Per Hour, or Million BTU Per Hour |

### Unit of Measure

<table>
<thead>
<tr>
<th>Unit of Measure</th>
<th>Unit of Measure Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallons</td>
<td>G</td>
</tr>
<tr>
<td>Gallons Per Hour</td>
<td>E</td>
</tr>
<tr>
<td>Liters</td>
<td>L</td>
</tr>
<tr>
<td>Liters Per Hour</td>
<td>N</td>
</tr>
<tr>
<td>Liters Per Day</td>
<td>V</td>
</tr>
<tr>
<td>Short Tons Per Hour</td>
<td>D</td>
</tr>
<tr>
<td>Short Tons Per Day</td>
<td>N</td>
</tr>
<tr>
<td>Metric Tons Per Hour</td>
<td>B</td>
</tr>
<tr>
<td>Metric Tons Per Day</td>
<td>S</td>
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<tr>
<td>Pounds Per Hour</td>
<td>J</td>
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<tr>
<td>Hectares</td>
<td>A</td>
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<td>Kilograms Per Hour</td>
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<tr>
<td>Nectares-Meter</td>
<td>Q</td>
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<tr>
<td>Million BTU Per Hour</td>
<td>X</td>
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<tr>
<td>BTU Per Hour</td>
<td>I</td>
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<tr>
<td>Cubic Yards</td>
<td>Y</td>
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<tr>
<td>Cubic Meters</td>
<td>C</td>
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<tr>
<td>Acres</td>
<td>B</td>
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<tr>
<td>Acre-feet</td>
<td>A</td>
</tr>
<tr>
<td>Hectares</td>
<td>Q</td>
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<tr>
<td>Nectares-Meter</td>
<td>Q</td>
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</table>

### OMB #: 2050-0024; Expires 12/31/2014
### 7. Process Codes and Design Capacities (Continued)

**EXAMPLE FOR COMPLETING Item 7 (shown in line number X:1 below):** A facility has a storage tank, which can hold 533.788 gallons.

<table>
<thead>
<tr>
<th>Line Number</th>
<th>A. Process Code (From list above)</th>
<th>B. PROCESS DESIGN CAPACITY</th>
<th>C. Process Total Number of Units</th>
<th>For Official Use Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1</td>
<td>533.788</td>
<td>G</td>
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<tr>
<td>1</td>
<td>X 0 4</td>
<td>175600.0</td>
<td>C</td>
<td>010</td>
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<tr>
<td>2</td>
<td>S 0 1</td>
<td>194.1</td>
<td>C</td>
<td>001</td>
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<tr>
<td>3</td>
<td>S 0 1</td>
<td>242.0</td>
<td>C</td>
<td>001</td>
</tr>
</tbody>
</table>

**Note:** If you need to list more than 13 process codes, attach an additional sheet(s) with the information in the same format as above. Number the line sequentially, taking into account any lines that will be used for “other” process (i.e., D99, S99, T04, and X99) in Item 8.

### 8. Other Processes (Follow instructions from Item 7 for D99, S99, T04, and X99 process codes)

<table>
<thead>
<tr>
<th>Line Number</th>
<th>A. Process Code (Enter # in sequence with Item 7)</th>
<th>B. PROCESS DESIGN CAPACITY</th>
<th>C. Process Total Number of Units</th>
<th>For Official Use Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>2 T 0 4</td>
<td>100.00</td>
<td>U</td>
<td>001</td>
</tr>
</tbody>
</table>
9. Description of Hazardous Wastes - Enter Information in the Sections on Form Page 5

A. EPA HAZARDOUS WASTE NUMBER - Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR Part 261, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

B. ESTIMATED ANNUAL QUANTITY - For each listed waste entered in Item 9.A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in Item 9.A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE - For each quantity entered in Item 9.B, enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

<table>
<thead>
<tr>
<th>ENGLISH UNIT OF MEASURE</th>
<th>CODE</th>
<th>METRIC UNIT OF MEASURE</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>POUNDS</td>
<td>P</td>
<td>KILOGRAMS</td>
<td>K</td>
</tr>
<tr>
<td>TONS</td>
<td>T</td>
<td>METRIC TONS</td>
<td>M</td>
</tr>
</tbody>
</table>

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure, taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:
   For listed hazardous waste: For each listed hazardous waste entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all listed hazardous wastes.

   For non-listed waste: For each characteristic or toxic contaminant entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

   NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:
   1. Enter the first two as described above.
   2. Enter "000" in the extreme right box of Item 9.D(1).
   3. Use additional sheet, enter line number from previous sheet, and enter additional code(s) in Item 9.E.

2. PROCESS DESCRIPTION: If code is not listed for a process that will be used, describe the process in Item 9.D(2) or in Item 9.E(2).

   NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER - Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:
   1. Select one of the EPA Hazardous Waste Numbers and enter it in Item 9.A. On the same line complete Items 9.B, 9.C, and 9.D by estimating the total annual quantity of the waste and describing all the processes to be used to store, treat, and/or dispose of the waste.
   2. In Item 9.A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In Item 9.D.2 on that line enter "included with above" and make no other entries on that line.
   3. Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.

   EXAMPLE FOR COMPLETING Item 9 (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operations. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

<table>
<thead>
<tr>
<th>Line Number</th>
<th>A. EPA Hazardous Waste No. (Enter code)</th>
<th>B. Estimated Annual Qty of Waste</th>
<th>C. Unit of Measure (Enter code)</th>
<th>D. PROCESSES</th>
</tr>
</thead>
<tbody>
<tr>
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<td>K 0 5 4</td>
<td>900</td>
<td>P</td>
<td>T 0 3 D 8 0</td>
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<tr>
<td>X 2</td>
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<td>400</td>
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<td>D 0 0 1</td>
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<td>X 4</td>
<td>D 0 0 2</td>
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<td>Included With Above</td>
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<tr>
<td>Line Number</td>
<td>A. EPA Hazardous Waste No. (Enter code)</td>
<td>B. Estimated Annual Qty of Waste</td>
<td>C. Unit of Measure (Enter code)</td>
<td>D. PROCESSES (1) PROCESS CODES (Enter Code)</td>
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<td>M</td>
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10. **Map**  
Attach to this application a topographical map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all spring, rivers, and other surface water bodies in this map area. See instructions for precise requirements.

11. **Facility Drawing**  
All existing facilities must include a scale drawing of the facility (see instructions for more detail).

12. **Photographs**  
All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures, existing storage, treatment, and disposal areas, and sites of future storage, treatment, or disposal areas (see instructions for more detail).

13. **Comments**  
See attached narrative from previous Part A Form (Section XII)
7. PROCESS—CODES AND DESIGN CAPACITIES (continued)

The Waste Isolation Pilot Plant (WIPP) geologic repository is defined as a “miscellaneous unit” under 40 CFR §260.10. “Miscellaneous unit” means a hazardous waste management unit where hazardous waste is treated, stored, or disposed of and that is not a container, tank, surface impoundment, waste pile, land treatment unit, landfill, incinerator, containment building, boiler, industrial furnace, or underground injection well with appropriate technical standards under 40 CFR Part 146, corrective action management unit, or unit eligible for research, development, and demonstration permit under 40 CFR §270.65. The WIPP is a geologic repository designed for the disposal of defense-generated transuranic (TRU) waste. Some of the TRU wastes disposed of at the WIPP contain hazardous wastes as co-contaminants. More than half the waste to be disposed of at the WIPP also meets the definition of debris waste. The debris categories include manufactured goods, biological materials, and naturally occurring geological materials. Approximately 120,000 cubic meters (m³) of the 175,660 m³ of WIPP wastes is categorized as debris waste. The geologic repository has been divided into ten discrete hazardous waste management units (HWMU) which are being permitted under 40 CFR Part 264, Subpart X.

During the Disposal Phase of the facility, which is expected to last 25 years, the total amount of waste received from off-site generators and any derived waste will be limited to 175,564 m³ of TRU waste of which up to 7,080 m³ may be remote-handled (RH) TRU mixed waste. For purposes of this application, all TRU waste is managed as though it were mixed.

The process design capacity for the miscellaneous unit (composed of ten underground HWMUs in the geologic repository) shown in Section 7 B, is for the maximum amount of waste that may be received from off-site generators plus the maximum expected amount of derived wastes that may be generated at the WIPP facility. In addition, two HWMUs have been designated as container storage units (S01) in Section 7 B. One is inside the Waste Handling Building (WHB) and consists of the contact-handled (CH) bay, waste shaft conveyance loading room, waste shaft conveyance entry room, RH bay, cask unloading room, hot cell, transfer cell, and facility cask loading room. This HWMU will be used for waste receipt, handling, and storage (including storage of derived waste) prior to emplacement in the underground geologic repository. No treatment or disposal will occur in this S01 HWMU. The capacity of this S01 unit for storage is 194.1 m³, based on 36 ten-drum overpacks on 18 facility pallets, four CH Packages at the TRUDOCKs, one standard waste box of derived waste, two loaded casks and one 55-gallon drum of derived waste in the RH Bay, one loaded cask in the Cask Unloading Room, 13 55-gallon drums in the Hot Cell, one canister in the Transfer Cell and one canister in the Facility Cask Unloading Room. The second S01 HWMU is the parking area outside the WHB where the Contact- and Remote-Handled Package trailers and the road cask trailers will be parked awaiting waste handling operations. The capacity of this unit is 50 Contact-Handled Packages and twelve Remote-Handled Packages with a combined volume of 242 m³. The HWMUs are shown in Figures B3-2, B3-3, and B3-4.

During the ten year period of the permit, up to 175,564 m³ of CH-TRU mixed waste (CH and RH) could be emplaced in Panels 1 to 10A8 and up to 7,079 m³ of RH TRU mixed waste could be emplaced in Panels 4 to 10A8. Panels 9 and 10 will be constructed under
the initial term of this permit. These latter areas will not receive waste for disposal under this permit.
RCRA PART A APPLICATION CERTIFICATION

The U.S. Department of Energy (DOE), through its Carlsbad Field Office, has signed as “owner and operator,” and Nuclear Waste Partnership LLC, the Management and Operating Contractor (MOC), has signed this application for the permitted facility as “co-operator.”

The DOE has determined that dual signatures best reflect the actual apportionment of Resource Conservation and Recovery Act (RCRA) responsibilities as follows:

The DOE’s RCRA responsibilities are for policy, programmatic directives, funding and scheduling decisions, Waste Isolation Pilot Plant (WIPP) requirements of DOE generator sites, auditing, and oversight of all other parties engaged in work at the WIPP, as well as general oversight.

The MOC’s RCRA responsibilities are for certain day-to-day operations (in accordance with general directions given by the DOE and in the Management and Operating Contract as part of its general oversight responsibility), including, but not limited to, the following: certain waste handling, monitoring, record keeping, certain data collection, reporting, technical advice, and contingency planning.

For purposes of the certification required by Title 20 of the New Mexico Administrative Code, Chapter 4, Part 1 (20.4.1 NMAC), Subpart IX, §270.11(d), the DOE’s and the MOC’s representatives certify, under penalty of law that this document and all attachments were prepared under their direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on their inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of their knowledge and belief, true, accurate, and complete for their respective areas of responsibility. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner and Operator Signature: Original signed by Jose R. Franco
Title: Manager, Carlsbad Field Office
for: U.S. Department of Energy
Date: 6-25-12

Co-Operator Signature: Original signed by Farok Sharif
Title: Project Manager
for: Nuclear Waste partnership Partnership LLC
Date: 6-25-12
APPENDIX B1
OTHER ENVIRONMENTAL PERMITS
### Active Environmental Permits and Approvals for the Waste Isolation Pilot Plant as of February 2014

<table>
<thead>
<tr>
<th>Granting Agency</th>
<th>Type of Permit</th>
<th>Permit/Right of Way Number</th>
<th>Granted/Submitted *</th>
<th>Expiration</th>
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<tr>
<td>1. Department of the Interior, Bureau of Land Management</td>
<td>Right-of-Way for Water Pipeline</td>
<td>NM053809</td>
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<td>4. Department of the Interior, Bureau of Land Management</td>
<td>Right-of-Way for Dosimetry and Aerosol Sampling Sites</td>
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<td>09/04/81 (Valor Telecom of NM LLC)</td>
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<td>NM-6-5 Cooperative Agreement</td>
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<td>21. New Mexico Environment Department Air Quality Bureau</td>
<td>Operating Permit for two backup diesel generators</td>
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<td>22. New Mexico Environment Department-Petroleum Storage Tank Bureau</td>
<td>Storage Tank Registration Certificate</td>
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<td>23. Office of New Mexico State Engineer</td>
<td>Monitoring Well Exhaust Shaft Exploratory Borehole</td>
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1 *Non DOE grantee is noted
2 P&A=Plugged and Abandoned
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Figure B2-1
General Location of the WIPP Facility
Figure B2-2
Planimetric Map-WIPP Facility Boundaries
LEGEND

- - - WIPP Site Boundary 10,240 Acres.
- - - U.S. DOE Right of Way Number NM-53609. For Waterline, 50 Feet Wide.
- - - The DOE had Agreed with the City of Carlsbad to Allow the Individuals to Tap this Line Located within the North Access Road Right of Way.
- - - Stock Water Tanks and Tap Lines Connected to the Main WIPP Waterline.
- - - Southwestern Public Service Company Right of Way Number NM-43203 for Power 60 Feet Wide.
- - - General Telephone of the Southwest Right of Way for Telephone Line, 30 Feet Wide, Located within the North access Road Right of Way.
- - - General Telephone of the Southwest Right of Way Number NM-60174 for Telephone Line, 30 Feet Wide, Located within the Railroad Right of Way.
- - - U.S. DOE Right of Way Number NM-55675 for North Access Road, 170 Feet Wide.
- - - El Paso Natural Gas company Right of Way for Gas Pipeline, 30 Feet Wide in Section 16, 50 Feet Wide Elsewhere.
- - - U.S. DOE Right of Way Number NM-55689 for Access Railroad, 150 Feet Wide.

NOTES
1. The Property Protection Area is a fenced area of approximately 35 acres. It contains all surface facilities with the exception of salt storage piles, parking lot, landfill and waste water stabilization lagoons.

2. Zone II overlies the maximum extent of the Area available for underground development.

3. WIPP site boundary (WSB) provides a one mile buffer area around the area available for underground development.

Figure B2-2a
Legend to Figure B2-2

U.S. DOE Right of Way for Access Roads includes Right of Way Number NM-123703 for the South Access Road which is 140 Feet Wide.
Replace this page with the Topographic Map from the earlier version of the draft Permit
Figure B3-1
Spatial View of the WIPP Facility

PANEL CLOSURE AREAS
SALT HANDLING SHAFT
EXHAUST SHAFT
WASTE SHAFT
SHAFT PILLAR AREA
2150 FEET
PANELS 1 THROUGH 10A HAZARDOUS WASTE DISPOSAL UNITS
WASTE SHAFT CONVEYANCE HEADFRAME OF THE WASTE HANDLING BUILDING
WASTE DISPOSAL AREA
UNDERGROUND FACILITIES
SURFACE FACILITIES
AIR INTAKE SHAFT
Figure B3-2
Repository Horizon
Figure B3-3
Waste Handling Building - CH TRU Mixed Waste Container Storage and Surge Areas
Figure B3-4
Parking Area-Container Storage and Surge Areas
APPENDIX B4
PHOTOGRAPHS
Figure B4-1
Aerial Photograph of the Waste Isolation Pilot Plant
Figure B4-2
Underground - Panel One - Waste Disposal Room
Figure B4-3
Aerial Photograph of the Waste Handling Building
Figure B4-4
TRUDOCKs in CH Bay of the Waste Handling Building
Figure B4-5
NE Corner of CH Bay of the Waste Handling Building
Figure B4-6
Westward View of CH Bay of the Waste Handling Building
Figure B4-7
Waste Shaft Conveyance - Loading Facility Pallet with CH Waste, Waste Handling Building
Figure B4-8
RH Bay (Photo Taken July 2000)
Figure B4-9
Cask Unloading Room and Bridge Crane
Figure B4-11
Transfer Cell
Figure B4-12
Facility Cask Loading Room and Facility Cask Rotating Device
ATTACHMENT D

RCRA CONTINGENCY PLAN
ATTACHMENT D

RCRA CONTINGENCY PLAN

TABLE OF CONTENTS

Introduction ......................................................................................................................... 1

D-1 General Information ........................................................................................................ 1
  D-1a Disposal Phase Overview .......................................................................................... 3
  D-1b Waste Description ..................................................................................................... 4
  D-1c Containers ................................................................................................................ 5
  D-1d Description of Containers ....................................................................................... 5
  D-1e Description of Surface Hazardous Waste Management Units ............................... 6
    D-1e(1) CH Bay Operations ......................................................................................... 6
    D-1e(2) RH Complex Operations ................................................................................ 6
    D-1e(3) Parking Area Container Storage Unit (Parking Area Unit) ............................ 7
  D-1f Off-Normal Events .................................................................................................. 7
  D-1g Containment ........................................................................................................... 7

D-2 Response Personnel ..................................................................................................... 8

D-3 Implementation ............................................................................................................. 10

D-4 Emergency Response Method ...................................................................................... 12
  D-4a Notification .............................................................................................................. 13
    D-4a(1) Initial Emergency Response and Alerting the RCRA Emergency Coordinator ........................................................................................................... 13
    D-4a(2) Communication of Emergency Conditions to Facility Employees .............. 15
    D-4a(3) Notification of Local, State, and Federal Authorities ................................... 15
    D-4a(4) Notification of the General Public .................................................................. 17
  D-4b Identification of Hazardous Materials ................................................................... 17
  D-4c Assessment of the Nature and Extent of the Emergency ....................................... 18
  D-4d Control, Containment, and Correction of the Emergency ..................................... 19
    D-4d(1) All Emergencies ............................................................................................... 19
    D-4d(2) Fire .................................................................................................................. 21
    D-4d(3) Explosion ......................................................................................................... 23
    D-4d(4) Spills ................................................................................................................ 24
    D-4d(5) Decontamination of Personnel ....................................................................... 25
    D-4d(6) Control of Spills or Leaking or Punctured Containers of CH and RH TRU Mixed Waste ............................................................................................................. 25
    D-4d(7) Natural Emergencies ...................................................................................... 28
    D-4d(8) Roof Fall ......................................................................................................... 29
    D-4d(9) Structural Integrity Emergencies .................................................................... 32
    D-4d(10) Emergency Termination Procedures .......................................................... 32
  D-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases .................... 34
  D-4f Management and Containment of Released Material and Waste ......................... 35
  D-4g Incompatible Waste ............................................................................................... 37
  D-4h Post-Emergency Facility and Equipment Maintenance and Reporting ................ 37
  D-4i Container Spills and Leakage ................................................................................ 38
  D-4j Tank Spills and Leakage ........................................................................................ 38

PERMIT ATTACHMENT D
Page D-i
D-4k  Surface Impoundment Spills and Leakage .................................................................38
D-5   Emergency Equipment ........................................................................................................38
D-6   Coordination Agreements ..................................................................................................38
D-7   Evacuation Plan ...................................................................................................................40
D-7a  Surface Evacuation On-site and Off-site Staging Areas ........................................40
D-7b  Underground Assembly Areas and Egress Hoist Stations ........................................41
D-7c  Plan for Surface Evacuation .................................................................................................42
D-7d  Plan for Underground Evacuation ......................................................................................42
D-7e  Further Site Evacuation .........................................................................................................42
D-8   Required Reports ..................................................................................................................43
D-9   Location of the Contingency Plan and Plan Revision .........................................................43
References ...................................................................................................................................45
LIST OF TABLES

Table                              Title
Table D-1  Hazardous Substances in Large Enough Quantities to Constitute a Level II Incident
Table D-2  Resource Conservation and Recovery Act Emergency Coordinators
Table D-3  Planning Guide for Determining Incident Levels and Response
Table D-4  Physical Methods of Mitigation
Table D-5  Chemical Methods of Mitigation
Table D-6  Emergency Equipment Maintained at the Waste Isolation Pilot Plant
Table D-7  Types of Fire Suppression Systems by Location
Table D-8  Hazardous Release Reporting, Federal
Table D-9  Hazardous Release Reporting, State of New Mexico

LIST OF FIGURES

Figure                             Title
Figure D-1  WIPP Surface Structures
Figure D-1a  Legend to Figure D-1
Figure D-2  Spatial View of the WIPP Facility
Figure D-3  WIPP Underground Facilities
Figure D-4  Direction and Control Under Emergency Conditions in Which the Plan Has Been Implemented
Figure D-4a  WIPP Facility Emergency Notifications
Figure D-5  Underground Emergency Equipment Locations and Underground Evacuation Routes
Figure D-6  Fire-Water Distribution System
Figure D-7  Underground Diesel Fuel-Station Area Fire-Protection System
Figure D-8  WIPP On-Site Assembly Areas and WIPP Staging Areas
Figure D-8a  RH Bay Evacuation Routes
Figure D-8b  RH Bay Hot Cell Evacuation Route
Figure D-8c  Evacuation Routes in the Waste Handling Building
Figure D-9  Designated Underground Assembly Areas
Figure D-10  Waste Handling Building Pre-Fire Survey (First Floor)
Figure D-10a  Waste Handling Building Pre-Fire Survey (First Floor - Fire Hydrant/Post Indicator Location)
Figure D-11  Waste Handling Building Pre-Fire Survey (Second Floor)
Figure D-11a  Waste Handling Building Pre-Fire Survey (Second Floor - Fire Hydrant/Post Indicator Location)
Figure D-12  WIPP Hazardous Materials Incident Report, Page 1 of 3

LIST OF DRAWINGS

Drawing                             Title
41-F-087-014  Waste Handling Building 411 Fire Water Collection System Flow Diagram
ATTACHMENT D

RCRA CONTINGENCY PLAN

Introduction

The WIPP facility is owned and co-operated by the U.S. Department of Energy (DOE) and co-operated by its designated Management and Operating Contractor (MOC) (Permit Section 1.5.3).

This Contingency Plan was prepared in accordance with the Resource Conservation and Recovery Act (RCRA) requirements codified in 20.4.1.500 NMAC (incorporating 40 CFR §264.50 to §264.56), “Contingency Plan and Emergency Procedures,” and submitted in compliance with 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(7)). The purpose of this document is to define responsibilities, to describe coordination of activities, and to minimize hazards to human health and the environment from fires, explosions, or any sudden or nonsudden release of hazardous waste, or hazardous waste constituents to air, soil, or surface water (20.4.1.500 NMAC (incorporating 40 CFR §264.51 [a])). This plan consists of descriptions of processes and emergency responses specific to hazardous substances, contact-handled (CH) and remote-handled (RH) transuranic (TRU) mixed waste and other hazardous waste handled at the WIPP facility.

D-1 General Information

The WIPP facility is located 26 miles (mi) (42 kilometers [km]) east of Carlsbad, in Eddy County in southeastern New Mexico, and includes an area of 10,240 acres (ac) (4,144 hectares [ha]). The facility is located in an area of low-population density, with fewer than 30 permanent residents living within a 10 mi (16 km) radius of the facility. The area surrounding the facility is used primarily for grazing, potash mining, and mineral exploration. Resource development that would affect WIPP facility operations or the long-term integrity of the facility is not allowed within the 10,240 ac (4,144 ha) that have been set aside for the WIPP Project.

The WIPP facility is designed to receive containers of TRU waste, which will be transported to the WIPP facility from the ten major and other minor DOE TRU mixed waste generator and/or storage sites. The waste will be emplaced in the bedded salt of the Salado Formation, 2,150 feet (ft) (655 meters [m]) below ground surface.

As a geologic facility for the management of TRU mixed waste, the WIPP repository is regulated as a “miscellaneous unit,” as defined under 20.4.1.500 NMAC (incorporating 40 CFR §264.601 to §264.603). The areas at the WIPP facility subject to this permit include the surface container storage areas in the Waste Handling Building (WHB) Container Storage Unit (WHB Unit) and the Parking Area Container Storage Unit (Parking Area Unit), located south of the WHB, and the areas below ground in which waste will be emplaced.

The WIPP facility includes other surface structures, shafts, and underground areas (Figures D-1, D-2, and D-3). Surface structures other than the WHB, that support TRU mixed waste management include:

Exhaust Filter Building - houses the filter banks to which the underground ventilation can be diverted in the unlikely event of an underground release of radionuclides.
Guard and Security Building - houses the facility security personnel and communications equipment necessary for them to perform their duties. Section D-4a specifies the duties of the security officers relative to contingency actions.

Safety and Emergency Services Building - houses the surface emergency response vehicles (fire truck, rescue truck, ambulance), Health Services (first aid), Emergency Operations Center, and the Dosimetry Laboratory. The Hazardous Material Response Trailer is staged at the WIPP facility in an area that is readily accessible to Emergency Services. Emergency Services is located in Building 452. Table D-6 describes emergency equipment and associated locations.

Support Building - houses the Central Monitoring Room (see section D-4a).

Transuranic Package Transporter-II (TRUPACT-II) Maintenance Facility - is located west of the CH bay. No TRU mixed waste management activities will occur in this facility.

Surface facilities used for storage of support equipment are identified in Table D-6.

Building 452, Safety and Emergency Services Facility, houses the emergency response vehicles, emergency equipment, the mine rescue room, mine rescue team equipment, and the Emergency Operations Center (EOC). The Hazardous Material Response Trailer is staged at the WIPP facility in an area readily accessible to Emergency Services. Emergency Services is located in Building 452.

The RCRA permit addresses TRU mixed waste management activities in the WHB Unit, the Parking Area Unit, and the disposal units. The provisions of this Contingency Plan apply to hazardous waste disposal units (HWDU) in the underground waste disposal panels, storage in the WHB Unit and the Parking Area Unit, the Waste Shaft, and supporting TRU mixed waste handling areas. The remainder of the facility will not manage TRU mixed waste. This Contingency Plan has also been designed in accordance with 20.4.1.300 NMAC (incorporating 40 CFR § 262.34(a)(4) - Standards for Generators of Hazardous Waste), and will be implemented whenever there is a fire, explosion, or release of hazardous waste which could threaten human health or the environment. Hazardous substances in the remainder of the facility are included as possible triggers of the Contingency Plan but are outside the scope of the regulations promulgated pursuant to RCRA. This allows WIPP to maintain one emergency response plan which is consistent with the National Response Teams Integrated Contingency Plan Guidance (Federal Register, Vol. 61, No. 109, June 5, 1996). Inclusion is based on their National Fire Protection Association (NFPA) ratings in addition to their storage quantities. The majority of hazardous substances on-site are not expected to trigger the Contingency Plan because they are present in the same form and concentration as the product packaged for distribution and use by the general public or are used in a laboratory under the direct supervision of a technically qualified individual. Superfund Amendments and Reauthorization Act (SARA) Title III excludes these from emergency planning reporting. The list of hazardous substances in large enough quantities to constitute a Level II incident (Section D-3) is provided in Table D-1. In addition to TRU mixed waste, these are the only hazardous substances currently on site which, if spilled, may be of sufficient impact to cause this Contingency Plan to be implemented. Magnesium Oxide (MgO) is stored on-site in large quantities. It is used as backfill in the waste emplacement rooms as a pH buffer. The pH buffer will limit the solubility of radionuclides after the underground rooms are filled and closed. MgO is not a hazardous...
substance, a release of MgO will not create hazardous waste and poses no threat to human health or the environment, and is therefore not addressed in the Contingency Plan.

Wastes generated as a result of maintenance or response actions will be categorized into one of three groups and disposed of accordingly. These are: 1) nonhazardous wastes to be disposed of in an approved landfill, 2) hazardous nonradioactive wastes to be disposed of at an off-site RCRA permitted facility, and 3) TRU mixed waste to be disposed of in the underground HWDUs. Disposal of TRU mixed waste in the WIPP facility is subject to regulation under 20.4.1.500 NMAC. As required by 20.4.1.500 NMAC (incorporating 40 CFR §264.601), the Permittees will demonstrate that the environmental performance standards for a miscellaneous unit, which are applied to the HWDUs in the underground, will be met. In addition, the technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.170 to §264.178) are applied to the operation of the container storage units in the WHB Unit and in the Parking Area Unit south of the WHB. Liquid wastes that may be generated as a result of the fire fighting water or decontamination solutions will be managed as follows:

Non-Mixed - Hazardous waste liquids contaminated only with hazardous constituents will be placed into containers and managed in accordance with 20.4.1.300 NMAC (incorporating 40 CFR §262.34) requirements. The waste will be shipped to an approved off-site treatment, storage, or disposal facility.

Mixed - Liquids contaminated with TRU mixed waste (inside the WHB Unit) will be solidified as they are placed into containers with cement, Aquaset, or absorbent material in them. The solidified materials will be disposed of in the underground WIPP repository as derived waste.

This chapter of the permit application describes the HWDUs, the TRU mixed waste management facilities and operations, compliance with the environmental performance standards, and with the applicable technical requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.170 to §264.178 and §264.601, respectively). The configuration of the WIPP facility consists of completed structures; including all buildings and systems for the operation of the facility.

D-1a Disposal Phase Overview

The Disposal Phase will consist of receiving CH TRU mixed waste shipping containers, unloading and transporting the waste containers to the underground HWDUs, emplacing the waste in the underground HWDUs, and subsequently achieving closure of the underground HWDUs in compliance with applicable State and Federal regulations.

The TRU mixed waste that will be disposed at the WIPP facility results primarily from activities related to the reprocessing of plutonium-bearing reactor fuel and fabrication of plutonium-bearing weapons, as well as from research and development. This TRU mixed waste consists largely of such items as paper, cloth, and other organic material; laboratory glassware and utensils; tools; scrap metal; shielding; and solidified sludges from the treatment of wastewater. Much of this TRU mixed waste is also contaminated with substances that are defined as hazardous under 20.4.1.200 NMAC.
D-1b Waste Description

Waste destined for WIPP are, or were, produced as a byproduct of weapons production and have been identified in terms of waste streams based on the processes that produced them. Each waste stream identified by generators is assigned to a Waste Summary Category to facilitate RCRA waste characterization, and reflect the final waste forms acceptable for WIPP disposal.

These Waste Summary Categories are:

S3000—Homogeneous Solids

Solid process residues defined as solid materials, excluding soil, that do not meet the applicable regulatory criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2[g] and [h])). Included in solid process residues are inorganic process residues, inorganic sludges, salt waste, and pyrochemical salt waste. Other waste streams are included in this Waste Summary Category based on the specific waste stream types and final waste form. This category includes wastes that are at least 50 percent by volume solid process residues.

S4000—Soils/Gravel

This waste summary category includes waste streams that are at least 50 percent by volume soil. Soils are further categorized by the amount of debris included in the matrix.

S5000—Debris Wastes

This waste summary category includes waste that is at least 50 percent by volume materials that meet the criteria for classification as debris (20.4.1.800 NMAC (incorporating 40 CFR §268.2)). Debris is a material for which a specific treatment is not provided by 20.4.1.800 NMAC (incorporating 40 CFR §268 Subpart D), including process residuals such as smelter slag from the treatment of wastewater, sludges or emission residues.

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. Particles smaller than 2.36 inches in size may be considered debris if the debris is a manufactured object and if it is not a particle of S3000 or S4000 material.

Examples of waste that might be included in the S5000 Waste Summary Category are asbestos-containing gloves, fire hoses, aprons, flooring tiles, pipe insulation, boiler jackets, and laboratory tabletops. Also included are combustible debris constructed of plastic, rubber, wood, paper, cloth, graphite, and biological materials. Examples of graphite waste that would be included are crucibles, graphite components, and pure graphite.
Wastes may be generated at the WIPP facility as a direct result of managing the TRU and TRU mixed wastes received from the off-site generators. Such generated waste may occur in either the WHB Unit or the Underground. For example, when TRU mixed wastes are received at the WHB Unit, the CH or RH Package shipping containers 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 plan, this waste is referred to as “derived waste.” All such derived waste will be placed in the rooms in HWDUs along with the TRU mixed waste for disposal.

D-1c Containers

The waste containers that will be used at the WIPP facility qualify as “containers,” in accordance with 20.4.1.101 NMAC (incorporating 40 CFR §260.10). That is, they are “portable devices in which a material is stored, transported, treated, disposed of, or otherwise handled.”

TRU mixed waste containers, containing off-site waste, will not be opened at the WIPP facility. Derived waste containers are kept closed at all times unless waste is being added or removed.

Waste, including “derived waste,” containing liquid in excess of TSDF-WAC limits shall not be emplaced in the WIPP (See Permit Attachment C, Section C-1c).

Special requirements for ignitable, reactive, and incompatible waste are addressed in 20.4.1.500 NMAC (incorporating 40 CFR §§264.176 and 177). The RCRA Permit Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (TSDF-WAC) precludes ignitable, reactive, or incompatible TRU mixed waste from being placed into storage or disposed of at WIPP.

D-1d Description of Containers

CH TRU mixed waste containers will be either 55-gallon (gal) (208-liter (L)) drums singly or arranged into seven (7)-packs, 85-gal (322-L) drums (used as singly or arranged into four (4)-packs, 100-gal (379 L) drums singly or arranged into three (3)-packs, ten-drum overpacks (TDOP), 66.3 ft³ (1.88 m³) SWBs, or standard large box 2s (SLB2).

RH TRU mixed waste containers are either canisters or drums. Canisters will be loaded singly in an RH-TRU 72-B cask and drums will be loaded in a CNS 10-160B cask. Drums in the CNS 10-160B cask will be arranged singly or in drum carriage units containing up to five drums each. Canisters and drums are described in Permit Attachment M1.

Remote-Handled TRU mixed waste may arrive in shielded containers with an internal capacity of 4.0 ft³ (0.11 m³). Shielded containers will be arranged as three-packs.

1 Typically contamination that is less than six square feet in area and less than 2000 disintegrations per minute (dpm) alpha or 20,000 dpm beta/gamma, may be decontaminated. Containers that exceed these thresholds will be returned to the point of origin for decontamination.
D-1e  Description of Surface Hazardous Waste Management Units

The WHB is the surface facility where waste handling activities will take place. The WHB has a total area of approximately 84,000 square feet (ft²) (7,804 square meters [m²]) of which 49,710 ft² (4,618 m²) are designated as the WHB Unit for TRU mixed waste management. Within the WHB Unit, 32,307 ft² (3,001 m²) are designated for the waste handling and container storage of CH TRU mixed waste and 17,403 ft² (1,617 m²) are designated for the handling and storage of RH TRU mixed waste. These areas are being permitted as container storage units. The concrete floors within the WHB Unit are sealed with an impermeable coating that has excellent resistance to the chemicals in TRU mixed waste and, consequently, provide secondary containment for TRU mixed waste. In addition, a Parking Area Unit south of the WHB will be used for storage of waste in sealed shipping containers awaiting unloading. This area is also being permitted as a container storage unit. The sealed shipping containers provide secondary containment in this hazardous waste management unit (HWMU).

D-1e(1)  CH Bay Operations

Once unloaded from the Contact-Handled Package, CH TRU mixed waste containers (3-pack of shielded containers, 7-packs of 55-gal drums, 3-packs of 100-gal drums, 4-packs of 85-gal drums, SWBs, TDOPs, or one SLB2) are placed on the facility pallet. The waste containers are stacked on the facility pallets (one- or two-high, depending on weight considerations). The use of facility pallets will elevate the waste at least 6 inches (in.) (15 centimeters [cm]) from the floor surface. Pallets of waste will then be stored in the CH bay. This storage area will be clearly marked to indicate the lateral limits of the storage area. This storage area will have a maximum capacity of thirteen facility pallets of waste during normal operations. These pallets will typically be in the CH Bay storage area for a period of up to five days.

In addition, four Contact-Handled Packages, containing up to 640 ft³ of CH TRU waste in containers, may occupy positions at the TRUPACT-II Unloading Docks (TRUDOCK).

Aisle space shall be maintained in all CH Bay waste storage areas. The aisle space shall be adequate to allow unobstructed movement of fire response personnel, spill-control equipment, and decontamination equipment that would be used in the event of an off-normal event. An aisle space between facility and containment pallets will be maintained in all CH TRU mixed waste storage areas.

D-1e(2)  RH Complex Operations

Loaded RH TRU casks are received in the RH Bay of the WHB. The RH Bay is served by an overhead bridge crane used for cask handling and maintenance operations. Storage in the RH Bay occurs in the RH-TRU 72-B or CNS 10-160B casks. A maximum of two loaded casks may be stored in the RH Bay and a maximum of one cask in the Cask Unloading Room may be stored at one time. A minimum of 44 inches (1.1 m) will be maintained between loaded casks in the RH Bay. The cask serves as secondary containment in the RH Bay for the RH TRU mixed waste payload container. In addition, the RH Bay has a concrete floor.

Single RH TRU mixed waste canisters are unloaded from the RH-TRU 72-B casks in the Transfer Cell of the RH Complex where they are transferred to facility casks. Drums of RH TRU mixed waste will be transferred remotely from the CNS 10-160B cask, into the Hot Cell, and loaded into a canister. Storage in the Hot Cell occurs in either drums or canisters. A maximum
of 12 55-gallon drums of RH TRU mixed waste and one 55-gallon drum of derived waste (94.9 ft³ (2.7 m³)) may be stored in the Hot Cell. Except for the derived waste drum, individual 55-gallon drums may not be stored in the Hot Cell for more than 25 days. The Transfer Cell houses the Transfer Cell Shuttle Car, which is used to facilitate transferring the canister to the facility cask. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of waste handling. A maximum of one canister (31.4 ft³ (0.89 m³)) may be stored in the Transfer Cell in a shielded insert in the Transfer Cell Shuttle Car or in a RH-TRU 72-B cask.

The Facility Cask Loading Room provides for transfer of a canister to the facility cask for subsequent transfer to the waste shaft conveyance and to the Underground Hazardous Waste Disposal Unit. The Facility Cask Loading Room also functions as an air lock between the waste shaft and the Transfer Cell. Storage in this area typically occurs at the end of a shift or in an off-normal event that results in the suspension of waste handling. A maximum of one canister (31.4 ft³ (0.89 m³)) may be stored in the Facility Cask in the Facility Cask Loading Room.

Derived waste will be stored in the RH Bay and in the Hot Cell.

D-1e(3) Parking Area Container Storage Unit (Parking Area Unit)

The area extending south from the WHB within the fenced enclosure identified as the Controlled Area on Figure A1-2 is defined as the Parking Area Container Storage Unit. This area provides storage for up to 6,734 ft³ (191 m³) of CH and/or RH TRU mixed waste contained in up to 40 loaded Contact-Handled Packages and 8 Remote-Handled Packages. Secondary containment and protection of the waste containers from standing rainwater are provided by the transportation containers. Up to 12 additional Contact-Handled Packages and four additional Remote-Handled Packages may be stored in the Parking Area Surge Area so long as the requirements of Permit Sections 3.1.2.3 and 3.1.2.4 are met. No more than 50 Contact-Handled and 12 Remote-Handled Packages may be stored in the Parking Area Storage Unit.

The safety criteria for Contact-Handled and Remote-Handled Packages require that they be opened and vented at a frequency of at least once every 60 days. During normal operations, Contact-Handled and Remote-Handled Packages will not require venting while located in the Parking Area Unit. Any off-normal event which results in the need to store a waste container in the Parking Area Unit for a period of time approaching fifty-nine (59) days shall be mitigated by returning the shipment to the generator prior to the expiration of the 60 day NRC venting period or by moving the Contact-Handled or Remote-Handled Package inside the WHB Unit where the waste will be removed and placed in one of the permitted storage areas or in the underground hazardous waste disposal unit.

D-1f Off-Normal Events

Off-normal events could interrupt normal operations in the waste management process line. Shipments of waste from the generator sites will be stopped in any event which results in an interruption to normal waste handling operations that exceeds three days.

D-1g Containment

The WHB Unit has concrete floors, which are sealed with a coating designed to resist all but the strongest oxidizing agents. Such oxidizing agents do not meet the TSDF-WAC and will not be
accepted in TRU mixed waste at the WIPP facility. Therefore, TRU mixed wastes pose no compatibility problems with respect to the WHB Unit floor.

During normal operations, the floor of the normal storage areas within the CH Bay and RH Complex shall be visually inspected on a weekly basis to verify that it is in good condition and free of obvious cracks and gaps. When a RH TRU mixed waste container is present in the RH Complex, inspections will be conducted visually and/or using closed-circuit television cameras in order to manage worker dose and minimize radiation exposures. Manual inspections of the areas are performed at least annually during routine maintenance periods when waste is not present.

Floor areas of the WHB used during off-normal events will be inspected prior to use and weekly while in use. Containers located in the permitted storage areas shall be elevated from the surface of the floor. Facility pallets provide at least 6 in (15 centimeters [cm]) of elevation from the surface of the floor. TRU mixed waste containers that have been removed from Contact-Handled or Remote-Handled Packages shall be stored at a designated storage area inside the WHB so as to preclude exposure to the elements.

Secondary containment at permitted storage areas inside the WHB Unit shall be provided by the floor. The Parking Area Unit and TRUDOCK storage area of the WHB Unit do not require engineered secondary containment, since waste is not stored there unless it is protected by the Contact-Handled or Remote-Handled Packaging. Floor drains, the fire suppression water collection sump, and portable dikes, if needed, will provide containment for liquids that may be generated by fire fighting. Sump capacities and locations are shown in Drawing 41-F-087-014. Residual fire fighting liquids will be placed in containers and managed as described above.

Secondary containment at storage locations inside the RH Bay, Cask Unloading Room, Transfer Cell, and Facility Cask Loading Room is provided by the cask or canisters that contain drums of RH TRU mixed waste. In the Hot Cell, secondary containment is provided by the Hot Cell subfloor. In addition, the RH Complex contains a 220-gallon (833-L) sump in the Hot Cell, a 11,400-gallon (43,152-L) sump in the RH Bay, and a 220-gallon (833-L) sump in the Transfer Cell to collect any liquids.

**D-2 Response Personnel**

Persons qualified to act as the RCRA Emergency Coordinator, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.55), are listed in Table D-2.

A RCRA Emergency Coordinator will be on-site at the WIPP facility 24 hours a day, seven days a week, with the responsibility for coordinating emergency response measures. RCRA Emergency Coordinators are listed in Table D-2, where four individuals have been designated primary RCRA Emergency Coordinators. This is because the on-duty Facility Shift Manager (FSM) is designated as the RCRA Emergency Coordinator. The four individuals shown serve as FSM on a rotating shift basis.

Persons qualified to act as the RCRA Emergency Coordinator are thoroughly familiar with this Contingency Plan, the TRU mixed waste and hazardous waste operations and activities at the WIPP facility, the locations of TRU mixed waste and hazardous waste activities, the locations on the site where hazardous materials are stored and used, and the locations of waste staging and accumulation areas. They are familiar with the characteristics of hazardous substances, TRU mixed waste and hazardous waste handled at the WIPP facility, the location of TRU mixed waste is...
waste and hazardous waste records within the WIPP facility, and the facility layout. In addition, persons qualified to act as the RCRA Emergency Coordinator have the authority to commit the necessary resources to implement this Contingency Plan. Figure D-4 outlines the RCRA Emergency Coordinator’s position relative to other organizations that provide support.

In addition to the RCRA Emergency Coordinator, the following individuals or groups have specified responsibilities during any WIPP facility emergency:

- **Assistant Chief Office Warden (ACOW)**—Persons assigned to take accountability for sections of the site, and then reporting the accountability to the Chief Office Warden.

- **Central Monitoring Room Operator (CMRO)**—The on-shift operator responsible for Central Monitoring Room (CMR) operations, including coordination of facility communications. The facility log is maintained by the CMRO.

- **Chief Office Warden (COW)**—A predesignated individual with responsibilities for complete surface accountability at staging areas in the event of an evacuation. The Chief Office Warden receives reports from the ACOWs.

- **Emergency Response Team (ERT)**—Supplemental group trained to respond to surface emergencies, to provide emergency first aid, and to respond to releases of hazardous waste or hazardous material. ERT members are part of the WIPP Supplemental Emergency Response Program.

- **Emergency Services Technician (EST)/Fire Protection Technician (FPT)**—Regular employee whose job is that of full-time emergency responder. During non-emergency conditions, the EST/FPT inspects facility fire suppression systems and emergency equipment. The EST/FPT completes specific sections of the “WIPP Hazardous Material Incident Report.” Additional technical personnel complete identified sections of the report.

- **Fire Brigade**—The fire brigade is a team of five personnel who respond to site emergencies. The team consists of an Incident Commander and four fire fighters. The fire fighters are trained in accordance with NFPA Standards for Industrial Fire Brigades (Fire Brigades that perform both advanced exterior and interior structural fire fighting).

- **First Line Initial Response Team (FLIRT)**—Supplemental primary responders in the event of a general underground emergency for medical and hazardous material response. The FLIRT also provides backup support for the ERT in the event of a general surface-facility emergency. FLIRT members are part of the WIPP Supplemental Emergency Response Program.

- **Mine Rescue Team (MRT)**—Supplemental group responsible for underground reentry and rescue after an emergency evacuation. The MRT responds in accordance with 30 CFR Part 49 requirements. MRT members are part of the WIPP Supplemental Emergency Response Program.

- **Office Warden**—An individual assigned responsibility for assuring that personnel are evacuated from his/her assigned area or building during evacuations. Office Wardens
maintain a list of all personnel in their specific area. This list is compared with the physical presence of personnel who assemble at the staging areas. The Office Wardens report area accountability to the ACOWs.

- **EOC Staff** - The EOC consists of a minimum staff of three MOC management positions (the Crisis Manager, a Safety Representative and an Operations Representative) to activate the EOC. The full EOC Staff includes the Crisis Manager, the Deputy Crisis Manager, a Safety Representative, an Operations Representative and the EOC Coordinator. Additional technical and logistics personnel will provide support as necessary. The EOC is activated by the FSM. Since EOC staff are performing duties similar to their normal job functions and providing support related to their area of expertise, no specific RCRA training is required.

**D-3 Implementation**

The provisions of this Contingency Plan will be implemented immediately whenever there is an emergency event (e.g., a fire, an explosion, or a natural occurrence that involves or threatens hazardous or TRU mixed wastes or a release of hazardous substances, hazardous materials, or hazardous wastes) that could threaten human health or the environment, or whenever the potential for such an event exists as determined by the RCRA Emergency Coordinator, as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.51(b)). The following information is utilized for categorization of events to determine implementation of the Contingency Plan:

1. Medical Emergencies (does not implement the Contingency Plan)

2. Non-emergency (does not implement the Contingency Plan)
   a. Fire already out, did not involve any hazardous materials.
   b. Spill or release involved materials excluded according to the SARA Title III, Statute 42 U.S.C. 11021 (e). Such as:
      1) Any substance present in the same form and concentration as product packaged for distribution and use by the general public. (Example: Cleaning solutions)
      2) Any substance to the extent it is used in a laboratory under the direct supervision of a technically qualified individual.
      3) Petroleum, including crude oil or any fraction thereof, which is not otherwise specifically listed or designated as a hazardous substance by Comprehensive Environmental Response, Compensation and Liability Act ([CERCLA](https://www.epa.gov/cercla)).
3. Incident Level I: According to the NFPA 471, Responding to Hazardous Materials Incidents (See Table D-3). If the product(s) involved in the fire, explosion, spill or leakage meets the following criteria, it will be classified as a Level I incident and does not implement the Contingency Plan.

   a. The product does not require a U.S. Department of Transportation (DOT) placard, is a NFPA listed 0 or 1 for all categories, or is Other Regulated Materials A, B, C, or D.

   b. The fire is under control and the reactivity rating of the material is less than a rating 2, indicating a low potential for subsequent explosion as the hazardous material can be considered normally stable.

   c. There was no release or the release can be confined with readily available resources.

   d. There is no life-threatening situation.

   e. There is no potential environmental impact.

4. Incident Level II: According to NFPA 471, Responding to Hazardous Materials Incidents, (See Table D-3). If the product(s) involved in the fire, explosion, spill or leakage meets the following criteria, it will be classified as a Level II incident and the Contingency Plan will be implemented by the RCRA Emergency Coordinator.

   a. The product requires a DOT placard, is an NFPA 2 for any categories, or is Environmental Protection Agency (EPA) regulated waste (Site-specific: Table D-1 and TRU mixed waste) AND

   b. The incident involves multiple packages.

   c. There is potential for the fire to spread since the hazardous material’s flammability level (rating 2) is below 200 degrees Fahrenheit, or the reactivity (rating 2) indicates that violent chemical changes are possible and thus may be explosive.

   d. The release may not be controllable without special resources.

   e. The incident requires evacuation of a limited area for life safety.

   f. The potential for environmental impact is limited to soil and air within incident boundaries.

   g. The container is damaged but able to contain the contents to allow handling or transfer of product.
5. Incident Level III: According to NFPA 471, Responding to Hazardous Materials Incidents (See Table D--3). If the product(s) involved in the fire, explosion, spill or leakage meet the following criteria, it will be classified as a Level III incident and the Contingency Plan will be implemented by the RCRA Emergency Coordinator.

a. The product is a poison A (gas), an explosive A/B, organic peroxide, flammable solid, material that is dangerous when wet, chlorine, fluorine, anhydrous ammonia, NFPA 3 and 4 for any categories including special hazards, EPA extremely hazardous substances, and cryogenics.

b. The site-specific container size for this incident level will be a tank truck.

c. There is potential for the fire to spread since the hazardous material’s flammability level (rating 3 or 4) is below 100 degrees Fahrenheit, or the reactivity (rating 3 or 4) indicates that the material may explode.

d. The release may not be controlled even with special resources.

e. The incident requires mass evacuation of a large area for life safety.

f. Even though the NFPA guidelines for this incident level indicate that the potential for environmental impact is severe, due to the site engineering controls, the impact is contained within the HWMUs.

g. The container is damaged to such an extent that catastrophic rupture is possible.

The above categories include fire situations, weather conditions, natural phenomena, and explosions which will have to be evaluated to make an incident level determination. A Level II (potential threat to human health in localized area, potential for moderate on-site environmental impact) or Level III (potential threat to human health in a larger area, potential for severe environmental impact) incident by definition is considered to be a potential threat to human health or the environment and, therefore, is considered to be an emergency requiring activation of the Contingency Plan.

D-4 Emergency Response Method

Methods that describe how and when the WIPP Contingency Plan will be implemented cover the following 11 implementation areas:

1. Notification (Section D-4a)
2. Identification of hazardous materials (Section D-4b)
3. Assessment of the nature and extent of the emergency (Section D-4c)
4. Control, containment, and correction of the emergency (Section D-4d)
5. Prevention of recurrence or spread of fires, explosions, or releases (Section D-4e)
6. Management and containment of released material and waste (Section D-4f)
7. Incompatible waste (Section D-4g)
8. Post-emergency facility and equipment maintenance and reporting (Section D-4h)
9. Container spills and leakage (Section D-4i)
10. Tank spills and leakage (Section D-4j)
11. Surface impoundment spills and leakage (Section D-4k)
**D-4a Notification**

Notification requirements in the event of an emergency at a RCRA hazardous waste management facility are defined by 20.4.1.500 NMAC (incorporating 40 CFR §§264.56(a) and (d)). Necessary notifications in case of an emergency at the WIPP facility are described in this section (Figure D-4a). Personnel at the WIPP facility are trained to respond to emergency notifications.

**D-4a(1) Initial Emergency Response and Alerting the RCRA Emergency Coordinator**

The first person to become aware of an incident shall immediately report the situation to the CMRO, and provide the following information, as appropriate:

- Name and telephone number of the caller
- Location of the incident and the caller
- Time and type of incident
- Severity of the incident
- Magnitude of the incident
- Cause of the incident
- Assistance needed to deal with or control the incident
- Areas or personnel affected by the incident

In addition to receiving incident reports, the CMRO continuously monitors (24 hours a day) the status of mechanical, electrical, and/or radiological conditions at selected points on the site, both above and below ground. Alarms to indicate abnormal conditions are located throughout the WIPP facility. The alarm(s) (e.g., fire, radiation) may be the first notification of an emergency situation received by the CMRO. The CMRO monitors alarms, takes telephone calls and radio messages, and initiates outgoing calls to emergency staff and outside agencies.

Once the CMRO is notified of a fire, explosion, or a release anywhere in the facility (either by eyewitness or an alarm), the RCRA Emergency Coordinator is immediately notified. Once notified, the RCRA Emergency Coordinator assumes responsibility for the management of activities related to the assessment, abatement, and/or cleanup of the incident.

A RCRA Emergency Coordinator is on-site at all times and, therefore, can be reached at any time via a two-way radio or over the public address (PA) and plectrons on-site. If the RCRA Emergency Coordinator is unavailable or unable to perform these duties, a qualified alternate RCRA Emergency Coordinator is available.

The EST/FPT is also notified in case of fire, explosion, or release. The RCRA Emergency Coordinator, as incident commander, determines if supplemental emergency responders are necessary. Notification of the ERT (surface) is made by using the ERT pagers and/or the public announcement system. Notification of the FLIRT is by using the Mine Page Phone System. If the MRT is needed the RCRA Emergency Coordinator will instruct the CMRO to make a PA announcement for the MRT to assemble in the Mine Rescue Room, located in a predetermined location.
Off-shift personnel may be notified using the on-call list, which is updated weekly by the Permittees. The FSM/CMRO, each individual on the on-call list, and WIPP Security receive copies of the on-call list. The CMRO may direct Security to make the notifications.

The response to an unplanned event will be performed in accordance with procedures based on the applicable Federal, State, or local regulations and/or guidelines for that response. These include the U.S. Mine Safety and Health Administration (MSHA); NMAC; CERCLA; Chapter 74, Article 4B, New Mexico Statutes Annotated 1978, New Mexico Emergency Management Act; and agreements between the Permittees and local authorities (Section D-6) for emergencies throughout the WIPP facility.

After notification by the CMRO, the EST/FPT shall immediately investigate to determine pertinent information relevant to the actual or potential threat posed to human health or the environment. The information will include the location of release, type, and quantity of spilled or released material (or potential for release due to fire, explosion, weather conditions, or other naturally occurring phenomena), source, areal extent, and date and time of release. The EST/FPT shall provide information for classification of the incident, according to the emergency response guidelines, to the RCRA Emergency Coordinator. The RCRA Emergency Coordinator then classifies the incident after evaluation of all pertinent information. This classification will consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off from water or chemical agents used to control fire and heat-induced explosions).

When the RCRA Emergency Coordinator determines that an Incident Level II or III has occurred, the Contingency Plan is implemented. The RCRA Emergency Coordinator then may choose to activate the EOC for additional support (Figure D-4). If the RCRA Emergency Coordinator determines that due to extenuating circumstances the potential to upgrade to an incident Level II or III exists, the RCRA Emergency Coordinator also may activate the EOC. The EOC will assist the RCRA Emergency Coordinator in mitigation of the incident with use of communications equipment and technical expertise from any WIPP organization (see Section D-4c).

The EOC staff will assess opportunities for coordination and the use of mutual-aid agreements with local outside agencies making additional emergency personnel and equipment available (Section D-6), as well as the use of specialized response teams available through various State and Federal agencies. As a DOE-owned facility, the WIPP facility may use the resources available from the Federal Response Plan, signed by 27 Federal departments and agencies in April 1987, and developed under the authorities of the Earthquake Hazards Reduction Act of 1977 (42 U.S.C. 7701 et seq.) and amended by the Stafford Disaster Relief Act of 1988. Most resources are available within 24 hours. The WIPP facility maintains its own emergency response capabilities on-site. In addition to the supplemental emergency responders, radiological control technicians, environmental sampling technicians, wildlife biologists, and various other technical experts are available for use on an as-needed basis.
D-4a(2) Communication of Emergency Conditions to Facility Employees

Procedures for notifying facility personnel of emergencies depend upon the type of emergency. Methods of notification are:

- **Local Fire Alarms**
  
The local fire alarms sound a bell tone and may be activated automatically or manually in the event of a fire.

- **Surface Evacuation Signal**
  
The evacuation signal is a yelp² tone and is manually activated by the CMRO when needed. The CMRO shall follow the evacuation signal with verbal instructions and ensure the Site Notification System (i.e., the plectron) has been activated.

- **Underground Evacuation Warning System**
  
The evacuation signal is a yelp tone and flashing strobe light. In the event of an evacuation signal, underground personnel will proceed to the nearest egress hoist station (Section D-7b) to be apprised of the nature of the emergency and the evacuation route to take. Underground personnel are trained to report to the underground assembly areas and await further instruction if all power fails or if ventilation stops. If evacuation of underground personnel is required, this will be done using the backup electric generators and in accordance with the applicable requirements of MSHA.

- **Contingency Evacuation Notification**
  
If the primary warning system consisting of alarms and signals fails to operate when activated (as in a total power outage and failure of the back-up power systems), WIPP Security will be notified by the CMRO to initiate the contingency evacuation plan. In this event Security officers will alert personnel to evacuate the area and will check trailers, if possible, to ensure that personnel have been alerted/evacuated.

WIPP facility personnel are trained and given instruction during General Employee Training to recognize the various alarm signals and the significance of each alarm. WIPP facility employees and site visitors are required to comply with directions from emergency personnel and alarm system notifications and to follow instructions concerning emergency equipment, shutdown procedures, and emergency evacuation routes and exits.

D-4a(3) Notification of Local, State, and Federal Authorities

If it is determined that the facility has had a fire, an explosion, a spill, or a release of hazardous waste or hazardous waste constituents (included in 20.4.1.200 NMAC (incorporating 40 CFR § 261)) in the miscellaneous unit or TRU mixed waste handling areas, or an emergency resulting in a release of a hazardous substance (included in 40 CFR §302.4 and §302.6 or the New

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² The yelp tone increases from 500 to 1,000 hertz and drops to 500 hertz.
Mexico Emergency Management Act, §74-4B-3 and §74-4B-5) that could threaten human health or the environment outside the facility, the RCRA Emergency Coordinator, after consultation with the DOE as the owner of the facility, will assure that local authorities are notified by telephone and/or radio, including:

- Carlsbad Police Department (telephone number: [575] 885-2111) (or 911)
- Carlsbad Fire Department (telephone number: [575] 885-2111) (or 911)
- Eddy County Sheriff (telephone number: [575] 887-7551)
- Hobbs Fire Department (telephone number: [575] 397-9265)

After local authorities are notified, the RCRA Emergency Coordinator will ensure notification of the following:

- New Mexico Environment Department (NMED) Department of Public Safety
  24-Hour Emergency Reporting Telephone Number: (505) 827-9329
  FAX number: (505) 827-9368

- Department of Public Safety WIPP Coordinator
  Telephone Number: (505) 827-9221
  FAX number: (505) 829-3434

- Hazardous Materials Emergency Response, Chemical Safety Office, Department of Public Safety, State Emergency Response Commission
  Telephone number: (505) 476-9681
  FAX number: (505) 476-9695

- National Response Center
  Telephone number: 1-800-424-8802
  FAX number: (202) 479-7181

- Local Emergency Planning Committee
  Telephone number: (575) 885-3581
  Fax number: (575) 628-3973

The first notification of public safety and regulatory agencies will include the following:

- The name and address of the facility and the name and phone number of the reporter
- The type of incident (fire, explosion, or release)
- The date and time of the incident
- The type and quantity of material(s) involved, to the extent known
- The exact location of the incident
- The source of the incident
The extent of injuries, if any

Possible hazards to human health and the environment (air, soil, water, wildlife, etc.) outside the facility

The name, address, and telephone number of the party in charge of or responsible for the facility or activity associated with the incident

The name and the phone number of the RCRA Emergency Coordinator

The identity of any surface and/or groundwater involved or threatened and the extent of actual and potential water pollution

The steps being taken or proposed to contain and clean up the material involved in the incident

The RCRA Emergency Coordinator will also be available to advise the appropriate local, State, or Federal officials on whether or not local areas should be evacuated.

D-4a(4) Notification of the General Public

Immediate notification of the general public through the public safety and emergency agencies listed above will be made by, or under the direction of, the RCRA Emergency Coordinator following an evaluation to determine if local adjacent areas need to be evacuated. This evaluation will be made in consultation with the DOE who, as the owner of the facility, has management responsibility for the land withdrawal area. DOE policy is to provide accurate and timely information to the public by the most expeditious means possible concerning emergency situations at the WIPP site that may affect off-site personnel, public health and safety, and/or the environment. A DOE (DOE) Management representative is always on-call. This person is available by pager or telephone 24 hours a day.

A Hazards Assessment was conducted, which indicated no need for protective actions or emergency action levels, as defined by the Permittees, for the facility. Therefore, no procedures are in place for evacuation of the public. Procedures are in place for notification of the public by radio, television, and newspapers for news items which might include notification of on-site emergency situations. These procedures include a Public Affairs Coordinator in the EOC who writes and transmits press releases to the DOE office, where formal press conferences are conducted.

D-4b Identification of Hazardous Materials

The identification of hazardous wastes, hazardous waste constituents, or hazardous materials involved in a fire, an explosion, or a release to the environment is a necessary part of the assessment of an incident, as described in 20.4.1.500 NMAC (incorporating 40 CFR §264.56(b)). RCRA hazardous waste and hazardous substances and materials listed in 40 CFR §302.4 and §302.6 or New Mexico Emergency Management Act, §74-4B-3 and §74-4B-5 and, involved in any release at the WIPP facility will be identified. The identification of likely hazardous materials at any location is enhanced because hazardous materials and hazardous waste are only stored or managed in specified locations throughout the WIPP facility. An attempt will be made to identify products involved by occupancy/location, container shape,
markings/color, placards/labels, United Nations/North America/Product Identification Number, on-site technical experts, or field sampling. Further, the ES&H department maintains an updated inventory of hazardous materials/substances that are brought on site, and a master MSDS listing in the Safety and Emergency Services Facility, Building 452.

Sources of information available to identify the hazardous wastes, substances, or materials involved in a fire, an explosion, or a release at the WIPP facility include operator/supervisor knowledge of their work areas, materials used, and work activities underway; the WIPP Waste Information System (WWIS), which identifies the location within the facility of emplaced TRU mixed waste, including emplaced derived waste; and waste manifests and other waste characterization information in the operating record. The WWIS also includes information on wastes that are in the waste handling process. Also available are MSDSs for hazardous material in the various user areas throughout the facility, waste acceptance records, and materials inventories for buildings and operating groups at the WIPP facility. Information or data from the derived waste accumulation areas, the hazardous waste staging area, satellite staging areas, and nonregulated waste accumulation areas are included.

TRU mixed waste received by the WIPP facility during the Disposal Phase will be characterized for hazardous constituents prior to receipt, and acceptable knowledge will be used to characterize derived waste prior to emplacement.

Information required for identifying TRU mixed hazardous constituents in case of an incident is readily available through the WWIS and the waste acceptance records. Waste accepted at WIPP is already known to be compatible with all materials used to respond to an emergency. All non-TRU mixed waste materials received on site, other than those listed in Table D-1, are in such small quantities that no reaction could develop which would trigger an Incident Level II or III response.

The RCRA Emergency Coordinator will have access to the WWIS through Operations, or through the Facility Shift Manager’s Office.

The RCRA Emergency Coordinator has access to the inventory lists and MSDSs in the Safety and Emergency Services Facility at all times.

D-4c Assessment of the Nature and Extent of the Emergency

Once the required notifications have been made, the RCRA Emergency Coordinator will ensure that the identity, exact source, amount, and areal extent of any released materials are determined, as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.56(b)). The RCRA Emergency Coordinator will determine whether the occurrence constitutes an emergency based on knowledge of the area and access to the waste identification/characterization information described in Section D-4b. An emergency will require response by only trained emergency response personnel. The RCRA Emergency Coordinator will be responsible for responding to immediate and potential hazards, using the services of trained personnel to determine: 1) the identity of hazardous wastes, hazardous waste constituents, and other hazardous materials involved in a release, as described in Section D-4b; 2) whether or not a release involved a reportable quantity of a hazardous substance; 3) the areal extent of a release; 4) the exact source of a release; and 5) the potential hazards to human health or to the environment.
After the materials involved in an emergency are identified, the specific information on the associated hazards, appropriate personal protective equipment (PPE), decontamination, etc., will be obtained from MSDSs and from appropriate chemical reference materials at the same location. These information sources may be accessed by the RCRA Emergency Coordinator or through several WIPP facility organizations.

The emergency assessment requires determination of hazards involving evaluation of several criteria, including:

- Exposure: magnitude of actual or potential exposure to employees, the general public, and the environment; duration of human and environmental exposure; pathways of exposure
- Toxicity: types of adverse health or environmental effects associated with exposures; the relationship between the magnitude of exposure and adverse effects
- Reactivity: hazardous materials or hazardous wastes, which are not TRU mixed wastes, involved in an incident will be assessed for reactivity through accessing the MSDSs for the affected material and the recommended method(s) for managing such waste
- Uncertainties: considerations for undeterminable or future exposures; uncertain or unknown health effects, including future health effects

D-4d Control, Containment, and Correction of the Emergency

The WIPP facility is required to control an emergency and to minimize the potential for the occurrence, recurrence, or spread of releases due to the emergency situation, as described in 20.4.1.500 NMAC (incorporating 40 CFR §264.56 (e)). The WIPP Emergency Response procedures utilize the incident mitigation guidelines in NFPA 471, Responding to Hazardous Materials Incidents, with initial response priority being on control, and those actions necessary to ensure confinement and containment (the first line of defense) in the early, critical stages of a spill or leak. The RCRA Emergency Coordinator is responsible for stopping processes and operations when necessary, and removing or isolating containers. TRU mixed waste will remain within the WHB Unit, the Parking Area Unit, and the underground HWDU.

D-4d(1) All Emergencies

The WIPP Emergency Response procedures include, but are not limited to, the following actions appropriate for control:

1. Isolate the area from unauthorized person by fences, barricades, warning signs, or other security and site control precautions. Isolation and evacuation distances vary, depending upon the chemical/product, fire, and weather situations.

2. Identify the chemical/product according to Section D-4b.

3. Drainage controls.

4. Stabilization of physical controls (such as dikes or impoundment[s]).
5. Capping of contaminated soils to reduce migration.

6. Using chemicals and other materials to retard the spread of the release or to mitigate its effects.

7. Excavation, consolidation, removal, or disposal of contaminated soils.

8. Removal of drums, barrels, or tanks where it will reduce exposure risk during situations such as fires.

If the facility stops operations in response to a fire, explosion, or release, the RCRA Emergency Coordinator shall ensure continued monitoring for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever appropriate. If operations continue, personnel normally assigned to these tasks will continue.

Both natural and synthetic methods will be employed to limit the releases of hazardous materials so that effective recovery and treatment can be accomplished with minimum additional risk to human health or the environment. A combination of the above methods to achieve protection of human health and the environment, with emphasis on two basic methods for mitigation of hazardous materials incidents - Physical and Chemical (Tables D-4, D-5) mitigation, will be used.

1. Physical methods of control involve any of several processes to reduce the area of the spill/leak, or other release mechanism (such as fire suppression).

   A. Absorption is the process in which materials hold liquids through the process of wetting. Absorption is accompanied by an increase in the volume of the sorbate/sorbent system through the process of swelling. Some of the materials utilized in response to Level I incidents or Level II incidents involving liquids will be absorbent sheets of polyolefin-type fibers, spill control bucket materials (specifically for solvents, neutralization, or for acids/caustics), and absorbent socks for general liquids or oils.

   B. Covering refers to a temporary form of mitigation for radioactive incidents that will be utilized in response to Level II or Level III incidents involving CH TRU mixed waste. These could include absorbent sheets, plastic, or actual ambulance blankets.

   C. Dikes or Diversions refer to the use of physical barriers to prevent or reduce the quantity of liquid flowing into the environment. Dikes may be soil or other barriers temporarily utilized to hold back the spill or leak. Diversion refers to the methods used to physically change the direction of the flow of the liquid. Absorbent socks or earth may be utilized as dikes or diversions for all levels of incidents.

   D. Overpacking is accomplished by the use of an oversized container. Overpack containers will be compatible with the hazards of the materials involved.

   E. Plug and Patch refers to the use of compatible plugs and patches to reduce or temporarily stop the flow of materials from small holes, rips, tears, or gashes in containers. A Series “A” hazardous response kit containing nonsparking...
equipment to control and plug leaks may be utilized for response to all levels of incidents.

F. Transfer refers to the process of moving a liquid, gas, or some forms of solids, either manually or by pump, from a leaking or damaged container. Scoops, shovels, jugs, and pails as well as drum transfer pumps for chemical and petroleum transfer are utilized as needed in response to all levels of incidents.

G. Vapor Suppression refers to the reduction or elimination of vapors emanating from a spilled or released material through the most efficient method or application of specially designed agents such as an aqueous foam blanket.

2. Chemical Methods of Mitigation

A. Neutralization is the process of applying acids or bases to a spill to form a neutral salt. The application of solids for neutralizing can often result in confinement of the spilled material. This would include using the neutralizing adsorbents.

B. Solidification is the process whereby a hazardous liquid is added to material such as an absorbent so that a solid material results.

The established procedures are based upon the incident level and a graded approach for nonradioactive or CH TRU waste emergencies and initiated to:

1. Minimize contamination or contact (through PPE, etc.)
2. Limit migration of contaminants
3. Properly dispose of contaminated materials

For RH TRU mixed waste that is not managed in shielded containers, the detection of contamination on or damage to a RH TRU mixed waste canister or a facility canister may occur outside the Hot Cell during cask to cask transfer of the canister or during loading of the Shielded Insert in the Transfer Cell. When such contamination or damage is found, the Permittees have the option to decontaminate or return the canister to the generator/storage site or another site for remediation. In the case of a damaged facility canister, the Shielded Insert may be used as an overpack to facilitate further management. Contamination may also be detected within the Hot Cell during the unloading of the CNS 10-160B shipping cask. In this case, the Permittees may decontaminate the 55-gallon drums or return them to the generator/storage site or another site for remediation. Spills or releases that occur within the RH Complex or the underground as the result of RH TRU mixed waste handling will be mitigated by using appropriate measures which may include the items above.

D-4d(2) Fire

The incident level emergency response identified in Section D-3 includes fire/explosion potential. WIPP fire response includes incipient, exterior structure fires, and internal structure fires. The RCRA Emergency Coordinator can implement the Memoranda of Understanding (MOU) for additional support.

The first option in mine fire response will be to apply mechanical methods to stop fires (e.g., cut electrical power). The last option in mine fire response will be to reconfigure ventilation using...
control doors associated with the underground ventilation system. The following actions are implemented in the event of a fire:

1. All emergency response personnel at an incident will wear appropriate PPE.

2. Only fire extinguishing materials that are compatible with the materials involved in the fire will be used to extinguish fires. Compatibility with materials involved in a fire are determined by pre-fire plans, Emergency Response Guide Book (DOT, 1993), DOT labeling, and site-specific knowledge of the emergency response personnel. Water and dry chemical materials have been determined to be compatible with all components of the TRU mixed waste. Pre-fire plans for the WHB are included in Figures D-10 and D-11.

Fires in areas of the WHB Unit should not propagate, due to limited amount of combustibles, and the concrete and steel construction of the structures. Administrative controls, such as landlord inspections and EST/FPT inspections, help to insure good housekeeping is maintained. Combustible material and TRU mixed waste will be isolated, if possible. Firewater drain trenches collect the water and channel it into a sump. In areas not adjacent to the trenches, portable absorbent dikes (pigs) will be used to retain as much as possible, until it can be transferred to containers or sampled and analyzed for hazardous constituents.

3. If the fire spreads or increases in intensity, personnel will be directed to evacuate.

4. The RCRA Emergency Coordinator will remain in contact with responding personnel to advise them of the known hazards.

5. In order to ensure that storm drains and/or sewers do not receive potentially hazardous runoff, dikes will be built around storm drains to control discharge as needed. Collected waste will be sampled and analyzed for hazardous constituents, before being discharged to evaporation ponds. There are two ponds south of the security fence, opposite the WHB Unit, that will collect drainage from the parking area. The rest of the site, inside the security fence, drains to the large pond to the west. Samples will be taken from these ponds, after the emergency has been abated, to determine any cleanup requirements. NMED will approve any procedures associated with the sampling and analysis of the ponds.

6. The RCRA Emergency Coordinator maintains overall control of the emergency and may accept and evaluate the advice of WIPP facility personnel and emergency response organization members, but retains overall responsibility.

7. The RCRA Emergency Coordinator will be in overall control of WIPP facility emergency response efforts until the emergency is terminated.

8. Materials involved in a fire can be identified in the following ways:
   - According to Section D-4b.
   - If the contents of the waste container cannot be determined based on its location and the label is destroyed by fire, the material will be treated as an
unknown, evaluated for radiological contamination, and analyzed according to methods in the EPA's "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" (SW-846), Third Edition, after the fire has been extinguished.

- Airborne radioactivity samples may be obtained during a fire involving radioactive materials, using portable and fixed air samplers. Response personnel will be adequately protected from airborne radioactivity by their PPE required for fire response.

9. Only materials compatible with the waste may be used for fire response.

10. When cleanup has proceeded to the point of finding no radionuclide activity, then the "swipe" can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

- For waste containers, once radiologically clean and free of any visible evidence of hazardous waste spills on the container, it will be placed in the underground without further action.

- For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues (for further information see Section D-4d, Emergency Termination Procedures).

11. Fire suppression materials used in response to incidents will be retained on-scene, where an evaluation will be performed to determine appropriate recovery and disposal methods.

D-4d(3) Explosion

The following actions will be implemented in the event that an explosion that involves or threatens hazardous or TRU mixed waste or hazardous materials has occurred:

1. The area will be evacuated immediately.

2. The CMRO will immediately notify the appropriate emergency response personnel and the RCRA Emergency Coordinator about the explosion.

3. Injured personnel will be treated and transported as necessary.

4. The RCRA Emergency Coordinator will remain in contact with responding personnel to advise them of the known hazards involved and the degree and location of the explosion and associated fires.

5. The RCRA Emergency Coordinator will be in command and may accept and evaluate the advice of WIPP facility personnel and emergency response organization members, but retains the overall responsibility. Selections of methods and tactics of response are the responsibility of the Incident Commander.
6. The RCRA Emergency Coordinator will be in overall control of WIPP facility emergency response efforts until the emergency is terminated.

7. When cleanup has proceeded to the point of finding no radionuclide activity, then samples may be taken for chemical analysis if there is visible evidence to suspect additional hazardous waste residues. Chemical residues on floor surfaces resulting from a hazardous waste explosion will be evaluated, sampled, analyzed (if required), isolated, and returned to appropriate containers, and surfaces will be cleaned using appropriate cleaners.

8. The RCRA Emergency Coordinator may shut down operational units (e.g., process equipment and ventilation equipment) that have been affected directly or indirectly by the explosion. Once the areas have been determined safe for reentry, processes may be reactivated.

D-4d(4) Spills

Protection of response personnel at a hazardous material incident is paramount. The primary methods to protect personnel are time, distance, and shielding. If a Level II or III incident exists, the RCRA Emergency Coordinator will implement the following actions:

1. The immediate area will be evacuated.

2. The RCRA Emergency Coordinator will review facility records to determine the identity and chemical nature of released material.

3. Entry team procedures will be utilized, with special attention to the following:
   - Buddy system
   - Appropriate PPE
   - Backup rescue team
   - Supplemental communication signals (hand signals and hand-light signals)
   - Monitoring equipment
   - Exposure time limitations

4. If possible, the source of the release will be secured.

5. A dike to contain runoff may be built.

6. Emergency responders will ensure that storm drains and/or sewers do not receive potentially hazardous runoff or spilled material. They may build dikes around storm drains to control discharge.

7. Released wastes may be collected and contained by stabilizing or neutralizing the spilled material, as appropriate, pouring an absorbent over the spilled material, and sweeping or shoveling the absorbed material into drums or other appropriate containers. The absorbents have been determined to be compatible with all components of the TRU mixed waste.
8. No TRU mixed waste that may be incompatible with the released material will be managed in the affected area until cleanup procedures are complete.

9. The RCRA Emergency Coordinator will direct spill control, decontamination, and termination procedures described below.

D-4d(5) Decontamination of Personnel

Decontamination of personnel with radioactive contamination is the responsibility of the Radiological Control (RC) section. If a person is contaminated with radioactivity during a site evacuation to the staging areas, the contaminated area will be covered before the person can be moved (under escort by RC personnel) to the staging area. The RC personnel will ensure the contaminated person remains segregated from other site personnel while under RC supervision.

In the event of an emergency that requires immediate evacuation of the area, the contamination can be covered by any method warranted, given the circumstance (e.g., clean clothing wrapped around the area). If the size of the radioactive contamination on the body is small and localized, it can be covered with clothing (e.g., glove, shoe cover, coveralls). If the size of the radioactive contamination on the body is large, it may be covered by dressing the individual in a full set of Anti-Contamination clothing (coveralls, hood, gloves, shoe covers, etc.).

If time and location permit and the contamination is on the face, it will be decontaminated immediately using a cloth moistened with tepid water (and a mild detergent, if necessary). If the size of the radioactive contamination on the individual’s body is small and localized, it will be decontaminated using the same method as for the face, but after the individual has been transferred to an area appropriate for conducting decontamination.

If the individual is transferred to the staging area prior to decontamination, he/she will be decontaminated at the staging area using site procedures for personnel decontamination and using decontamination supplies and equipment as appropriate for the extent and magnitude of the contamination.

D-4d(6) Control of Spills or Leaking or Punctured Containers of CH and RH TRU Mixed Waste

In the event of spills or leaking or punctured containers of CH and RH TRU mixed waste, the WIPP responds to three distinct phases: 1) the event, 2) the re-entry, and 3) the recovery.

During the event, the following immediate actions are completed: 1) stop work, 2) warn others (notify CMR), 3) isolate the area, 4) minimize exposure, and 5) close off unfiltered ventilation. These actions can take place simultaneously, as long as they are completed before proceeding to the re-entry phase.

CH TRU Mixed Waste

Prior to the re-entry following an event involving containers that are managed as CH TRU mixed waste, a Radiological Work Permit (RWP) is written for personnel to enter with protective clothing to assess the conditions, take surveys and samples, and mitigate problems that could compound the hazards in the area (cover up spilled material with plastic material sheeting and or any approved fixatives such as paint, place equipment in a safe configuration, etc.). During the re-entry phase, smears and air sample filters are taken and counted. This information is
used by cognizant managers, RC personnel, and As Low As Reasonably Achievable (ALARA) Committee representatives to determine an appropriate course of action to recover the area. A plan to decontaminate and recover affected areas and equipment will be approved with a separate RWP written to establish the radiological controls required for the recovery.

During the recovery phase, the plan will be executed to utilize the necessary resources to conduct decontamination and/or overpacking operations as needed. The completion of this phase will occur prior to returning the affected area and/or equipment to normal activities. The recovery phase will include activities to minimize the spread of contamination to other areas. These activities will involve placing the waste material in another container; vacuuming the waste material; overpacking or plugging/patching the spilled, leaking, or punctured waste container; and/or decontaminating the affected area(s). If an affected surface cannot be decontaminated to releasable levels, it may be covered with a fixative coating and established as a Fixed Contamination Area to prevent spread of contamination, or it may be removed using heavy machinery and tools, packaged in approved waste containers, and emplaced in the underground. Every reasonable effort to minimize the amount of derived waste, while providing for the health and safety of personnel, will be made.

Should a breach of a CH TRU mixed waste container occur at the WIPP that results in removable contamination exceeding the small area “spot” decontamination levels, the affected container(s) (e.g., breached and contaminated) will be placed into an available overpack container (e.g., 85-gal drum, SWB, TDOP), except that TDOPs and SLB2s will be decontaminated, repaired/patched in accordance with 49 CFR §173 and §178 (e.g., 49 CFR §173.28), or returned to the generator. The decontamination of equipment and the overpacking of contaminated/damaged waste containers will be performed in the vicinity of the incident. For example, under normal operations CH TRU mixed waste will be handled only in the areas of the WHB Unit. Therefore, it is within these same areas that decontamination and/or overpacking operations would occur. By eliminating the transport of contaminated equipment to other areas for decontamination or overpacking, the risk of spreading contamination is reduced.

Equipment used during a spill cleanup or CH TRU mixed waste overpacking operation could include: cloths, brushes, scoops, absorbents, squeegees, tape, bags, pails, slings, hand tools, and others as needed for a given incident.

At the underground emplacement room, salt contaminated by a spill of CH TRU mixed waste would be either covered or cleaned up, depending on location, extent, and spilled material, due to potential radioactive contamination spread via the salt dust. The contaminated salt would be covered to isolate it from the workers, and the stacking of waste containers would resume or would be removed and packaged as site-derived waste using applicable site procedures for decontaminating surfaces.

The decontamination methods will initially involve wiping down structures, equipment, and other containers in the area with absorbent cloths moistened with tepid water. Surveys of these structures will take place and the need to continue decontamination activities will be established. If further decontamination is required, nonhazardous decontaminating agents, such as Liquinox®, Simple Green®, Windex®, citric acid, Bartlett Strip Coat®, and high pressure CO₂ will be used to prevent generating CH TRU mixed waste.

RWPs and other administrative controls provide protective measures to help ensure that new hazardous constituents will not be added during decontamination activities.
Certain structures and/or equipment may be disassembled to facilitate decontamination or may be placed directly into a derived waste container. Items used in the spill cleanup and decontamination operations (e.g., swipes, tools, PPE, etc.) may also be placed into a derived waste container.

When decontamination is deemed by the recovery team to be complete, RC personnel will conduct one final, intensive radcon survey of the area and components in the area to release it for uncontrolled use. The free release criteria for items, equipment, and areas is < 20 dpm/100 cm² for alpha radioactivity and < 200 dpm/100 cm² for beta-gamma radioactivity. Personnel will then perform hazardous material sampling after decontamination efforts are complete to verify the removal of hazardous waste substances. After cleanup is complete, facility personnel will complete an inspection and include the details of the spill and cleanup in the log.

**RH TRU Mixed Waste**

For RH TRU mixed waste, the detection of contamination on or damage to a RH TRU mixed waste canister or a facility canister may occur outside the Hot Cell during cask to cask transfer of the canister or during loading of the Shielded Insert in the Transfer Cell. When such contamination or damage is found, the Permittees have the option to decontaminate or return the canister to the generator/storage site or another site for remediation. In the case of a damaged facility canister, the Shielded Insert may be used as an overpack to facilitate further management. Contamination may also be detected within the Hot Cell during the unloading of the CNS 10-160B shipping cask. In this case, the Permittees may decontaminate the 55-gallon drums or return them to the generator/storage site or another site for remediation. Spills or releases that occur within the RH Complex or the underground as the result of RH TRU mixed waste handling will be mitigated by using the following measures, as appropriate:

During the re-entry phase, an evaluation of the incident, including the nature of the release, amount, location, and other appropriate factors, will be performed. A RWP will be written and approved prior to personnel entering the Hot Cell with the appropriate PPE to further assess the situation, perform surveys and take samples, and, if possible, mitigate problems that could compound the hazards in the area. Based on the results of the evaluation, a determination will be made by the RCRA Emergency Coordinator, with input from the cognizant managers, radiological control personnel, and ALARA Committee representatives whether to implement the Contingency Plan and to determine the appropriate course of action to recover from the event. An action response plan to decontaminate and recover affected areas and equipment, together with an RWP establishing the radiological controls required for the recovery will be developed and approved.

Should a breach of a RH TRU mixed waste container occur in the Hot Cell that results in removable contamination exceeding the small area “spot” decontamination levels, the affected container(s) (e.g., breached and contaminated) will be placed into a canister and processed for disposal. The decontamination of equipment, cleanup of spilled material and the overpacking of contaminated/damaged waste containers will be performed in the vicinity of the incident. For example, under normal operations RH TRU mixed waste in 55-gallon drums will be handled only in the Hot Cell. Therefore, it is within this area that decontamination and/or overpacking operations would occur. By eliminating the transport of contaminated equipment to other areas for decontamination or overpacking, the risk of spreading contamination is reduced. Contaminated materials for the cleanup and overpacking of a breached RH TRU mixed waste container may be managed as CH TRU mixed waste, depending on the surface dose rate.
Equipment used during a spill cleanup or RH TRU mixed waste overpacking operation could include: cloths, brushes, scoops, absorbents, squeegees, tape, bags, pails, slings, hand tools, and other equipment as needed for a given incident.

The decontamination methods may initially involve wiping down structures, equipment, and other containers in the area with absorbent cloths moistened with tepid water. Surveys of these structures will take place and the need to continue decontamination activities will be established. If further decontamination is required, nonhazardous decontaminating agents, such as Liquinox®, Simple Green®, Windex®, citric acid, Bartlett Strip Coat®, and high pressure CO₂ will be used to prevent generating CH TRU mixed waste.

RWPs and other administrative controls provide protective measures to help ensure that new hazardous constituents will not be added during decontamination activities.

Certain structures and/or equipment within the Hot Cell may be disassembled to facilitate decontamination or may be placed directly into a derived waste container. Items used in the spill cleanup and decontamination operations (e.g., swipes, tools, PPE, etc.) may also be placed into a derived waste container.

When decontamination of the Hot Cell is deemed by the recovery team to be complete, RC personnel will conduct one final, intensive radcon survey of the area and components in the area to release it for continued use. The free release criteria for items and equipment that will be released for uncontrolled use are < 20 dpm/100 cm² for alpha radioactivity and < 200 dpm/100 cm² for beta-gamma radioactivity. Personnel will then perform hazardous material sampling after decontamination efforts are complete to confirm the removal of hazardous waste substances. After cleanup is complete, facility personnel will complete an inspection and include the details of the spill and cleanup in the log. The recovery phase must be completed before the affected area and/or equipment are returned to service.

**D-4d(7) Natural Emergencies**

After a natural emergency (earthquake, flood, lightning strike, etc.) that involves hazardous waste or hazardous materials, the FSM will ensure the following actions are taken:

1. Inspect containers which have not been disposed and containment for signs of leakage or damage. Inspect areas where containers are stored looking for leaking containers and for deterioration of containers and the containment system.

2. Inspect affected equipment or areas associated with hazardous waste management activities for proper operating mode in accordance with site procedures and manually check to ensure automatic and alarmed features on the units are working.

3. Inspect affected equipment or areas within the HWMUs in accordance with site procedures for damage.

4. Inspect electrical boards and overhead electrical lines for damage.

5. Check container areas for signs of leakage or damage to drums and containers.
6. Check affected buildings and fencing directly related to hazardous waste management activities for damage.

7. Conduct a general survey of the site looking for signs of land movement, etc.

8. Take any necessary corrective measures, however temporary, to rectify potential or real problems.

9. Record inspection results.

D-4d(8) Roof Fall

Roof fall is not expected to affect RH TRU mixed waste because it is emplaced in the rib of the disposal room and not subject to impact from a roof fall. The following incident description and mitigation apply to CH TRU mixed waste.

The WIPP underground is routinely evaluated for stability and safety of the underground openings. These evaluations can be as simple as the MSHA required visual checks by personnel working in the area or as extensive as the expert review of the roof support system for Room 1 Panel 1 conducted in 1991. An in-depth evaluation of all of the accessible underground is performed on an annual basis as part of the formal ground control operating plans. Weekly visual and sounding inspections are performed by the Permittees. More frequent inspections and evaluations are performed in areas where roof or ribs are in need of evaluations, based on visual observations, analysis of rock deformation data, excavation effects program data acquired from observation holes, and support system performance.

This process applies not only to the waste disposal rooms but to the entire WIPP underground. Prior to waste emplacement, stability of each room will be evaluated. This evaluation will concentrate on the age and current performance of the installed support systems (if any) and the rate of roof beam expansion based on data from installed instrumentation. The roof support system's performance and surety, to provide the support necessary for the required time will be addressed. Criteria used will include design parameters such as the amount of load, the deformation of the installed system, and the number and type of component failures observed, if any. Geotechnical criteria will include parameters such as the type and quantity of fracturing, roof beam expansion rates, and future ground performance based on a predictive model.

Should the evaluation results indicate that remedial actions are necessary prior to placement of waste, experiences at the WIPP indicate that rebolting or installing supplemental support can extend the safe life of a room for several years.

After waste emplacement commences, geomechanical monitoring will continue with monitors that are tied into a computer network program. The readings obtained will provide information needed for the roof beam stability assessment. Visual observations of the ground and the support systems will also continue in all accessible areas. Based on the experiences from the Site and Preliminary Design Validation test rooms, it has been proven that any developing instability will be detected through monitoring. Multiple measures to deal with the observed conditions can be implemented months before an event to mitigate any risk associated with a roof fall in the storage room or any affected area within the mine. At a minimum, the affected area will be isolated and withdrawn from ventilation flow. Isolation operations will utilize current available methods, materials, and equipment.
Ground control conditions which could result in a fall can be divided into two scenarios: The first consists of spalling (falling) of individual small and localized rock falling on waste containers. By definition, they can be considered insignificant as no damage to the drums can occur. The second consists of an entire section of roof falling on multiple stacks of waste containers. Each of these scenarios is discussed below.

**Spalling-of-Ground Scenario**

The maximum distance between the room roof and a container of waste is 10 ft. Waste containers are designed to withstand impact loads of at least 1,000 pounds (lbs) dropped from a height of 6 ft. flat or 450 lbs dropped on a circumferential edge from a height of 4 ft. Both of which correspond to an allowable impact stress of 25,450 pounds per square inch (psi). Rocks from spalling are small and would not be of sufficient weight when striking a drum from a 10 ft vertical height to cause an impact stress of more than 25,450 psi. Taking into account the falling distance, average weight, and the typical shape of the salt rock, the conclusion is that puncturing a drum by spalling is non-credible.

**Fall-of-Ground Scenario**

Fall-of-ground occurs when a large section of roof beam falls onto the waste containers. As previously discussed, the possibility of this occurring in an active room is remote, due to continuous monitoring and engineered roof support systems.

The following actions have been developed and will be taken by the RCRA Emergency Coordinator should a rock fall occur in an active waste emplacement area of the repository:

**Spalling-of-Ground Actions**

1. Determine whether the roof conditions allow for safe entry and if the waste container or containers in question are accessible.

The process used to determine if a roof condition of a room will allow for safe entry is the same as the ground control inspection process used for inspection of the ground conditions and roof bolt integrity. The inspection will begin at a safe and sound roof starting point and consist of visual inspections of roof bolts, roof, and rib areas for missing or damaged bolts; deformed roof bolt plates; or roof and rib cracks, fractures, or separations. If during the visual inspection suspicious roof bolts, roof, or ribs are found, then operators will proceed with sounding the area in question with a scaling bar for loose roof bolts, bad roof, or ribs (loose roof bolts will not ring when sounded). Bad roof or ribs will have a drummy, hollow, or un-solid sound when struck with the scaling bar. When this operation is performed, a safe avenue for retreat is always maintained. Also maintained is a position such that an unexpected event will not place personnel in a position where the scaling bar or material being scaled could fall on personnel. If the inspection reveals ground that cannot be safely scaled manually or with the available mining equipment, the affected area, up to and including the entire room, will be barricaded and removed from ventilation flow.

The criteria used to determine whether a waste container is accessible is based on the location of the container, the amount of waste in the room, and the expense of
reaching the waste container safely versus the expense of abandonment of the room. For example, if the room is 95% filled and spalling-of-ground punctured a waste container at or near the exit of the room, the decision to isolate the room and move waste emplacement activities to the next room would be prudent.

2. Restrict access in ventilation flow path downstream of the incident.

3. Restrict ventilation to the affected room to ensure that there is no spread of contamination that may have been released. Survey for contamination and establish the boundaries.

4. Inspect accessible and affected containers and containment for signs of leakage or damage.

5. Cover the spill area with material such as plastic or fabric sheets or paint, in a way that would safely isolate the area.

6. Determine if the covered spill area safely allows for continued waste disposal operations or whether further cleanup is required. If further cleanup is required, provide with cleanup methods described below. Note: Cleaning may not be required since this is the permitted disposal area.

7. Inspect any affected equipment (vehicles, handling equipment, and communication and alarm equipment) for proper function.

8. Repackage spilled waste and repackage, plug, or patch breached waste containers into 55 or 85-gallon drums, SWBs, or TDOPs, depending on volume. Temporarily locate overpack waste containers in an adjacent room. Remove only those intact waste containers necessary to clear the area for decontamination.

9. At the underground emplacement room, salt contaminated by a spill of TRU mixed waste will be covered with materials such as salt, plastic or fabric sheets or PVA to isolate it from the workers or removed and packaged as site derived waste in accordance with site procedures for decontaminating surfaces.

10. Manage the radioactive debris as derived waste.

11. Characterize containers of waste based on the waste containers that were damaged.

12. Replace the removed and derived waste containers into the waste stack as appropriate and update the WWIS.


**Fall-of-Ground Actions**

1. Restrict access in ventilation flow path downstream of the incident.

2. Restrict the room from ventilation flow by closing bulkhead regulators.
3. Survey for radiological contamination and establish the boundary for a Radiological Buffer Area.

4. Install barricade devices to remove access.

5. At the underground emplacement room, salt contaminated by a spill of TRU mixed waste will be covered with materials such as salt, plastic or fabric sheets, or PVA to isolate it from the worker or removed and packaged as site derived waste using damp rags, hand tools, and HEPA filtered vacuums.

   The criteria used to determine whether to close the entire panel or just the affected room of waste containers would include the location of the roof fall and the stability of the unaffected roof area in the panel. Techniques to determine the stability would be the same as previously described in this section.

D-4d(9) Structural Integrity Emergencies

In the event of a WIPP facility emergency involving underground structural integrity, the situation will be handled as a natural emergency. Monitoring and inspection procedures ensure the safety and integrity of the WIPP facility underground.

D-4d(10) Emergency Termination Procedures

For the transition from emergency phase to cleanup phase, the following items will be complete:

- Emergency scene will be stable
- Release of hazardous substance will be stopped
- Reaction of hazardous substance will be controlled
- The released hazardous substance will be contained within a localized and manageable area
- The area of contamination will be adequately secure from unauthorized entry

At every incident involving hazardous materials, there is a possibility that response personnel and their equipment will become contaminated. Emergency response personnel have procedures to minimize contamination or contact, and to properly dispose of contaminated materials.

For nonemergencies and Incident Level I emergencies, the following methods of decontamination are available for personnel, environment, and/or equipment according to emergency response procedures:

- Absorption
- Adsorption
- Chemical degradation
- Dilution
- Disposal
• Isolation
• Neutralization
• Solidification

Any necessary verification of air, soil, or water samples will be directed by the RCRA Emergency Coordinator. Immediately after an emergency, the RCRA Emergency Coordinator will provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility in accordance with standard operating procedures.

For Level II and III incidents after the emergency itself is controlled and contained, the RCRA Emergency Coordinator will be responsible for the development and implementation of an incident-specific decontamination plan.

PPE will be decontaminated or disposed according to procedure before it is returned to its storage location.

As part of the facility’s defense-in-depth approach, equipment will be assumed to be contaminated after each hazardous material response and a thorough check for radioactive contamination will be conducted. If contamination is found, a technically sound decontamination process will be followed. Many types of equipment are difficult to decontaminate and may have to be discarded as hazardous or derived waste. Whenever possible, pieces of equipment will be disposable or made of nonporous material.

If radioactive contamination is detected on equipment or on structures, it will be assumed that hazardous constituents may also be present. Radiological surveys to determine whether a potential release of hazardous constituents has occurred (Permit Attachment I3) will be used along with other techniques as a detection method to determine when decontamination is required. Radiological cleanup standards will be used to determine the effectiveness of decontamination efforts. To provide verification of the effectiveness of the removal of hazardous waste constituents, once a contaminated surface is demonstrated to be radiologically clean, the “swipe” can be sent for analysis for hazardous constituents. The use of these confirmation analyses is as follows:

For waste containers, the analyses become documentation of the condition of the container at the time of emplacement. These containers will be placed in the underground without further action, once the radiological contamination is removed, unless there is visible evidence of hazardous waste spills or hazardous waste on the container and this contamination is considered likely to be released prior to emplacement in the underground. In no case shall these containers contain a total liquid content equal to, or which exceeds, one volume percent of the container.

For area contamination, once the area is cleaned up and is shown to be radiologically clean, it will be sampled for the presence of hazardous waste residues. If the area is large, a sampling plan will be developed. The sampling plan will be approved by the NMED before it is implemented. If the area is small, swipes will be used. If the results of the analysis show that residual contamination remains, a decision will be made whether further cleaning will be beneficial or whether final clean up will be deferred until closure. Appropriate notations will be entered into the operating record to assure proper consideration of formerly contaminated areas at the time of closure. Furthermore,
measures such as covering, barricading, and/or placarding will be used as needed to mark areas that remain contaminated.

For all Contingency Plan emergency responses, the RCRA Emergency Coordinator will ensure, in keeping with standard operating procedures, that, in the affected area(s) of the facility:

- No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed
- All emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use, or replaced before operations are resumed

D-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases

During an emergency, the RCRA Emergency Coordinator will ensure that reasonable measures are taken so that fires, explosions, and releases do not occur, recur, or spread to TRU mixed waste or other hazardous materials at the facility, as required under 20.4.1.500 NMAC (incorporating 40 CFR §§264.56(e) and (f)). These measures include:

- Stopping processes and operations.
- Collecting and containing released wastes and materials.
- Removing or isolating containers of waste or hazardous substances posing a threat.
- Ensuring that wastes managed during an emergency are handled, stored, or treated with due consideration for compatibility with other wastes and materials on site and with containers utilized (Section D-4h).
- Restricting personnel not needed for response activities from the scene of the incident.
- Evacuating the area.
- Curtailing nonessential activities in the area.
- Conducting preliminary inspections of adjacent facilities and equipment to assess damage.
- Overpacking and/or removing damaged containers/drums from affected areas. Damaged equipment and facilities will be repaired as appropriate.
- Constructing, monitoring, and reinforcing temporary dikes as needed.
- Maintaining fire equipment on standby at the incident site in cases where ignitable liquids have been or may be released and ensuring that all ignition sources are kept out of the area. Ignitable liquids will be segregated, contained, confined, diluted, or otherwise controlled to preclude inadvertent explosion or detonation.
No operation that has been shut down in response to the incident will be restarted until
authorized by the RCRA Emergency Coordinator. Sections D-4g, Incompatible Waste, and D-
4h, Post-Emergency Facility and Equipment Maintenance and Reporting, address specific
issues related to decreasing the possibility of a recurrence or spread of a release, a fire, or an
explosion.

After resolution of the incident, a Root Cause Analysis will be conducted to review all Level II
and Level III incidents for determination of cause, and the corrective action plan to prevent
recurrence.

D-4f Management and Containment of Released Material and Waste

Once initial release or spill containment has been completed, the RCRA Emergency
Coordinator will ensure that recovered hazardous materials and waste are properly stored
and/or disposed, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.56(g)). For spills
of liquid, the perimeter of the spill will be diked with an absorbent material that is compatible with
the material(s) released. Free-standing liquid will be transferred to a marked compatible
container. The remaining liquid will be absorbed with an absorbent material and swept or
scooped into a marked compatible container. Spill residue will be removed. Spills of dry material
will be swept or shoveled into a labeled compatible recovery container. Material recovered from
the spill will be transferred to clean containers or tanks or to containers or tanks that have held a
compatible material. All containers will meet DOT specifications for shipping the wastes, and
materials will be recovered.

Nonradioactive hazardous waste resulting from the cleanup of a fire, an explosion, or a release
involving a nonradioactive hazardous waste or hazardous substance at the WIPP facility will be
contained and managed as a hazardous waste until such time as the waste is disposed of, or
determined to be nonhazardous, as defined in 20.4.1.200 NMAC (incorporating 40 CFR §261)
Subparts C and D. In most cases, hazardous materials inventories for the various buildings and
areas at the facility will allow a determination of the hazardous materials present in any cleanup
of a release or of the residues from an emergency condition (The quantities of such spills are so
small, it is not likely to trigger an Incident Level II or III). When necessary samples of the waste
will be collected and analyzed to determine the presence of any hazardous characteristics
and/or hazardous waste constituents; this information is needed to evaluate disposal options.
EPA-approved sampling and analytical methods will be utilized. Hazardous wastes will be
transferred to the Hazardous Waste Staging Area. The staging area is used to store hazardous
waste awaiting transfer to an off-site treatment or disposal facility in accordance with applicable
regulations (e.g., 20.4.1 NMAC and DOT regulations). The Hazardous Waste Staging Area for
nonradioactive hazardous waste is Buildings 474A and 474B, as shown in Figure D-1.
Nonradioactive hazardous wastes will be shipped off-site for disposal at a RCRA permitted
disposal facility.

Under normal operations, administrative controls will be implemented to ensure that hazardous
materials and incompatible materials will not be introduced to the radioactive materials area
during TRU mixed waste handling operations. Examples of administrative controls include
restricting the waste received in the TRU mixed waste management area(s) to TRU mixed
waste properly manifested from the generator sites and ensuring that materials used in these
area(s) are restricted to only those that have previously been determined to be compatible with
the TRU mixed waste. The RCRA Emergency Coordinator will have access to building design
information and information on specific equipment used within an area upon which to base a
determination of the compatibility of materials with the area. If necessary, the RCRA Emergency Coordinator will use EPA-600/2-80-076, “A Method for Determining the Compatibility of Hazardous Waste,” (EPA, 1980) for making compatibility determinations. Waste resulting from the cleanup of a fire, explosion, or release in the miscellaneous unit, the CH TRU mixed waste handling areas, or the RH Complex will be considered derived from the received TRU mixed waste and may be treated and managed as CH TRU mixed waste depending on the surface dose rate.

In the event of a prolonged cessation of TRU mixed waste handling operations, TRU mixed waste can be placed in areas of the WHB Unit that are available for such contingencies. These areas and the TRU mixed waste containers in them would be located so that adequate aisle space would be maintained for unobstructed movement of personnel and equipment in an emergency. Permit Attachments A1 and A2 describe the HWMUs in detail, including the facility description, support structures and equipment, security, waste handling areas, ventilation, and fire protection.

The contaminated area will be decontaminated. If a release is to a permeable surface, such as soil, asphalt, concrete, or other surface, the surface material will be removed and placed in containers meeting applicable DOT requirements. Contaminated soil, asphalt, concrete, or other surface material, as well as materials used in the cleanup (e.g., rags and absorbent material) will be contained and disposed of in the same manner as dictated for the contaminant. Clean soil, new asphalt, or new concrete will be emplaced at the spill location.

If a spill occurs on an impermeable surface, the surface will be decontaminated with water and/or a detergent. In the event that the spilled material is water reactive, a compatible nonhazardous cleaning solution will be used. Contaminated wash water or cleaning solution will be transferred to an appropriate container, marked, and managed as described above for nonradioactive or radioactive liquid wastes.

In the event of a hazardous material or hazardous waste release, the RCRA Emergency Coordinator will ensure that no wastes will be received or disposed of in the affected areas until cleanup operations have been completed. This is to ensure that incompatible waste will not be present in the vicinity of the release.

Because of the restrictions which the WIPP facility places on generators, and because of control of WIPP operations, TRU mixed wastes and derived wastes will not contain any incompatible wastes. However, the areas established for the temporary holding of nonradioactive waste routinely generated at the WIPP facility is divided into bays to accommodate the management of wastes that may be incompatible. If waste is generated as the result of a spill or release of hazardous materials or nonradioactive hazardous waste, the waste generated as a result of abatement and cleanup will be evaluated to determine its compatibility with other wastes being managed in the temporary holding areas. The evaluation will be by identifying the material or waste that was spilled or released and determining its characteristics (e.g., ignitable, reactive, corrosive, or toxic). The waste generated by the abatement and cleanup activities will be stored in that part of the temporary holding area that has been established to manage wastes with which it is compatible.

For small nonemergency liquid spills (e.g., a detergent solution leaking out of the pump handle during decontamination, a spill of hydraulic fluid while servicing a vehicle), spill control procedures will be used to contain and absorb free-standing liquid. The contaminated absorbent
will be swept or shoveled into a compatible container and managed as described above. No
notifications will be required, but site procedures require documentation of the incident.

**D-4g Incompatible Waste**

Implementation of the TSDF-WAC for the WIPP ensures that incompatible TRU mixed waste
will not be shipped to the WIPP facility. Nonradioactive waste at the WIPP facility will be
carefully segregated during handling and holding and will be transported within and off the
facility. The RCRA Emergency Coordinator will not allow hazardous or TRU mixed waste
operations to resume in a building or area in which incompatible materials have been released
prior to completion of necessary post-emergency cleanup operations to remove potentially
incompatible materials. In making the determination of compatibility, the RCRA Emergency
Coordinator will have available the resources and information described in Section D-4b,
Identification of Hazardous Materials. In addition, ES&H department personnel will be available
for consultation. Finally, the RCRA Emergency Coordinator may use EPA-600/2-80-076, (EPA,
1980).

**D-4h Post-Emergency Facility and Equipment Maintenance and Reporting**

The RCRA Emergency Coordinator will ensure that emergency equipment that is located or
used in the affected area(s) of the facility and listed in the Contingency Plan is cleaned and
ready for its intended use before operations are resumed, as specified in 20.4.1.500 NMAC
(incorporating 40 CFR §264.56(h)(2)). Any equipment that cannot be decontaminated will be
discarded as waste (e.g., hazardous, mixed, solid), as appropriate. The WIPP facility is
committed to replacing any needed equipment or supplies that cannot be reused following an
emergency. After the equipment has been cleaned, repaired, or replaced, a post-emergency
facility and equipment inspection will be performed, and the results will be documented.

Cleaning and decontaminating equipment will be accomplished by physically removing gross or
solid residue; rinsing with water or another suitable liquid, if required; and/or washing with
detergent and water. Decontamination and cleaning will be conducted in a confined area, such
as a wash pad or building equipped with a floor drain and sump isolated from the environment.
Care will be taken to prevent wind dispersion of particles and spray. Liquid or particulate
resulting from cleaning and decontamination of equipment will be placed in clean, compatible
containers. Waste produced in an emergency cleanup in the TRU mixed waste handling areas
is derived waste and will be emplaced in the underground derived waste emplacement area.
Waste resulting from decontamination operations elsewhere in the WIPP facility will be analyzed
for hazardous waste constituents and/or hazardous waste characteristics to ensure proper
management.

When the WIPP facility has completed post-emergency cleanup of waste and hazardous
residues from areas where waste management operations are ready to resume and the RCRA
Emergency Coordinator has ensured that emergency equipment used in managing the
emergency has been cleaned or replaced and is fit for service, the notifications will be made by
the Permittees to the following: the EPA Region VI Administrator; the Secretary of the NMED;
and any relevant local authorities. This post-emergency notification complies with 20.4.1.500
NMAC (incorporating 40 CFR §264.56(i)), and is the responsibility of the RCRA Emergency
Coordinator.
D-4i Container Spills and Leakage

The waste received at the WIPP facility will meet stringent TSDF-WAC (e.g., no more than one percent liquid), which will minimize the possibility of waste container degradation and liquid spills. Should a spill or release occur from a container, following an initial assessment of the event, the WIPP facility will immediately take the following actions, in compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.52(a) and §264.171):

- Assemble the required response equipment, such as protective clothing and gear, heavy equipment, empty drums, overpack drums, and hand tools
- Transfer the released material to a container that is in good condition or overpack the leaking container into another container that is in good condition
- Once the release has been contained, determine the areal extent of migration of the release and proceed with appropriate cleanup action, such as chemical neutralization, vacuuming, or excavation

D-4j Tank Spills and Leakage

The TRU mixed waste handling areas at the WIPP facility do not include tank storage or treatment of hazardous waste, as defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and as regulated under 20.4.1.500 NMAC (incorporating 40 CFR §264) Subpart J. At the WIPP facility, tanks are used to store water and petroleum fuels only. The petroleum tanks store diesel and unleaded gasoline.

D-4k Surface Impoundment Spills and Leakage

The WIPP facility does not manage hazardous or TRU mixed waste using a surface impoundment, as defined in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), and as regulated under 20.4.1.500 NMAC (incorporating 40 CFR §264) Subpart K. Surface impoundment regulations are not applicable to the WIPP facility.

D-5 Emergency Equipment

A variety of equipment is available at the facility for emergency response, containment, and cleanup operations in both the HWMUs and the facility in general. This includes equipment for spill control, fire control, personnel protection, monitoring, first aid and medical attention, communications, and alarms. This equipment is immediately available to emergency response personnel. A listing of major emergency equipment available at the WIPP facility, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.52(e)), is shown in Table D-6. Table D-7 identifies the locations where fire suppression systems are provided. Locations of the underground emergency equipment are shown in Figure D-5. The firewater-distribution system map is shown in Figure D-6. The underground fuel area fire-protection system is shown in Figure D-7.

D-6 Coordination Agreements

The Permittees have established MOUs with off-site emergency response agencies for firefighting, medical assistance, hazardous materials response, and law enforcement. In the
event that on-site response resources are unable to provide all the needed response actions
during either a medical, fire, hazardous materials, or security emergency, the RCRA Emergency
Coordinator will notify appropriate off-site response agencies and request assistance. Once on
site, off-site emergency response agency personnel will be under the direction of the RCRA
Emergency Coordinator.

The MOUs with off-site cooperating agencies are available from the Permittees. A listing and
description of the MOUs with state and local agencies and mining operations in the vicinity of
the WIPP facility, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.37 and
§264.52(c)), are:

- An agreement among the Permittees, Intrepid Potash NM LLC, and Mosaic Potash
  Carlsbad Inc., provides for the mutual aid and assistance, in the form of MRTs, in the
  event of a mine disaster or other circumstance at either of the two facilities. This
  provision ensures that the WIPP MOC will have two MRTs available at all times when
  miners are underground.

- A memorandum of agreement between the City of Carlsbad, New Mexico, and the
  WIPP MOC for ambulance service assistance provides that, upon notification by the
  WIPP MOC, the Carlsbad Fire Department/Ambulance Service will be dispatched from
  Carlsbad toward the WIPP site by a designated route and will accept the transfer of
  patient(s) being transported by the WIPP facility ambulance at the point both
  ambulances meet. If the patient(s) is not transferrable, the Carlsbad Fire
  Department/Ambulance Service will provide equipment and personnel to the WIPP
  facility ambulance, as necessary.

- A MOU between the DOE and the Carlsbad Medical Center provides for the treatment
  of radiologically contaminated personnel who have incurred injuries beyond the
  treatment capabilities at the WIPP facility. The DOE will provide transport of the
  patient(s) to the Carlsbad Medical Center for decontamination and medical treatment.

- A MOU between the DOE and the Lea Regional Medical Center provides for the
  treatment of radiologically contaminated personnel who have incurred injuries beyond
  the treatment capabilities at the WIPP facility. The DOE will provide transport of the
  patient(s) to the Lea Regional Medical Center for decontamination and medical
  treatment.

- A MOU between the DOE and the U.S. Department of Interior (DOI), represented by
  the Bureau of Land Management (BLM), Roswell District, provides for a fire-
  management program that will ensure a timely, well-coordinated, and cost-effective
  response to suppress wild fire within the withdrawal area using the WIPP incident
  commander for fire-management activities. The DOI will provide firefighting support if
  requested. In addition, the MOU provides for responsibilities concerning cultural
  resources, grazing, wildlife, mining, gas and oil production, realty/lands/rights-of-way,
  and reclamation.

- A mutual-aid firefighting agreement between the Eddy County Commission and the
  DOE provides for the assistance of the Otis and Joel Fire Departments (a volunteer
  fire district created under the Eddy County Commission and the New Mexico State Fire
Marshall’s Office), including equipment and personnel, at any location within the WIPP Fire Protection Area upon request by an authorized representative of the WIPP Project. These responsibilities are reciprocal.

- A mutual-aid agreement between the City of Hobbs and the DOE provides for mutual ambulance, medical, fire, rescue, and hazardous material response services; provides for joint annual exercises; provides for use of WIPP facility radio frequencies by the City of Hobbs during emergencies; and provides for mutual security and law enforcement services, within the appropriate jurisdiction limits of each party.

- A mutual-aid agreement between the City of Carlsbad and the DOE provides for mutual ambulance, medical, fire, rescue, and hazardous material response services; provides for joint annual exercises; provides for use of WIPP facility radio frequencies by the City of Carlsbad during emergencies; and provides for mutual security and law enforcement services, within the appropriate jurisdiction limits of each party.

- A MOU between the DOE and the New Mexico Department of Public Safety (DPS) concerning Mutual Assistance and Emergency Management applies to any actual or potential emergency or incident that: 1) involves a significant threat to employees of the Permittees or general public; 2) involves property under the control or jurisdiction of either the DOE or the State; 3) involves a threat to the environment which is reportable to an off-site agency; 4) requires the combined resources of the DOE and the state; 5) requires a resource that the DOE has which the State does not have, or a resource the State has which DOE does not have; or 6) involves any other incident for which a joint determination has been made by the DOE and the State that the provisions of this MOU will apply. The MOU provides that the DPS shall permit qualified and security cleared DOE Emergency Management members into the State EOC for the purpose of: a) coordinating communications functions; b) evaluating and maintaining communications capabilities; c) participating in exercises; d) link the State’s High Frequency radio communications network with the DOE; and e) assisting the State during radioactive materials accidents that require joint operations or the use of the DOE Radiological Assistance Program team. The DOE shall permit qualified and security cleared members the State Emergency Management community into the DOE’s EOCs for the purposes of coordinating communications and activities. Additional duties for each participant are specified for assistance in incidents or emergencies.

D-7 Evacuation Plan

If it becomes necessary to evacuate the WIPP facility, the assigned on-site and off-site staging areas have been established. The off-site staging areas are outside the security fence. The WIPP facility has implementation procedures for both surface and underground evacuations. Drills are performed on these procedures at the WIPP facility at least once annually. The following sections describe the evacuation plan for the WIPP facility, as required under 20.4.1.500 NMAC (incorporating 40 CFR §264.52(f)).

D-7a Surface Evacuation On-site and Off-site Staging Areas

Figure D-8 shows the surface staging areas. Personnel report to their Office Wardens at designated staging areas where accountability is conducted. If site evacuation is necessary, the
RCRA Emergency Coordinator will decide which staging areas are to be used and will advise Office Wardens of the selections. The RCRA Emergency Coordinator will communicate the locations to Office Wardens via office warden pager, radio, plectron, WIPP Security, or telephone, as appropriate. Office Wardens will direct personnel to the selected staging area outside the security fence. Personnel who are working in a contaminated area when site evacuation is announced, will assemble at specific staging areas to minimize contact with other personnel during the evacuation (Figure D-8).

Office Wardens conduct accountability of personnel assigned to their specific areas. For complete surface accountability, the Office Wardens report to their ACOW, who reports to the COW. When the COW has reports from all ACOWs, surface accountability is reported to the CMRO, who then notifies the RCRA Emergency Coordinator of the accountability.

The COW and all ACOWs communicate between themselves and the CMRO using devices (e.g., telephones, radios, pagers, the public address system, email, Internet). The Office Wardens, Assistant Office Wardens, ACOWs, and COW are notified by a public address announcement (or other devices) in accordance with emergency response procedures for evacuation or sheltering in place. At the staging areas Office Wardens report directly to their ACOW.

There are three off-site staging areas identified on Figure D-8. The RCRA Emergency Coordinator determines which staging area will be used. Security officers remain at the primary staging area gate 24 hours a day, and the vehicle trap is opened for personnel during emergency evacuations. The north gate has a single person gate and large gate which can be opened, similar to the main gates for the primary staging area. The east gate is a turnstile gate. Upon notification by the RCRA Emergency Coordinator, Security will respond, open gates, and facilitate egress for evacuation.

The on-site staging areas are identified in Figure D-8. These are used for building or area evacuations as determined by the RCRA Emergency Coordinator.

D-7b Underground Assembly Areas and Egress Hoist Stations

In the event of an underground or surface event, the RCRA Emergency Coordinator can call for underground personnel to report to assembly areas (Figure D-9). Underground personnel are also trained to immediately report to assembly areas under specific circumstances (i.e. loss of underground power or ventilation). If accountability is required, the underground will be evacuated. The Underground Controller is responsible for underground accountability by comparing the brass numbers with the brass tags signed out in the lamproom. Each assembly area contains a Mine Page Phone, miner's aid station, and evacuation maps.

In accordance with 30 CFR §57.11, the mine maintains two escapeways. These escapeways are designated as Egress Hoist Stations. When an underground evacuation is called for, all underground personnel report to the Egress Hoist Stations.

Decontamination of underground personnel will be conducted the same way as described for surface decontamination. Contaminated personnel are trained to remain segregated from other personnel until RC personnel can respond to the incident at the underground location.
D-7c  Plan for Surface Evacuation

Surface evacuation notification is initiated by the RCRA Emergency Coordinator directing the CMRO to sound the surface evacuation alarm. The Office Wardens assist personnel in evacuation from their areas. Evacuation routes and instructions are posted throughout the site.

If the FSM/CMRO notifies the ERT members by a communication device (e.g., pager) to respond to an identified area, these members will not depart the site during an evacuation, but will report to the FSM for instructions and accountability. The EST/FPT notifies the COW of response members present. These personnel will not evacuate until released by the RCRA Emergency Coordinator.

D-7d  Plan for Underground Evacuation

Notification for underground evacuation will be made using the underground evacuation alarm and strobe light signals.

Personnel will evacuate to the nearest egress hoist station. Primary underground evacuation routes (identified by green reflectors on the rib) will be used, if possible. Secondary underground evacuation routes (identified by red reflectors on the rib) will be used if necessary (Figure D-5). Brass tags will be collected from personnel at the hoist collar on the surface, and taken to the Underground Controller, who functions as an Office Warden. When all brass tags are accounted for, underground accountability is reported to the RCRA Emergency Coordinator.

Upon reaching the surface, personnel will report to their on-site staging area to receive further instructions.

Members of the FLIRT and the MRT who may be underground, will evacuate the underground when an underground evacuation is called for. A reentry by the MRT will be performed according to 30 CFR 49 and MSHA regulations for reentry into a mine. The two MRTs are trained in compliance with 30 CFR 49 in mine mapping, mine gases, ventilation, exploration, mine fires, rescue, and recovery.

D-7e  Further Site Evacuation

In the event of an evacuation involving the need to transport employees, the following transportation will be available:

- Buses/vans—WIPP facility buses/vans will be available for evacuation of personnel. The buses/vans are stationed in the employee parking lot.

- Privately Owned Vehicles—Because many employees drive to work in their own vehicles, these vehicles may be utilized in an emergency. Personnel may be directed as to routes to be taken when leaving the facility.

These vehicles may be used to transport personnel who have been released from the site by the RCRA Emergency Coordinator.
D-8 Required Reports

The RCRA Emergency Coordinator, on behalf of the Permittees, will note in the operating record the time, date, and details of any incident that requires implementing this Contingency Plan. This notation will be in the facility log maintained by the CMRO. In compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.56(j)), within 15 days after the incident, the Permittees will ensure that a written report on the incident will be submitted to the EPA Region VI Administrator and to the Secretary of the NMED. The report will include:

- The name, address, and telephone number of the Owner/Operator
- The name, address, and telephone number of the facility
- The date, time, and type of incident (e.g., fire, explosion or release)
- The name and quantity of material(s) involved
- The extent of injuries, if any
- An assessment of actual or potential hazards to human health or the environment, where this is applicable
- The estimated quantity and disposition of recovered material that resulted from the incident

In addition to the above report, the Permittees will ensure that the ES&H Manager, or designee, submits reports to the appropriate agencies as listed in Tables D-8 and D-9.

In accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.56(i)), the Permittees will notify the Secretary of the NMED and EPA Region VI Administrator that the WIPP facility is in compliance with requirements for the cleanup of areas affected by the emergency and that emergency equipment used in the emergency response has been cleaned, repaired, or replaced and is fit for its intended use prior to the resumption of waste management operations in affected areas. The means the WIPP facility will use to meet these requirements are described in Sections D-4e, D-4f, D-4g, and D-4h.

The WIPP requires the EST/FPT to initiate the “WIPP Hazardous Materials Incident Report” if the Contingency Plan is implemented. A form is attached as Figure D-12. The form is initiated by the EST/FPT. The RCRA Emergency Coordinator, CMRO, and Environmental Compliance representatives complete their respective sections.

D-9 Location of the Contingency Plan and Plan Revision

The owner/operator of the WIPP facility will ensure that copies of this Contingency Plan are available to all emergency personnel and organizations described in Section D-2. When the Contingency Plan is revised, updated copies are manually distributed (electronically or via site mail) or hand delivered to applicable WIPP Facility emergency personnel and alternate Emergency Operations Center and Joint Information Center. In addition, the owner/operator will make copies available to the following outside agencies:
• Intrepid Potash NM LLC and Mosaic Potash Carlsbad Inc.
• Carlsbad Fire Department, Carlsbad
• Carlsbad Medical Center, Carlsbad
• Lea Regional Medical Center, Hobbs
• Otis Fire Department, Otis
• Hobbs Fire Department, Hobbs
• Joel Fire Department, Carlsbad
• BLM, Carlsbad
• New Mexico State Police

The owner/operator of the WIPP facility will ensure that this plan is reviewed annually and amended whenever:

• Applicable regulations are revised
• The RCRA Part B permit for the WIPP facility is revised in any way that would affect the Contingency Plan
• This plan fails in an emergency
• The WIPP facility design, construction, operation, maintenance, or other circumstances change in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous constituents or change the response necessary in an emergency
• The list of RCRA Emergency Coordinators change
• The list of WIPP facility emergency equipment changes.
References


11
### Table D-1

Hazardous Substances in Large Enough Quantities to Constitute a Level II Incident

<table>
<thead>
<tr>
<th>Chemical Description</th>
<th>Building Location</th>
<th>Hazard Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene Glycol Solution - 35%</td>
<td>Buildings 411; 412; 451; 452; 486; 463; 474C; FAC 414</td>
<td>Immediate (acute) Delayed (chronic)</td>
</tr>
<tr>
<td>Gasoline, Unleaded GASC0001</td>
<td>FAC 480</td>
<td>Fire Immediate (acute) Delayed (chronic)</td>
</tr>
<tr>
<td>No. 1 Diesel Fuel Oil GASC0210</td>
<td>U/G Fuel Station; Oil Depot U/G; FACs 480, 255.1 &amp; 255.2; Transport Tank; Building 456</td>
<td>Fire Immediate (acute) Delayed (chronic)</td>
</tr>
<tr>
<td>Multiple containers of TRU Waste as described in Permit Section 3.3.1</td>
<td>WHB Waste Shaft U/G</td>
<td>Delayed (chronic)</td>
</tr>
<tr>
<td>Hazardous materials in quantities that exceed 5 times the Reportable Quantity (Per DOE O 151.1) values as defined in 40 CFR 302</td>
<td>It should be noted that WIPP is not expected to possess such quantities. Fire</td>
<td>Immediate (acute) Delayed (chronic)</td>
</tr>
<tr>
<td>Name</td>
<td>Address*</td>
<td>Office Phone</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>R. C. (Russ) Stroble (primary)&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>234-8276 or 234-8554</td>
</tr>
<tr>
<td>J. E. (Joseph) Bealler&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>234-8276 or 234-8916</td>
</tr>
<tr>
<td>M. G. (Mike) Proctor&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>234-8276 or 234-8143</td>
</tr>
<tr>
<td>G. L. (Gary) Kessler&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. E. (Alvy) Williams&lt;sup&gt;1&lt;/sup&gt; (primary)</td>
<td></td>
<td>234-8276 or 234-8216</td>
</tr>
<tr>
<td>P. J. (Paul) Paneral&lt;sup&gt;1&lt;/sup&gt; (primary)</td>
<td></td>
<td>234-8498</td>
</tr>
<tr>
<td>J. R. (Joel) Howard&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>234-8325</td>
</tr>
<tr>
<td>M. L. (Mark) Long&lt;sup&gt;1&lt;/sup&gt; (primary)</td>
<td></td>
<td>234-8170</td>
</tr>
<tr>
<td>A.C (Andy) Cooper&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>234-8197</td>
</tr>
</tbody>
</table>

* NOTE: Personal information (home addresses and personal phone numbers) has been removed from informational copies of this Permit.

<sup>1</sup> The on-duty Facility Shift Manager is the primary RCRA Emergency Coordinator pursuant to 20.4.1.500 NMAC (incorporating 40 CFR §264.52), and is designated to serve as the RCRA Emergency Coordinator.

<sup>2</sup> The on-duty Facility Operations Engineer is the alternate RCRA Emergency Coordinator and is available as needed.
### Table D-3
Planning Guide for Determining Incident Levels and Response

<table>
<thead>
<tr>
<th>Incident Condition</th>
<th>Incident Level</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II *</td>
<td>III *</td>
</tr>
<tr>
<td><strong>Product identifications</strong></td>
<td>Placard not required, NFPA 0 or 1 all categories, all Other Regulated Materials A, B, C, and D.</td>
<td>DOT placarded, NFPA 2 for any categories, PCBs without fire, EPA regulated waste. SITE SPECIFIC: Table D-1 and TRU mixed waste AND</td>
<td>Poison A (gas), explosive A/B, organic peroxide, flammable, solid, materials dangerous when wet, chlorine, fluorine, anhydrous ammonia, radioactive materials, NFPA 3 and 4 for any categories including special hazards, PCBs and fire including special hazards, PCBs and fireDOT inhalation hazard, EPA extremely hazardous substances, and cryogenics.</td>
</tr>
<tr>
<td><strong>Container size</strong></td>
<td>Container size does not impact this incident level.</td>
<td>Involves multiple packages.</td>
<td>Tank truck.</td>
</tr>
<tr>
<td><strong>Fire/explosion potential</strong></td>
<td>Under control.</td>
<td>May spread/may be explosive.</td>
<td>May spread/may be explosive.</td>
</tr>
<tr>
<td><strong>Leak severity</strong></td>
<td>No release or small release contained or confined with readily available resources.</td>
<td>Release may not be controllable without special resources.</td>
<td>Release may not be controllable even with special resources.</td>
</tr>
<tr>
<td><strong>Life safety</strong></td>
<td>No life-threatening situation from materials involved.</td>
<td>Localized area, limited evacuation area.</td>
<td>Localized area, limited evacuation area.</td>
</tr>
<tr>
<td><strong>Environmental impact (Potential)</strong></td>
<td>None.</td>
<td>Limited to incident boundaries</td>
<td>Contained within the Hazardous waste Management Units.</td>
</tr>
<tr>
<td><strong>Container integrity</strong></td>
<td>Not damaged.</td>
<td>Damaged but able to contain the contents to allow handling or transfer of product.</td>
<td>Damaged to such an extent that catastrophic rupture is possible.</td>
</tr>
</tbody>
</table>

* Contingency Plan is implemented
### Table D-4
Physical Methods of Mitigation

<table>
<thead>
<tr>
<th>Method</th>
<th>Chemical</th>
<th></th>
<th>Radiological</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Liquid</td>
<td>Solid</td>
<td>Liquid</td>
<td>Solid</td>
</tr>
<tr>
<td>Absorption</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Covering</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dikes, diversions</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Overpack</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Plug/patch</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transfer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Vapor suppression</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table D-5
Chemical Methods of Mitigation

<table>
<thead>
<tr>
<th>Method</th>
<th>Chemical</th>
<th>Radiological</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Liquid</td>
<td>Solid</td>
</tr>
<tr>
<td>Neutralization</td>
<td>Yes</td>
<td>Yes(^{(1)})</td>
</tr>
<tr>
<td>Solidification</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

(1) When solid neutralizing agents are used, they will be used simultaneously with water.

(2) This method could be utilized for mitigation of firewater involving TRU-waste.
Table D-6
Emergency Equipment Maintained at the Waste Isolation Pilot Plant

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description and Capabilities</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Fire Alarms</td>
<td>Manual pull stations and automatic devices (sprinkler system flow, and smoke and thermal detectors) trigger fire alarm; locally visible and audible; visual display and alarm in Central Monitoring Room (CMR)</td>
<td>Guard and Security Building, Pumphouse, Warehouse/Shops, Exhaust Filter Building, Support Building, CMR/ Computer Room, Waste Handling Building, TRUPACT Maintenance Facility, SH Hoisthouse, Maintenance Shops, Guard Shack*, Auxiliary Warehouse, Core Storage Building, Engineering Building, Training Facility, Safety Building, Maintenance Shop, Hazardous Waste Storage (non-TRU) Area (Facility 474)</td>
</tr>
<tr>
<td>Underground Fire Alarms</td>
<td>Automatic/Manual; have priority over other paging channel signals but not override intercom channels; alarms sound in the general area of the control panel and are connected to the underground evacuation alarms; they also interface with the CMR.</td>
<td>Fire detection and control panel locations: Waste Shaft Underground Station, SH Shaft Underground Station, Between E-140 and E-300 in S-2180 Drift, E-O/N-1200, Fuel Station</td>
</tr>
<tr>
<td>Site-wide Evacuation Alarm</td>
<td>Transmitted over paging channel of the public address system, overriding its normal use; manually initiated according to procedures requiring evacuation; audible alarm produced by tone generator at 10 decibels above ambient noise level (or at least 75 decibels); flashing strobe lights; radios and/or pagers are used to notify facility personnel outside alarm range. Monthly test are performed on the PA, site notification alarms, and plectrons.</td>
<td>Site-wide</td>
</tr>
<tr>
<td>Vehicle Siren</td>
<td>Manual; oscillating; emergency services/surface response vehicles, is mechanical and electronic.</td>
<td>WIPP surface emergency vehicles</td>
</tr>
<tr>
<td>Public Address System</td>
<td>Includes intercom phones; handset stations and loudspeaker assemblies, each with own amplifiers; multichannel, one for public address and pages, and others for independent party lines.</td>
<td>Surface and underground</td>
</tr>
<tr>
<td>Intraplant Phones</td>
<td>Private automatic branch exchange; direct dial; provide communication link between surface and underground operations</td>
<td>Throughout surface and underground</td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Mine Page Phones</td>
<td>Battery-operated paging system</td>
<td>CMR, Mine Rescue Room, EOC, lamproom, underground at S550/W30, S100/W30, S1950/E140, SH Shaft Collar and Underground Station, Waste Shaft Collar and Underground Station, FSM desk, EST Station</td>
</tr>
<tr>
<td>Emergency Pagers</td>
<td>Manual; intermittent alarm signals</td>
<td>Issued to appropriate emergency personnel</td>
</tr>
<tr>
<td>Plectrons</td>
<td>Tone-alert radio receivers placed in areas not accessible by the public address system</td>
<td>Site-wide</td>
</tr>
<tr>
<td>Portable Radios</td>
<td>Two-way, portable; transmits and monitors information to/from other transmitters</td>
<td>Issued to individuals</td>
</tr>
<tr>
<td>Plant Base Radios</td>
<td>Two-way, stationary, VHF-FM; linked to Eddy County Sheriff Department, NM State Police, and Otis Fire Department, and WIPP Channels 1-18 (Communication with the Lea County Sheriff's Department, the Hobbs Fire Department, Carlsbad Medical Center and Lea Regional Hospital is available via the Eddy County dispatcher) (Site Security, Site Operations and Site Emergency, maintenance, repeater to Carlsbad). Wireless communications such as cellular phones may be used to contact the Eddy County emergency responders.</td>
<td>Various site locations</td>
</tr>
<tr>
<td>Mobile Phones</td>
<td>Provide communications link between WIPP Security and key personnel</td>
<td>Issued to individuals plus emergency vehicles,</td>
</tr>
</tbody>
</table>

**Spill Response**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description and Capabilities</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPILL-X-S Guns and Recharge Powder</td>
<td>Containment; (1)SPILL-X model SC-30-C(Gun) (1)SPILL-X model XC-30-S(Gun) (1)SPILL-X model SC-30-A(Gun); (1) A-Acid, 5 gallon bucket (Recharge Powder) (1)S-Solvent, 5 gallon bucket (Recharge Powder) (1)C-Caustic, 5 gallon bucket (Recharge Powder)</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Absorbent Sheets</td>
<td>Containment or cleanup; (1) 3’ x 100’ Sheet</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Absorbents</td>
<td>Grab and Go container; spill control bucket; (1) for solvents and neutralizing absorbents; 5 gallon bucket (1) for acids/caustics; 5 gallon bucket</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Absorbent Material</td>
<td>Containment or cleanup; (1) 100 ft. rolled or equivalent socks “Pig” for general liquid (1) 100 ft. rolled or equivalent socks “Pig” for oil</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Air Bag System</td>
<td>Extrication, Stabilization, Cribbing</td>
<td>Surface rescue truck</td>
</tr>
<tr>
<td></td>
<td>(1) bag system with tank kit and the following bag sizes:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) 12-ton, (1) 21.8-ton, (1) 17-ton</td>
<td></td>
</tr>
<tr>
<td>Air Chisel</td>
<td>Extrication</td>
<td>Surface rescue truck</td>
</tr>
<tr>
<td></td>
<td>(1) Capable of cutting 3/16” steel</td>
<td></td>
</tr>
<tr>
<td>Drum Transfer, Pumps and Drum Opener</td>
<td>Containment or cleanup;</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td></td>
<td>(1) unit for chemical transfer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) hand operated pump for petroleum transfer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) drum opener</td>
<td></td>
</tr>
<tr>
<td>Floor Squeegee</td>
<td>Containment or cleanup;</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td></td>
<td>(1) straight rubber blade, nonwood handle</td>
<td></td>
</tr>
<tr>
<td>Foam Concentrate</td>
<td>AFFF 6%</td>
<td>Fire truck # 1</td>
</tr>
<tr>
<td></td>
<td>(4) 5-gallon pail</td>
<td></td>
</tr>
<tr>
<td>Gas Cylinder Leak Control Kit</td>
<td>(1) Series A Hazardous Material Response Kit; contains nonsparking equipment to control and plug leaks</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Portable Generator</td>
<td>(1) Backup power; 5,000 watt; 120 or 240 volt</td>
<td>Surface rescue truck</td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Hand Tools</td>
<td>Containment and cleanup;</td>
<td>Underground rescue truck, HAZMAT trailer</td>
</tr>
<tr>
<td></td>
<td>Underground rescue truck:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)12# Sledge Hammer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)3/8&quot; Drive Socket Set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)½&quot; Drive Socket Set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)3/4&quot; Drive Socket Set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)25' ½&quot; Chain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)6' Wrecking Bar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)Bottle Jack</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)4# Hammer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)18&quot; Crescent Wrench</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)5' Pry Bar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)2' Pry Bar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)100' Extension Cord</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)4' Nylon Sling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)6' Nylon Sling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)10' Nylon Sling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>These tools are located in the HAZMAT Trailer. They are non-sparking.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)14&quot;L adjustable pipe wrench</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)15&quot; multi-opening bung wrench</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)hammer/crate opener</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)8&quot; pipe pliers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)8&quot; blade Phillips</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)#2 screwdriver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)6&quot; blade standard screwdriver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)Claw Hammer</td>
<td></td>
</tr>
<tr>
<td>Come-a-longs</td>
<td>(1) 4-ton; cable-type Ratchet lever tool designed specifically for lifting, lowering and pulling applications including jobs requiring rigging, positioning, and stretching. Used in rescue for extrication.</td>
<td>Surface rescue truck and underground rescue truck</td>
</tr>
<tr>
<td>Porta-power</td>
<td>(1) 10-ton hydraulic, hand-powered jaws used for extrication during rescues.</td>
<td>Surface rescue truck</td>
</tr>
<tr>
<td>Jugs</td>
<td>Containment or cleanup;</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td></td>
<td>(4) 1-gallon plastic</td>
<td></td>
</tr>
<tr>
<td>Pails</td>
<td>Containment or cleanup;</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td></td>
<td>(3) 5-gallon plastic</td>
<td></td>
</tr>
<tr>
<td>Portable Lighting</td>
<td>(1) Emergency lighting system; 120 volts; 500-watt bulbs, suitable for wet location</td>
<td>Underground rescue truck</td>
</tr>
<tr>
<td>Patching Kit</td>
<td>Series A Hazardous Response Kit; Class A; contains nonsparking equipment to control and plug leaks.</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Scoops and Shovels</td>
<td>Cleanup; plastic; various sizes; nonsparking; nonwood handles</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td></td>
<td>(1) Scoop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3) Shovels</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Medical Resources</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambulance #1</td>
<td>Equipped as per Federal Specifications KKK-A-1822 and New Mexico Emergency Medical Services Act General Order 35; equipped with a radio to Carlsbad Medical Center, VHF radio, UHF medical frequency, cellular phone</td>
<td>Surface (Safety and Emergency Services Facility)</td>
</tr>
<tr>
<td>Ambulance #2</td>
<td>Diesel and/or electric ambulance equipped with first aid kit, 2 stretchers, and other associated medical supplies</td>
<td>Underground</td>
</tr>
<tr>
<td>Rescue Truck</td>
<td>Special purpose vehicle; light and heavy duty rescue equipment; transports 1 litter patient, medical oxygen and supplies for mass casualties, fire suppression support equipment (rescue tool, air bag, K-12 Rescue Saw, 5,000-watt generator, self-contained breathing apparatus (SCBA), and much more equipment</td>
<td>Surface (Safety and Emergency Services Facility)</td>
</tr>
<tr>
<td><strong>Fire Detection and Fire Suppression Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Smoke, Thermal Detectors, or Manual Pull Stations</td>
<td>Ionization and photoelectric or fixed temperature/rate of rise detectors; visual display and alarm in CMR; manual pull stations. The underground has manual fire alarm pull stations located where personnel have access when evacuating. These are connected to the U/G evacuation alarm.</td>
<td>Guard and Security Building, Warehouse/Shops, Support Building, CMR/Computer Room, Waste Handling Building, TRUPACT Maintenance Facility, Waste Shaft Collar, Underground Fuel Station, SH Hoisthouse, Engineering Building, Industrial Safety Building, Training Facility</td>
</tr>
<tr>
<td>Fire Truck # 1</td>
<td>Equipped per Class “A” fire truck per NFPA; capacity 750 gallons, with pump capacity of 1200 gallons per minute</td>
<td>Surface (Safety and Emergency Services Facility)</td>
</tr>
<tr>
<td>Rescue Truck # 2 (U/G)</td>
<td>(1) 125-pound dry chemical extinguisher (1) 150-pound foam extinguisher</td>
<td>Underground</td>
</tr>
<tr>
<td>Extinguishers</td>
<td>Individual fire extinguisher stations; various types located throughout the facility, conforming to NFPA-10.</td>
<td>Buildings, underground, and underground vehicles</td>
</tr>
<tr>
<td>Automatic Dry Chemical Extinguishing Systems</td>
<td>Automatic; 1,000-pound system (Dry Chemical); actuated by thermal detectors or by manual pull stations</td>
<td>Underground fuel station</td>
</tr>
<tr>
<td>Sprinkler Systems</td>
<td>Fire alarms activated by water flow</td>
<td>Pumphouse, Guard and Security Building, Support Building, Waste Handling Building (contact- transuranic waste area only), Warehouse/Shops Building, Auxiliary Warehouse Building, TRUPACT Maintenance Facility, Training Facility, SH Shaft Hoisthouse, Exhaust Filter Building, Engineering Building, and Safety Building</td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Water Tanks, Hydrants</td>
<td>Fire suppression water supply; one 180,000-gallon capacity tank, plus a second tank with 100,000 gallon reserve</td>
<td>Tanks are at southwestern edge of WIPP facility; pipelines and hydrants are throughout the surface</td>
</tr>
<tr>
<td>Fire Water Pumps</td>
<td>Fire suppression water supply; pumps are rated at 125 pounds per square inch, 1,500 gallons per minute centrifugal pump, one with electric motor drive, the other with diesel engine; pressure maintenance pump</td>
<td>Pumphouse</td>
</tr>
<tr>
<td>Headlamps</td>
<td>Mounted on hard hat; battery operated</td>
<td>Each person underground</td>
</tr>
<tr>
<td>Underground Self-Rescuer Units</td>
<td>Short-term rebreathers; approximately 300</td>
<td>Each person underground</td>
</tr>
<tr>
<td>Self-Contained Self-Rescuer</td>
<td>At least 60 minutes of oxygen available. Approximately 400 units cached throughout the underground</td>
<td>Cached throughout the underground</td>
</tr>
<tr>
<td>Self-Contained Breathing Apparatus (SCBA)</td>
<td>Oxygen supply; 4-hour units; approximately 14 Mine Rescue Team Draeger units</td>
<td>Mine Rescue Training Room</td>
</tr>
<tr>
<td>Chemical and Chemical-Supported Gloves</td>
<td>Body protection; (12 pair) inner-cloth, (12 pair) outer-pvc, (5 pair) outer-viton</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Suit, Acid</td>
<td>Body protection; (4) acid</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Suit, Fully Encapsulated</td>
<td>Body protection; used with SCBAs; full outerboot; (4) Level A; (4) Level B</td>
<td>HAZMAT trailer</td>
</tr>
<tr>
<td>Antishock Trousers</td>
<td>Shock treatment; (2) inflatable, one on each ambulance</td>
<td>Ambulance # 1 and # 2</td>
</tr>
<tr>
<td>Heart Monitor and Defibrillator</td>
<td>Heart Monitor/defibrillator</td>
<td>Ambulance # 1 and # 2</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Patient care; Size D: (2) Ambulance #1 (1) Underground Ambulance (1) Health Services Size E: (1) Rescue Truck (2) Underground Ambulance Size M: (1) Ambulance #1</td>
<td>Ambulance # 1 and # 2, surface rescue truck</td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Resuscitators (Bag)</td>
<td>Disposable bag resuscitation</td>
<td>Ambulance # 1, Ambulance # 2</td>
</tr>
<tr>
<td></td>
<td>Ambulance #1:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) adult size</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) child size</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Underground Ambulance:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) adult size</td>
<td></td>
</tr>
<tr>
<td>Splints</td>
<td>Immobilize limbs;</td>
<td>Ambulance # 1 and # 2, Miner's Aid Stations</td>
</tr>
<tr>
<td></td>
<td>(1) Adult traction splint, lower extremity, with limb-supporting slings, padded ankle hitch and traction device per ambulance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Rigid splinting devices or equivalents, suitable for immobilization of upper extremities per ambulance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Rigid splinting devices or equivalents, suitable for the immobilization of lower extremities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Set of Airsplints:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 assorted splints; hand/wrist, half arm, full arm, foot/ankle, half leg, and full leg per miner's aid stations.</td>
<td></td>
</tr>
<tr>
<td>Stretchers</td>
<td>Patient transport;</td>
<td>Various combinations in Ambulance # 1 and # 2, Miner's Aid Station</td>
</tr>
<tr>
<td></td>
<td>(2) Spine Boards, one short and one long, with nylon straps per ambulance. (also used to perform cardiopulmonary resuscitation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) Emergency Stretchers or scoops, or combination per ambulance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) All-purpose multi-level ambulance stretch (gurney), with 3 safety straps and locking mechanism per ambulance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Stretcher in each miner's aid station.</td>
<td></td>
</tr>
<tr>
<td>Suctions</td>
<td>For medical emergencies:</td>
<td>Ambulances #1 and #2</td>
</tr>
<tr>
<td></td>
<td>Portable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) Suction unit, capable of delivering at least 300 mm. HG on each ambulance.</td>
<td></td>
</tr>
<tr>
<td>Trauma Kits</td>
<td>(1) adult blood pressure cuff and stethoscope</td>
<td>(1) kit in each: Ambulances #1 and #2, surface rescue truck</td>
</tr>
<tr>
<td></td>
<td>(4) soft-roller bandages</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3) triangular bandages</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) pkg. band-aids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) trauma dressings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(25) 4X4 sponges</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) roll adhesive tape</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) bite stick</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) penlight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) sterile burn sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) oropharyngeal airway</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1) glucose substance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2) sterile gauze dressings</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Description and Capabilities</td>
<td>Location</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Miner's Aid Station</td>
<td>For First Aid Stations in the Underground (1) Stretcher--as referenced above per station (1) Set of air splints--as referenced above per station (1) Blanket per station (1) Box of latex gloves (50) per station (5) Pathogen Wipes per station (1) First Aid Kit (24) per station; includes, (3) Band-Aid Combo Pak (2) Swabs, PVP (1) Antibiotic Ointment (1) Sting-Kill Swab (2) Dressing, compresses (2) Roller Bandages (2) Tape (2) Triangle Bandage (1) Eyedressing Pak (1) Burn Dressing (1) Ammonia Inhalants (1) User Log Sheet</td>
<td>Miner's Aid Stations - Various Underground Locations</td>
</tr>
<tr>
<td>First Aid Supplies</td>
<td>According to General Order #35 (12) bandages, soft roller, self-adhering type--4&quot; or 6&quot; x 5 yards. (6) triangular bandages, 40&quot; (1) box band-aids (1) 1 pair bandage shears (6) Trauma dressings, 30&quot; x 10&quot; (6) Trauma dressings, 5&quot; x 7&quot; (50) 4&quot; x 4&quot; sponges, individually wrapped and sterile (2) rolls adhesive tape (1) penlight (2) sterile burn sheets (2) oropharyngeal airways -- adult (2) oropharyngeal airways -- child (Ambulance #1 only) (2) oropharyngeal airways -- infant (Ambulance #1 only) (1) Glucose substance (3) Occlusive dressings (1) Roll aluminum foil (6) Rigid cervical collars--2 each small, medium and large sizes (4) Cold packs (4) Heat packs (2) Bite sticks</td>
<td>Ambulance #1</td>
</tr>
<tr>
<td>First Aid Supplies</td>
<td>(2) Transfer sheets (2) Blankets</td>
<td>Ambulances #1 and #2</td>
</tr>
</tbody>
</table>

Waste Isolation Pilot Plant
DRAFT Hazardous Waste Permit
February 2014
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description and Capabilities</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Aid Supplies</td>
<td>(2) #16g angiosets\n(2) #18g angiosets\n(2) #20g angiosets\n(1) 1000cc LR IV fluid\n(1) 500cc NS IV fluid</td>
<td>Ambulances #1 and #2,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>surface rescue truck</td>
</tr>
<tr>
<td>General Plant Emergency Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Lighting</td>
<td>For employee rescue and evacuation, and fire/spill containment; linked to main power supply, and selectively linked to back up diesel power supply and/or battery-backed power supply</td>
<td>Surface and underground</td>
</tr>
<tr>
<td>Backup Power Sources</td>
<td>Two diesel generators, and battery-powered uninterruptible power supply (UPS); use limited to essential loads; manual or remote starting 1,100-kilowatt diesel generators with on-site fuel for 62% load for 3 days for selected loads; 30-minute battery capacity for essential loads</td>
<td>Generators are east of Safety and Emergency Services Building; UPS is located at the essential loads</td>
</tr>
<tr>
<td>Hoists</td>
<td>Hoists in Waste Shaft, Air Intake Shaft, and SH Shaft</td>
<td>Waste Shaft, Air Intake Shaft, SH Shaft</td>
</tr>
<tr>
<td>Radiation Monitoring Equipment</td>
<td>(5) Portable alpha and beta survey meters, portable air samplers, and portable continuous air monitors</td>
<td>Building 412</td>
</tr>
<tr>
<td>Emergency Shower</td>
<td>For emergency flushing of chemical contact or injury</td>
<td>Surface</td>
</tr>
<tr>
<td>Eye Wash Fountains</td>
<td>For emergency flushing of affected eyes</td>
<td>Various locations on surface and in the underground</td>
</tr>
<tr>
<td>Decon Shower Equipment</td>
<td>Self-contained decon shower trailer, portable decon shower unit</td>
<td>Surface</td>
</tr>
<tr>
<td>Overpack containers</td>
<td>14-85 Gallon drums\n4-SWBs\n1-TDOP</td>
<td>Building 481</td>
</tr>
<tr>
<td>HEPA Vacuums</td>
<td>2 HEPA Vacuums to be utilized for removal of contamination.</td>
<td>Building 481</td>
</tr>
<tr>
<td>Aquaset or Cement</td>
<td>100 lbs. of aquaset or cement material for solidification of liquid waste generated as a result of fire fighting water or decontamination solutions.</td>
<td>Building 481</td>
</tr>
<tr>
<td>Paint or Fixative</td>
<td>1 - 5 gallon bucket of approved fixative to be used during recovery.</td>
<td>Building 481</td>
</tr>
<tr>
<td>TDOP Upender</td>
<td>Upender facilitates overpacking standard waste boxes</td>
<td>Building 481</td>
</tr>
<tr>
<td>Non hazardous Decontaminating Agents</td>
<td>4-1 Gallon bottles for decontamination of surfaces, equipment, and personnel</td>
<td>Building 481</td>
</tr>
</tbody>
</table>
### Table D-7
Types of Fire Suppression Systems by Location

<table>
<thead>
<tr>
<th>Location</th>
<th>AS</th>
<th>AD</th>
<th>MPS</th>
<th>PFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Handling Building</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support Building</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust Filter Building</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Pumphouse</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Underground Support Areas</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(also has rescue truck)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(as illustrated in Figure D-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station A Effluent Monitoring Shed</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Station B Effluent Monitoring Shed</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

(1) Symbols for WIPP fire-protection systems:
- **AS** = Automatic Wet Pipe Sprinkler System
- **AD** = Automatic Dry Chemical Extinguishing System
- **MPS** = Manual Pull Stations
- **PFE** = Portable Fire Extinguishers

(2) The Waste Handling Building and the Support Building contain the following:
- Automatic wet pipe sprinklers
- Fire detection in the heating, ventilation, and air conditioning instrumentation (Support Building, only)
- Manual pull stations
- Portable fire extinguishers
- Automatic detectors

The Safety and Emergency Services Building contains the following:
- Automatic wet pipe sprinklers
- Manual pull stations
- Portable fire extinguishers
- Automatic detectors

The Core Storage Building contains the following:
- Automatic wet pipe sprinklers
- Portable fire extinguishers

(3) The Exhaust Filter Building, Underground Facilities, Warehouse/Shops Building, Water Pumphouse, and Salt Handling Hoist house also have portable fire extinguishers, manual pull stations, and automatic detectors.
<table>
<thead>
<tr>
<th>Statute</th>
<th>Chemical Releases Covered</th>
<th>To Whom Report Will Be Made</th>
<th>What Will Be Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) (40 CFR Part 302)</td>
<td>“Reportable quantities” of CERCLA/SARA “hazardous substances.”</td>
<td>National Response Center: (800) 424-8802, State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (575) 885-3581</td>
<td>1) Chemical identification; 2) what hazardous substance; 3) quantity released; 4) time, location and duration of release; 5) media of release; 6) health risks and medical advice; 7) proper precautions (e.g., evacuation); and 8) name and phone number of reporter and facility. As soon as practicable, update of oral notice and response action taken. Send report to: New Mexico State Emergency Response Commission, Department of Public Safety, Title III Bureau, P.O. Box 1628, Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 324 S. Canyon Street, Suite B, Carlsbad, New Mexico 88220. National Response Center will contact the U.S. Environmental Protection Agency (EPA). EPA may request a written report.</td>
</tr>
<tr>
<td>Emergency Planning and Community Right-to-Know Act (SARA Title III) (40 CFR Parts 302 and 355)</td>
<td>SARA Title III “extremely hazardous substances.”</td>
<td>National Response Center: (800) 424-8802, State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (575) 885-3581.</td>
<td>1) Chemical identification; 2) what extremely hazardous substance; 3) quantity released; 4) time, location and duration of release; 5) media of release; 6) health risks and medical advice; 7) proper precautions (e.g., evacuation); and 8) name and phone number of reporter and facility. As soon as practicable, update of oral notice and response action taken. Send report to: New Mexico State Emergency Response Commission, Department of Public Safety, Title III Bureau, P.O. Box 1628, Santa Fe, New Mexico, 87504-1628, and Local Emergency Planning Committee, 324 S. Canyon Street, Suite B, Carlsbad, New Mexico 88220. National Response Center will contact the U.S. Environmental Protection Agency (EPA) for an address if a written report is requested by EPA.</td>
</tr>
<tr>
<td>Resource Conservation and Recovery Act (RCRA), 40 CFR §§264.56(a) and 265.56(a)</td>
<td>Any imminent or actual emergency situation.</td>
<td>State or local agencies with designated response roles, if their help is needed: Carlsbad Police Department: 885-2111; Carlsbad Fire Department: 885-2111; Eddy County Sheriff: 887-7551.</td>
<td>What assistance is required. Not Applicable (NA)</td>
</tr>
<tr>
<td>Statute</td>
<td>Chemical Releases Covered</td>
<td>To Whom Report Will Be Made</td>
<td>What Will Be Reported</td>
</tr>
<tr>
<td>---------</td>
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<td>-----------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>RCRA, 40 CFR §§264.56(d), 264.56(i), 265.56(d), and 265.56(i)</td>
<td>RCRA “hazardous waste” release, fire, or explosion, which could threaten human health or environment outside the facility.</td>
<td>National Response Center: (800) 424-8802 and State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response).</td>
<td>(1) Name and telephone number of reporter; (2) name and telephone number of facility; (3) time and type of incident; (4) name and quantity of materials involved; (5) extent of injuries, if any; and (6) possible health or environmental hazards outside the facility. Prior to resumption of operations, notify that: (1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and (2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.</td>
</tr>
<tr>
<td>RCRA, 40 CFR §§264.56(i), 264.56(j), 265.56(i), and 265.56(j)</td>
<td>Any incident which triggers implementation of Contingency Plan.</td>
<td>New Mexico Environment Department, Emergency Response Office, 24-hour telephone: (505) 827-9329 (emergencies); for non-emergencies contact (866) 428-6535 (24 hour voice mail) or Monday to Friday, 8 am to 5 pm: (505) 476-6000.</td>
<td>NA Within 15 days: 1) name, address and telephone number of owner/operator; 2) name, address and telephone number of facility; 3) date, time and type of incident (e.g. fire, explosion); 4) name and quantity of materials involved; 5) extent of injuries, if any; 6) possible hazards to human health or the environment; 7) estimated quantity of material that resulted from the incident. Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.</td>
</tr>
</tbody>
</table>
### Table D-9
Hazardous Release Reporting, State of New Mexico

<table>
<thead>
<tr>
<th>Regulations</th>
<th>Chemical Releases Covered</th>
<th>To Whom Report Will Be Made</th>
<th>What Will Be Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.4.1.500 and 600 NMAC</td>
<td>RCRA &quot;hazardous waste&quot; releases, fire, or explosion, which could threaten human health or environment outside the facility.</td>
<td>National Response Center: (800) 424-8802; State Emergency Response Commission and (505) 476-9620 (New Mexico State Police, Hazardous Materials Emergency Response)</td>
<td>1) Name and telephone number of reporter; 2) name and telephone number of facility; 3) time and type of incident; 4) name and quantity of material involved; 5) extent of injuries, if any; and 6) possible health or environmental hazards outside the facility.</td>
</tr>
<tr>
<td>20.4.1.500 and .600 NMAC</td>
<td>Any incident which triggers implementation of Contingency Plan.</td>
<td>New Mexico Environment Department, Emergency Response Office, 24-hour telephone: (505) 827-9329 (emergencies); for non-emergencies contact (866) 428-6535 (24 hour voice mail) or Monday to Friday, 8 am to 5 pm: (505) 476-6000,</td>
<td>1) Name and telephone number of reporter; 2) name and address of facility; 3) name and quantity of materials involved, to extent known; 4) extent of injuries, if any; and 5) possible hazards to human health or the environment, outside the facility.</td>
</tr>
</tbody>
</table>

Prior to resumption of operations, notify that: 1) no waste that may be incompatible with released material is treated, stored, or disposed of until cleanup is complete, and 2) all emergency equipment listed in the Contingency Plan is cleaned and fit for its intended use. Send to Secretary, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.
<table>
<thead>
<tr>
<th>Regulations</th>
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<th>To Whom Report Will Be Made</th>
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</tr>
</thead>
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<tr>
<td>New Mexico Emergency Management Act, Section 74-4B-5</td>
<td>Any accident (spill) involving hazardous materials (including hazardous substances, radioactive substances, or a combination thereof) which may endanger human health or the environment.</td>
<td>New Mexico Environment Department: (505) 827-9329, State Emergency Response Commission: (505) 476-9681 (New Mexico State Police, Hazardous Materials Emergency Response), and Local Emergency Planning Committee: (575) 885-3581</td>
<td>1) Name, address and telephone number of owner or operator; 2) name, address and telephone number of facility; 3) date, time and type of incident; 4) name and quantity of material(s) involved; 5) extent of any injuries; 6) assessment of actual or potential threat to environment or human health; and 7) estimated quantity and disposition of recovered material.</td>
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<tr>
<td>New Mexico Water Quality Control Commission, Part 1, Section 203</td>
<td>Any discharge from any facility of oil or any other water contaminant in such quantities as may, with reasonable probability, injure or be detrimental to human health, animal or plant life, or property.</td>
<td>Chief, Ground Water Quality Bureau, New Mexico Environment Department, or his counterpart in any constituent agency delegated responsibility for enforcement of the rules as to any facility subject to such delegation (505) 827-2918.</td>
<td>Within 24 hours: 1) the name, address, and telephone number of the person or persons in charge of the facility; 2) the name, address, and telephone number of the owner/operator of the facility; 3) the date, time, location, and duration of the discharge; 4) the source and cause of the discharge; 5) a description of the discharge, including its chemical composition; and 6) the estimated volume of discharge, and immediate damage from the discharge. Submit within seven days: verification of the prior oral notification, also provide any appropriate additions or corrections to the information contained in the prior oral notification. Within 15 days: submit a written report describing any corrective actions taken and/or to be taken relative to the discharge. Send reports to Chief, Ground Water Quality Bureau, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico, 87502.</td>
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<td>Regulations</td>
<td>Chemical Releases Covered</td>
<td>To Whom Report Will Be Made</td>
<td>What Will Be Reported</td>
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<td>------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
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<td>New Mexico Underground Storage Tank Regulations-2</td>
<td>Any known or suspected release from an Underground Storage Tank (UST) system, any spill or any other emergency situation.</td>
<td>New Mexico Environment Department Petroleum Storage Tank Bureau (505) 984-1741.</td>
<td>Within 24 hours: 1) the name, address, and telephone number of the agent in charge of the site at which the UST system is located, as well as the owner/operator of the system; 2) the name and address of the site and the location of the UST system on that site; 3) the date, time, location, and duration of the spill, release, or suspected release; 4) the source and cause of the spill, release, or suspected release; 5) a description of the spill, release, or suspected release, including its chemical composition; 6) the estimated volume of the spill, release, or suspected release; and 7) action taken to mitigate immediate damage from the spill, release, or suspected release.</td>
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<td>Mail or deliver within seven days of the incident, a written notice describing the spill, release, or suspected release and any investigation or follow-up action taken or to be taken. Send reports to Petroleum Storage Tank Bureau, New Mexico Environment Department, 2044 Galisteo Street, Santa Fe, New Mexico, 87504.</td>
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Figure D-1
WIPP Surface Structures
### Figure D-1a

**Legend to Figure D-1**

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<td>#458</td>
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<td>MODULAR OFFICE COMPLEX</td>
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Figure D-2
Spatial View of the WIPP Facility
Figure D-2
Spatial View of the WIPP Facility
Figure D-3

WIPP Underground Facilities

DISPOSAL AREA
PANELS 1 THROUGH 10
(HAZARDOUS WASTE DISPOSAL UNITS)
Figure D-3
WIPP Underground Facilities
Figure D-4
Direction and Control Under Emergency Conditions in Which the Plan Has Been Implemented

* = THE FSM IS THE RECPA EMERGENCY COORDINATOR
Figure D-4a
WIPP Facility Emergency Notifications
Figure D-5
Underground Emergency Equipment Locations and Underground Evacuation Routes
Figure D-5
Underground Emergency Equipment Locations and Underground Evacuation Routes
Figure D-6
Fire-Water Distribution System
Figure D-7
Underground Diesel Fuel-Station Area Fire-Protection System
Figure D-8
WIPP On-Site Assembly Areas and WIPP Staging Areas
Figure D-8b
RH Bay Hot Cell Evacuation Route
Figure D-8c
Evacuation Routes in the Waste Handling Building
Figure D-9
Designated Underground Assembly Areas
Figure D-9
Designated Underground Assembly Areas
Pre-Fire Survey

1. Bldg. Name: WASTE HANDLING BUILDING
2. Address: 411 SITE
3. Occ. Type: MAINTENANCE AND OPERATIONS PERSONNEL
4. Map #: 411-1
5. Roof Const.: METAL
6. Floor Const.: CONCRETE
7. Date: 07/27/95
8. Revision Date: 02/16/97
10. Fire Hydrants: FH#8 N, FH#11 E, FH#12 S, FH#13 S, FH#411

Figure D-10
Waste Handling Building Pre-Fire Survey (First Floor)

PERMIT ATTACHMENT D
Page D-89 of 95
Figure D-10a
Waste Handling Building Pre-Fire Survey
(First Floor - Fire Hydrant/Post Indicator Location)
Figure D-11
Waste Handling Building Pre-Fire Survey (Second Floor)
Figure D-11a
Waste Handling Building Pre-Fire Survey
(Second Floor - Fire Hydrant/Post Indicator Location)
## WIPP HAZARDOUS MATERIAL INCIDENT REPORT

<table>
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<th>Date:</th>
<th>Location:</th>
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### I. INITIAL INFORMATION
- **DATE:**
- **TIME:**
- **EST:**
- **REPORTED LOCATION:**
- **REPORTED BY:**
  - **DEPT.:**
- **INITIALLY REPORTED TO:**
  - **DEPT.:**
- **RESPONSIBLE MANAGER:**
  - **DEPT.:**

### II. WEATHER CONDITIONS
- **WIND DIRECTION:**
- **WIND SPEED:** mph
- **TEMP.:** °F
- **CONDITIONS** (i.e., icy, snowing, raining, cloudy, sunny):

### III. TYPE OF INCIDENT (SPILL, LEAK, ETC.)
- **Fire involved:** [ ]YES [ ]NO
  - **Materials Involved:**
    - **UN/NA NO.**
    - **Quantity:**
    - **Hazard Class:**
    - **NFPA Class:**

### IV. PERSONNEL INVOLVED IN CLEAN-UP ACTIVITIES
- **Personnel/Dept.**
- **Decon Method/Medical Treatment:**

### V. PERSONNEL CONTAMINATED NOT INVOLVED IN THE CLEANUP ACTIVITIES
- **Personnel/Dept.**
- **Material Contacted**
- **Decon/Medical Treatment:**

---

**Figure D-12**

WIPP Hazardous Materials Incident Report, Page 1 of 3
### WIPP HAZARDOUS MATERIAL INCIDENT REPORT

**Date:** ____________  **Location:** ____________________

#### VI. EQUIPMENT USED FOR CLEAN-UP AND CONTROL MEASURES

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#### VII. DESCRIPTION OF INCIDENT AND RESPONSE (including containment and control)

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#### VIII. ENVIRONMENTAL COMPLIANCE

**Date:** ____________  **Time:** ____________________ of evaluation.

**Waste Category:** ____________  **Disposition:** ____________________

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**EC Representative:**

<table>
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# WIPP HAZARDOUS MATERIAL INCIDENT REPORT

## IX. INITIAL NOTIFICATION BY CMRO

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<td>EC</td>
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**CMRO:**
- Print name
- Signature
- Date

**FSM:**
- Print name
- Signature
- Date

## X. CONTINGENCY PLAN IMPLEMENTATION

Contingency Plan implemented [ ]YES [ ]NO

**FSM:**
- Print name
- Signature
- Date

## XI. REVIEWS

Report submitted by:
- Print name
- Signature
- Date

**Emergency Management Manager:**
- Print name
- Signature
- Date

**EC Manager:**
- Print name
- Signature
- Date

**COMMENTS:**
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
- [ ]
ATTACHMENT E

INSPECTION SCHEDULE, PROCESS AND FORMS
# ATTACHMENT E

## INSPECTION SCHEDULE, PROCESS AND FORMS

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
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<tr>
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<td>Inspection Schedule</td>
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<td>Typical Logbook Entry</td>
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<td>Table E-2</td>
<td>Monitoring Schedule</td>
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ATTACHMENT E

INSPECTION SCHEDULE, PROCESS AND FORMS

Introduction

This Permit Attachment describes the facility inspections (including container inspections) that are conducted to detect malfunctions, deterioration, operator errors, and discharges that may cause or lead to releases of hazardous waste or hazardous waste constituents to the environment or that could be a threat to human health.

E-1 Inspection Schedule

Equipment instrumental in preventing, detecting, or responding to environmental or human health hazards, such as monitoring equipment, safety and emergency equipment, security devices, and operating or structural equipment are inspected. The equipment will be inspected for malfunctions, deterioration, potential for operator errors, and discharges which could lead to a release of hazardous waste constituents to the environment or pose a threat to human health.

The WIPP facility has developed and will maintain a series of written procedures that include all the detailed inspection procedures and forms necessary to comply with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)), during the Disposal Phase. Tables E-1 and E-1a list each item or system requiring inspection under these regulations, the inspection frequency, the organization responsible for the inspection, the applicable inspection procedure, and what to look for during the inspection. 20.4.1.500 NMAC (incorporating 40 CFR §§264.15(b), 264.174, and 264.602) list requirements that are applicable to the WIPP facility.

Operational procedures detailing the inspections required under 20.4.1.500 NMAC (incorporating 40 CFR §§264.15(a) and (b)), are maintained in electronic format on the WIPP computer network, in the Operating Record and, as appropriate, in controlled document locations at the WIPP facility. Frequency of inspections is discussed in detail in Section E-1a(2). Inspections are conducted often enough to identify problems in time to correct them before they pose a threat to human health or the environment and are based on regulatory requirements. The operational procedures assign responsibility for conducting the inspection, the frequency of each inspection, the types of problems to be watched for, what to do if items fail inspection, directions on record keeping, and inspector signature, date, and time. The operational procedures are maintained at the WIPP facility. Tables E-1 and E-1a summarize inspections, frequencies, responsible organizations, personnel making the inspection (by job title), and the types of anticipated problems as well as the references for the operational procedures. Inspection records are maintained at the WIPP site for three years. Beginning with the effective date of this Permit, records that are over the three year retention period are either maintained at the WIPP site or transferred to the WIPP Records Archive located in Carlsbad, NM until closure. The records maintained at the WIPP Records Archive are stored in facilities that are temperature and humidity controlled especially for the long term storage of records and readily retrievable and available for inspection.

Waste handling equipment and area inspections are typically controlled through established procedures and the results are recorded in logbooks or on data sheets. Operators are trained to consult the logbook to identify the status of any piece of waste handling equipment prior to its
use. Once a piece of equipment is identified to be operable, a preoperational inspection is initiated in accordance with the appropriate inspection procedure in Tables E-1, E-1a, or in operational procedures. Inspection results as described below are entered in the applicable logbook.

Inspections include identifying malfunctions or deteriorating equipment and structures. Inspection results and data, including deficiencies, discrepancies, or needed repairs are recorded. A negative inspection result does not necessarily lead to a repair. A deficiency, such as low fluid level, may be corrected by the inspector immediately. A discrepancy, such as an increasing trend of a data point, may necessitate additional inspection prior to the next scheduled frequency. The actions taken (corrected, additional inspection, or Action Request (AR) for repair submitted) are recorded on the inspection form, the WIPP automated Maintenance Management tracking program (CHAMPS) work order sheet, or the equipment logbook, whichever is applicable.

Items that are operational with restrictions are tagged with those restrictions. Items that are not operational are tagged and locked to prevent their use. Tagged and locked items are listed on the Tagout/Lockout Index. Once a scheduled repair or replacement is accomplished in accordance with the work authorization procedures, the tag or lock is removed from the item in accordance with the equipment tagout/lockout procedures. Normally, the individual inspecting the equipment/system is not qualified to make repairs and consequently, prepares an AR if repairs are needed. The AR is tracked by the CHAMPS system through the work control process. When parts are received and work instructions are completed, the work order can be scheduled on the Plan of the Day (POD). The POD is held daily to ensure facility configuration can support scheduled work items and to allocate and coordinate the resources necessary to complete the items.

Work orders are released for work by the responsible organization. When repairs are complete the responsible organization tests the equipment to ensure the repairs corrected the problem, then closes out the work order, to return the equipment to an operational status for normal operations to resume. Implementation of these procedures constitutes compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(c)).

Requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.15(d)), are met by the inspections for each item or system included in Tables E-1 and E-1a. Beginning with the effective date of this Permit, the results of the inspections are maintained in the operating record for three years and are then transferred to the WIPP Records Archive where they are maintained until closure. The inspection logs or summary records include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions. Major pieces of waste handling equipment are inspected using proceduralized inspections. Current copies of inspection forms are maintained in the Operating Record. Non-administrative changes (i.e., changes that affect the frequency or content of inspections) to inspection forms must be submitted to the NMED in accordance with the appropriate portions of 20 NMAC 4.1.900 (incorporating 40 CFR §270.42). The status of these pieces of equipment is maintained in an equipment logbook that is separate from the checklist. The logbook contains information regarding the condition of the equipment. Equipment operators are required, by the inspection checklist, to consult the logbook as the first activity in the inspection procedure. This logbook is maintained in the operating record. CH transuranic (TRU) mixed waste equipment that is controlled by a logbook includes the waste handling forklifts, all waste handling cranes, the adjustable center of gravity lift fixture, the CH...
TRU underground transporter, the facility transfer vehicle, the trailer jockey, and the push-pull attachment. RH TRU mixed waste equipment that is controlled by a logbook includes the 140/25-ton RH Bay overhead bridge crane, cask transfer cars, 25-ton cask unloading room crane, transfer cell shuttle car, RH Bay cask lifting yoke, facility grapple, 6.2-ton overhead hoist, facility cask rotating device, hot cell overhead powered manipulator, 15-ton hot cell crane, facility cask transfer car, 41-ton forklift, facility cask, and emplacement equipment. Inspections of the Cask Unloading Room, Hot Cell, Transfer Cell, Facility Cask Loading Room, RH Bay and radiation monitoring equipment will be recorded on data sheets. In addition to the inspections listed in Tables E-1 and E-1a, many pieces of equipment are subject to regular preventive maintenance. This includes more in-depth inspections of mechanical systems, load testing of lifting systems, calibration of measurement equipment and other actions as recommended by the equipment manufacturer or as required by DOE Orders. These preventive maintenance activities along with the inspections in Tables E-1 and E-1a make mechanical failure of waste handling equipment unlikely. The WIPP Safety Analysis Report (DOE, 1999) and the WIPP Remote-Handled Waste Preliminary Safety Analysis Report (RH PSAR) (DOE, 2000) contain the results of a systematic analysis of waste handling equipment and the hazards associated with potential mechanical failures. Equipment subject to failures that cannot practically be mitigated is retained for analysis and is the basis for contingency planning. The inspection procedures maintained in the Operating Record for operational and preventive maintenance are implemented to assure the equipment is maintained. An example equipment inspection checklist and a typical logbook form are shown as Figures E-1 and E-2. Actual checklists or forms are maintained within the Operating Record.

E-1a  General Inspection Requirements

Tables E-1, E-1a, and E-2 of this Permit Attachment list the major categories of monitoring equipment, safety and emergency systems, security devices, and operating and structural equipment that are important to the prevention or detection of, or the response to, environmental or human health hazards caused by hazardous waste. These systems may include numerous subsystems. These systems are inspected according to the frequency listed in Tables E-1 and E-1a, a copy of which is maintained at the WIPP facility. The frequency of inspections is based on the nature of the equipment or the hazard and regulatory requirements. When in use, daily inspections are made of areas subject to spills, such as TRU mixed waste loading and unloading areas in the WHB Unit, looking for deterioration in structures, mechanical items, floor coatings, equipment, malfunctions, etc., in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(4)).

As required in 20.4.1.500 NMAC (incorporating 40 CFR §264.33), the WIPP facility inspection procedures for communication and alarm systems, fire-protection equipment, and spill control and decontamination equipment include provisions for testing and maintenance to ensure that the equipment will be operable in an emergency.

E-1a(1)  Types of Problems

The inspections for the systems, equipment, structures, etc., listed in Tables E-1 and E-1a, include the types of problems (e.g., malfunctions, visible cracks in coatings or welds, and deterioration) to be looked for during the inspection of each item or system, if applicable, and are in compliance with 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(3)).
E-1a(2) Frequency of Inspections

Tables E-1, E-1a, and E-2 of this Permit Attachment list the inspection frequencies and monitoring schedule for equipment and systems subject to the 20.4.1 NMAC hazardous waste management requirements. The frequency is based on the rate of possible deterioration of the equipment and the probability of an environmental or human health incident if the deterioration or malfunction, or any operator error, goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, are inspected daily when in use, consistent with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(4)).

When RH TRU mixed waste is present in the RH Complex, inspections are conducted visually and/or using closed-circuit video cameras in order to manage worker dose and to minimize occupational radiation exposures to as low as reasonably achievable (ALARA). More extensive inspections of these areas are performed at least annually during routine maintenance periods and when RH TRU mixed waste is not present.

E-1a(3) Monitoring Systems

There are two monitoring systems used at the WIPP to provide assurance that facility systems are operating correctly, that areas can be used safely, and that there have been no releases of hazardous waste constituents. These systems are shown in Table E-2 and include the geomechanical monitoring system and the central monitoring system (CMS). The geomechanical monitoring system is used to assess the condition of mined excavations to assure no unsafe conditions are allowed to develop. The CMS continuously assesses the status of the fixed radiation monitoring equipment, electrical power, fire alarm systems, ventilation system, and other facility systems including water tank levels. In addition, the CMS collects data from the meteorological monitoring system.

E-1b Specific Process Inspection Requirements

20.4.1.500 NMAC (incorporating 40 CFR §264.15(b)(4)), requires inspections of specific portions of a facility, rather than the general facility. These include container storage areas and miscellaneous units. Both are addressed below.

E-1b(1) Container Inspection

Containers are used to manage TRU mixed waste at the WIPP facility. These containers are described in Permit Part 3. Off-site waste that will be managed and stored as CH TRU mixed waste will arrive in 55-gallon drums arranged as seven (7)-packs, in Ten Drum Overpacks (TDOP), in 85-gallon drums arranged as four (4) packs, in 100-gallon drums arranged as three (3) packs, in standard waste boxes (SWB), in standard large box 2s (SLB2s) or shielded containers as (3)-packs. The waste containers will be visually inspected to ensure that the waste containers are in good condition and that there are no signs that a release has occurred. This visual inspection shall not include the center drums of 7-packs and waste containers positioned such that visual observation is precluded due to the arrangement of waste assemblies on the facility pallets. If CH TRU mixed waste handling operations should stop for any reason with containers located on the TRUPACT-II Unloading Dock (TRUDOCK) storage area of the WHB Unit) or in room 108 while still in the Contact-Handled Packages, primary waste container inspections could not be accomplished until the containers of waste are removed from the shipping containers.
As described in Permit Attachment A1, Section A1-1d(3), off-site waste that will be managed and stored as RH TRU mixed waste will arrive in containers inside Nuclear Regulatory Commission (NRC)-certified casks designed to provide shielding and facilitate safe handling. Canisters, will be loaded singly into an RH-TRU 72-B cask. Drums will be loaded into a CNS 10-160B cask. The cask will be visually inspected upon arrival. Because RH TRU mixed waste is stored in the Parking Area Unit in sealed casks, there are no additional requirements for engineered secondary containment systems. Following removal of the canisters and drums, the interior of the cask will be inspected and surveyed for evidence of contamination that may have occurred during transport.

Off-site waste that will be managed and stored as RH TRU mixed waste is managed and stored in the RH Complex of the WHB. The RH Complex includes the following: RH Bay, the Cask Unloading Room, the Hot Cell, the Transfer Cell, and the Facility Cask Loading Room. As RH TRU mixed waste is held in canisters within a canister rack the physical inspection of the drum or canister is not possible. Inspections of RH TRU mixed waste in these areas occurs remotely via closed-circuit cameras a minimum of once weekly when stored waste is present. Because RH TRU mixed waste is in sealed casks, there are no additional requirements for engineered secondary containment systems. However, the floors in the RH Complex (including the RH Bay, Facility Cask Loading Room and Cask Unloading Room) are coated concrete and during normal operations (i.e., when waste is present), the floor of the RH Complex is inspected visually or by using close-circuit cameras on a weekly basis to verify that it is in good condition and free of visible cracks and gaps.

Inspections of RH TRU mixed waste containers stored in the Hot Cell and Transfer Cell are conducted using remotely operated cameras. RH TRU mixed waste in the Hot Cell is stored in either drums or canisters. The containers in the Hot Cell are inspected to ensure that they are in acceptable condition. RH TRU mixed waste in the Transfer Cell is stored in the RH-TRU 72-B cask or shielded insert; therefore, inspections in this area focus on the integrity of the cask or shielded insert. RH TRU mixed waste in the Facility Cask Loading Room is stored in the facility cask; therefore, inspections in this area focus on the integrity of the facility cask.

Inspections will be conducted in the Parking Area Unit at a frequency not less than once weekly when waste is present. These inspections are applicable to loaded Contact-Handled and Remote-Handled Packages. The perimeter fence located at the lateral limit of the Parking Area Unit, coupled with personnel access restrictions into the WHB Unit, will provide the needed security. The perimeter fence and the southern border of the WHB shall mark the lateral limit of the Parking Area Unit. Radiologically controlled areas can be established temporarily with barricades. More permanent structures can be installed. The western boundary can be established with temporary barricades since this area is within the perimeter fence. Access to radiologically controlled areas will only be permitted to personnel who have completed General Employee Radiological Training (GERT), a program defined by the Permittees, or escorted by personnel who have completed GERT. This program ensures that personnel have adequate knowledge to understand radiological posting they may encounter at the WIPP site. The fence of the Radiologically Controlled Area, south from the WHB airlocks, was moved to provide more maneuvering space for the trucks delivering waste. Since TRU mixed waste to be stored in the Parking Area Unit will be in sealed Contact-Handled or Remote-Handled Packages, there will be no additional requirements for engineered secondary containment systems. Inspections of the Contact-Handled and Remote-Handled Packages stored in the Parking Area Unit shall be conducted at a frequency no less than once weekly and will focus on the inventory and integrity.
of the shipping containers and the spacing between trailers carrying the Contact-Handled or Remote-Handled Packages. This spacing will be maintained at a minimum of four feet.

Container inspections will be included as part of the surface TRU mixed waste handling areas (i.e. Parking Area Unit and WHB Unit) inspections described in Tables E-1 and E-1a. These inspections will also include the Derived Waste Storage Areas of the WHB Unit. The Derived Waste Storage Areas will consist of containers of 55 or 85-gallon drums or SWBs for CH TRU mixed waste and 55-gallon drums for RH TRU mixed waste. A Satellite accumulation area (SAA) may be required in an area adjacent to the TRUDOCKs for CH TRU mixed waste. A SAA may also be required in the RH Bay and Hot Cell for RH TRU mixed waste. These SAAs will be set up on an as needed basis at or near the point of generation and the derived waste will be discarded into the active derived waste container. All SAAs will be inspected in accordance with 20.4.1.300 NMAC (incorporating 40 CFR §262.34).

E-1b(2) Miscellaneous Unit Inspection

20.4.1.500 NMAC (incorporating 40 CFR §264.602), requires that inspections required in 20.4.1.500 NMAC (incorporating 40 CFR §264.15 and §264.33), as well as any additional requirements needed to protect human health and the environment, be met. The requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.15 and §264.33) are discussed in Section E-1 of this Permit Attachment, along with how the WIPP facility complies with those requirements for standard types of inspections. Inspection frequencies for geomechanical monitoring equipment are provided in Table E-1. The monitoring schedule for geomechanical instrumentation is given in Table E-2.

References


FIGURES

1
2
### TYPICAL EQUIPMENT
#### WEEKLY CHECK LIST

<table>
<thead>
<tr>
<th>ITEM INSPECTED</th>
<th>Condition</th>
<th>Comments/Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical Checks:</strong></td>
<td>(examples)</td>
<td></td>
</tr>
<tr>
<td>Oil level</td>
<td></td>
<td></td>
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<tr>
<td>Radiator fluid level</td>
<td></td>
<td></td>
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<tr>
<td>Automatic transmission fluid level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operate all valves/check gauges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency brake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel level (&gt; ¾ full)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil pressure (at warm idle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tire Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sirens, horn, &amp; back-up alarm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deterioration Checks:</strong> (examples)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan belts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery (terminals, cables)</td>
<td></td>
<td></td>
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<tr>
<td>Run generator 5 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hose, nozzles &amp; valves</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leaks/Spills Checks:</strong> (examples)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaks around pump</td>
<td></td>
<td></td>
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<tr>
<td>Foam tank level</td>
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<td></td>
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<tr>
<td><strong>Required Equipment:</strong> (examples)</td>
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<td></td>
</tr>
<tr>
<td>Inspect SCBAs (&gt; 4050 psi)</td>
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<td></td>
</tr>
<tr>
<td>Hand tools &amp; equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trauma Kit</td>
<td></td>
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**Inspected by:**

<table>
<thead>
<tr>
<th>Print Name</th>
<th>Signature</th>
<th>Time/Date</th>
</tr>
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</table>

**Reviewed by:**

<table>
<thead>
<tr>
<th>Print Name</th>
<th>Signature</th>
<th>Time/Date</th>
</tr>
</thead>
</table>

**Comments:**

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**NOTE:** All items that are mandatory for every inspection form are shown in bold.

**Figure E-1**
Typical Inspection Checklist

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PERMIT ATTACHMENT E
Page E-9 of 26
<table>
<thead>
<tr>
<th>HOUR METER READING</th>
<th>EQUIPMENT NO.</th>
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<td></td>
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</tbody>
</table>

**DEFICIENCIES NOTED:**

- 
- 
- 
- 
- 

**PRE OPS COMPLETED PER**

- **Procedure Number**
- **SAT**
- **PROBLEMS NOTED**

**CORRECTIVE ACTIONS TAKEN:**

- 
- 
- 
- 
- 

<table>
<thead>
<tr>
<th>OPERATOR SIGNATURE</th>
<th>DATE</th>
<th>TIME</th>
<th>SUPERVISOR SIGNATURE/DATE</th>
</tr>
</thead>
<tbody>
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<td></td>
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</tr>
</tbody>
</table>

**NOTE:** All items that are mandatory for every inspection form are shown in bold.

---

**Figure E-2**

Typical Logbook Entry
<table>
<thead>
<tr>
<th>System/Equipment Name</th>
<th>Responsible Organization</th>
<th>Inspection a Frequency and Job Title of Personnel Normally Making Inspection</th>
<th>Procedure Number and Inspection Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Intake Shaft Hoist</td>
<td>Underground Operations</td>
<td>Preoperational See Lists 1b and c</td>
<td>WP 04-HO1004 Inspecting for Deterioration, Safety Equipment, Communication Systems, and Mechanical Operability in accordance with Mine Safety and Health Administration (MSHA) requirements</td>
</tr>
<tr>
<td>Ambulances (Surface and Underground) and related emergency supplies and equipment</td>
<td>Emergency Services</td>
<td>Weekly See List 11</td>
<td>WP 04-ED1301 Inspecting for Mechanical Operability and Deterioration</td>
</tr>
<tr>
<td>Adjustable Center of Gravity Lift Fixture</td>
<td>Waste Handling</td>
<td>Preoperational See List 8</td>
<td>WP 05-WH1410 Inspecting for Mechanical Operability and Deterioration</td>
</tr>
<tr>
<td>Backup Power Supply Diesel Generators</td>
<td>Facility Operations</td>
<td>Monthly See List 3</td>
<td>WP 05-WH1603 Inspecting for Mechanical Operability, Deterioration, and area around transporter clear of obstacles</td>
</tr>
<tr>
<td>Facility Inspections (Water Diversion Berms)</td>
<td>Facility Engineering</td>
<td>Annually See List 4</td>
<td>WP 10-WC3008 Inspecting for Damage, Impediments to water flow, and Deterioration</td>
</tr>
<tr>
<td>Central Monitoring Systems (CMS)</td>
<td>Facility Operations</td>
<td>Continuous See List 3</td>
<td>Automatic Self-Checking</td>
</tr>
<tr>
<td>Contact-Handled (CH) TRU Underground Transporter</td>
<td>Waste Handling</td>
<td>Preoperational See List 8</td>
<td>WP 05-WH1406 Inspecting for Mechanical Operability, Deterioration, path clear of obstacles, and guards in the proper place</td>
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<tr>
<td>Conveyance Loading Car</td>
<td>Waste Handling</td>
<td>Preoperational See List 8</td>
<td>WP 05-WH1204 Inspecting for Mechanical Operability, Deterioration, path clear of obstacles, and guards in the proper place</td>
</tr>
<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
<td>Inspection Frequency and Job Title of Personnel Normally Making Inspection</td>
<td>Procedure Number and Inspection Criteria</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>--------------------------------</td>
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<td>-----------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Exhaust Shaft Underground Operations</td>
<td>Quarterly See List 1a</td>
<td>PM041099 Inspecting for Deterioration(^b) and Leaks/Spills</td>
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</tr>
<tr>
<td>Eye Wash and Shower Equipment Equipment Custodian</td>
<td>Weekly See List 5</td>
<td>WP 12-IS1832 Inspecting for Deterioration(^b)</td>
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<tr>
<td></td>
<td>Semi-annually See List 2a</td>
<td>WP 12-IS1832 Inspecting for Deterioration(^b) and Fluid Levels—Replace as Required</td>
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</tr>
<tr>
<td>Fire Detection and Alarm System Emergency Services</td>
<td>Semiannually See List 11</td>
<td>12-FP0027 Inspecting for Deterioration(^b), Operability of indicator lights and, underground fuel station dry chemical suppression system. Inspection is per NFPA 17</td>
<td></td>
</tr>
<tr>
<td>Fire Extinguishers(^l) Emergency Services</td>
<td>Monthly See List 11</td>
<td>12-FP0036 Inspecting for Deterioration(^b), Leaks/Spills, Expiration, seals, fullness, and pressure</td>
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</tr>
<tr>
<td>Fire Hoses Emergency Services</td>
<td>Annually (minimum) See List 11</td>
<td>12-FP0031 Inspecting for Deterioration(^b) and Leaks/Spills</td>
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<tr>
<td>Fire Hydrants Emergency Services</td>
<td>Semi-annual/ annually See List 11</td>
<td>12-FP0034 Inspecting for Deterioration(^b) and Leaks/Spills</td>
<td></td>
</tr>
<tr>
<td>Fire Pumps Emergency Services</td>
<td>Weekly/annually See List 11</td>
<td>WP 12-FP0026 Inspecting for Deterioration(^b), Leaks/Spills, valves, and panel lights</td>
<td></td>
</tr>
<tr>
<td>Fire Sprinkler Systems Emergency Services</td>
<td>Monthly/ quarterly See List 11</td>
<td>WP 12-FP0025 Inspecting for Deterioration(^b), Leaks/Spills, static pressures, and removable strainers</td>
<td></td>
</tr>
<tr>
<td>Fire and Emergency Response Trucks (Seagrave Fire Apparatus, Emergency One Apparatus, and Underground Rescue Truck) Emergency Services</td>
<td>Weekly See List 11</td>
<td>12-FP0033 Inspecting for Mechanical Operability(^m), Deterioration(^b), Leaks/Spills, and Required Equipment(^d)</td>
<td></td>
</tr>
<tr>
<td>Forklifts Used for Waste Handling (Electric and Diesel forklifts, Push-Pull Attachment) Waste Handling Preoperational See List 8</td>
<td>WP 05-WH1201, WP 05-WH1207, WP 05-WH1401, WP 05-WH1402, WP 05-WH1403, and WP 05-WH1412</td>
<td>Inspecting for Mechanical Operability(^m), Deterioration(^b), and On board fire suppression system</td>
<td></td>
</tr>
<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
<td>Inspection a Frequency and Job Title of Personnel Normally Making Inspection</td>
<td>Procedure Number and Inspection Criteria</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
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<tr>
<td>Hazardous Material Response Equipment</td>
<td>Emergency Services</td>
<td>Weekly See List 11</td>
<td>12-FP0033 Inspecting for Mechanical Operability(m), Deterioration(b), and Required Equipment(c)</td>
</tr>
<tr>
<td>Miners First Aid Station</td>
<td>Emergency Services</td>
<td>Quarterly See List 11</td>
<td>12-FP0035 Inspecting for Required Equipment(c)</td>
</tr>
<tr>
<td>Mine Pager Phones (between surface and underground)</td>
<td>Facility Operations</td>
<td>Monthly See List 3</td>
<td>WP 04-PC3017 Testing of PA and Underground Alarms and Mine Page Phones at essential locations</td>
</tr>
<tr>
<td>Perimeter Fence, Gates, Signs</td>
<td>Security</td>
<td>Daily See List 6</td>
<td>PF0-010 Inspecting for Deterioration(b) and Posted Warnings</td>
</tr>
<tr>
<td>Personal Protective Equipment (not otherwise contained in emergency vehicles or issued to individuals): —Self-Contained Breathing Apparatus</td>
<td>Emergency Services</td>
<td>Weekly See List 11</td>
<td>12-FP0029 Inspecting for Deterioration(b) and Pressure</td>
</tr>
<tr>
<td>Public Address (and Intercom System)</td>
<td>Facility Operations</td>
<td>Monthly See List 3</td>
<td>WP 04-PC3017 Testing of PA and Underground Alarms and Mine Page Phones at essential locations Systems operated in test mode</td>
</tr>
<tr>
<td>Radio Equipment</td>
<td>Facility Operations</td>
<td>Daily See List 3</td>
<td>Radios are operated daily and are repaired upon failure</td>
</tr>
<tr>
<td>Rescue Truck (Surface and Underground)</td>
<td>Emergency Services</td>
<td>Weekly See List 11</td>
<td>12-FP0030 and 12-FP0033 Inspecting for Mechanical Operability(m), Deterioration(b), Leaks/Spills, and Required Equipment(c)</td>
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<tr>
<td>Salt Handling Shaft Hoist</td>
<td>Underground Operations</td>
<td>Preoperational See List 1b and c</td>
<td>WP 04-HO1002 Inspecting for Deterioration(b), Safety Equipment, Communication Systems, and Mechanical Operability(m) in accordance with MSHA requirements</td>
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<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
<td>Frequency and Job Title of Personnel Normally Making Inspection</td>
<td>Procedure Number and Inspection Criteria</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Self-Rescuers</td>
<td>Underground Operations</td>
<td>Quarterly See List 1c</td>
<td>WP 04-AU1026 Inspecting for Deterioration(^b) and Functionality in accordance with MSHA requirements</td>
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<tr>
<td>Surface TRU Mixed Waste Handling Area(^k)</td>
<td>Waste Handling</td>
<td>Preoperational or Weekly See List 8</td>
<td>WP 05-WH1101 Inspecting for Deterioration(^b), Leaks/Spills, Required Aisle Space, Posted Warnings, Communication Systems, Container Condition, and Floor coating integrity</td>
</tr>
<tr>
<td>TRU Mixed Waste Decontamination Equipment</td>
<td>Waste Handling</td>
<td>Annually See List 8</td>
<td>WP 05-WH1101 Inspecting for Required Equipment(^b)</td>
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<tr>
<td>Underground Openings—Roof Bolts and Travelways</td>
<td>Underground Operations</td>
<td>Weekly See List 1a</td>
<td>WP 04-AU1007 Inspecting for Deterioration(^b)</td>
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<tr>
<td>Underground—Geomechanical Instrumentation System (GIS)</td>
<td>Geotechnical Engineering</td>
<td>Monthly See List 9</td>
<td>WP 07-EU1301 Inspecting for Deterioration(^b)</td>
</tr>
<tr>
<td>Underground TRU Mixed Waste Disposal Area</td>
<td>Waste Handling</td>
<td>Preoperational See List 8</td>
<td>WP 05-WH1810 Inspecting for Deterioration(^b), Leaks/Spills, mine pager phones, equipment, unobstructed access, signs, debris, and ventilation</td>
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<tr>
<td>Uninterruptible Power Supply (Central UPS)</td>
<td>Facility Operations</td>
<td>Daily See List 3</td>
<td>WP 04-ED1542 Inspecting for Mechanical Operability(^m) and Deterioration(^b) with no malfunction alarms. Results of this inspection are logged in accordance with WP 04-AD3008.</td>
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<tr>
<td>TDOP Upender</td>
<td>Waste Handling</td>
<td>Preoperational See List 8</td>
<td>WP 05-WH1010 Inspecting for Mechanical Operability(^m) and Deterioration(^b)</td>
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<tr>
<td>Vehicle Siren</td>
<td>Emergency Services</td>
<td>Weekly See List 11</td>
<td>Functional Test included with inspection of the Ambulances, Fire Trucks, and Rescue Trucks</td>
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<tr>
<td>Ventilation Exhaust</td>
<td>Maintenance Operations</td>
<td>Quarterly See List 10</td>
<td>IC041098 Check for Deterioration(^b) and Calibration of Mine Ventilation Rate Monitoring Equipment</td>
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<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
<td>Inspection Frequency and Job Title of Personnel Making Inspection</td>
<td>Procedure Number and Inspection Criteria</td>
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<tr>
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<td>Waste Handling Cranes</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1407</td>
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<td></td>
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<td>See List 8</td>
<td>Inspecting for Mechanical Operability(^m), Deterioration(^b), and Leaks/Spills</td>
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<tr>
<td>Waste Hoist</td>
<td>Underground Operations</td>
<td>Preoperational</td>
<td>WP 04-HO1003</td>
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<td></td>
<td></td>
<td>See List 1b and c</td>
<td>Inspecting for Deterioration(^b), Safety Equipment, Communication Systems, and Mechanical Operability(^m), Leaks/Spills, in accordance with MSHA requirements</td>
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<tr>
<td>Water Tank Level</td>
<td>Facility Operations</td>
<td>Daily</td>
<td>SDD-WD00</td>
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<tr>
<td></td>
<td></td>
<td>See List 3</td>
<td>Inspecting for Deterioration(^b), and water levels. Results of this inspection are logged in accordance with WP 04-AD3008.</td>
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<tr>
<td>Push-Pull Attachment</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1401</td>
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<td>See List 8</td>
<td>Inspecting for Damage and Deterioration(^b)</td>
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<td>Trailer Jockey</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1405</td>
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<td>See List 8</td>
<td>Inspecting for Mechanical Operability(^m) and Deterioration(^b)</td>
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<td>Accessible Explosion-Isolation Walls</td>
<td>Underground Operations</td>
<td>Quarterly</td>
<td>Integrity and Deterioration(^b) of Accessible Areas</td>
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<tr>
<td>Accessible Bulkheads in Filled Panels</td>
<td>Underground Operations</td>
<td>Monthly</td>
<td>Integrity and Deterioration(^b) of Accessible Areas</td>
</tr>
<tr>
<td>Bolting Robot</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1203</td>
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<td>See List 8</td>
<td>Mechanical Operability(^m)</td>
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<tr>
<td>Yard Transfer Vehicle</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1205</td>
</tr>
<tr>
<td></td>
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<td>See List 8</td>
<td>Mechanical Operability(^m), Deterioration(^b), Path clear of obstacles and Guards in proper place</td>
</tr>
<tr>
<td>Payload Transfer Station</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1208</td>
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<td></td>
<td></td>
<td>See List 8</td>
<td>Mechanical Operability(^m), Deterioration(^b), and Guards in proper place</td>
</tr>
<tr>
<td>Monorail Hoist</td>
<td>Waste Handling</td>
<td>Preoperational</td>
<td>WP 05-WH1202</td>
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<td>See List 8</td>
<td>Mechanical Operability(^m), Deterioration(^b), and leaks/spills</td>
</tr>
<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
<td>Inspection a Frequency and Job Title of Personnel Normally Making Inspection</td>
<td>Procedure Number and Inspection Criteria</td>
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<tr>
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<tr>
<td>Bolting Station</td>
<td>Waste Handling</td>
<td>Preoperational See List 8</td>
<td>WP 05-WH1203 Mechanical Operability, Deterioration, and Guards in proper place</td>
</tr>
</tbody>
</table>
### Table E-1 (Continued)

**Inspection Schedule/Procedures Lists**

#### List 1: Underground Operations

| a. Mining Technician *  
| Senior Mining Technician *  
| Continuous Mining Specialist *  
| Senior Mining Specialist *  
| Mine OPS Supervisor *  |
| b. Waste Hoist Operator  
| Waste Hoist Shaft Tender  |
| c. U/G Facility Operations* - Self Rescuers  
| Shaft Technician *  |
| d. Operations Engineer  
| Supervisor U/G Services*  
| Senior Operations Engineer*  |

#### List 2: Industrial Safety

| a. Safety Technician *  
| Senior Safety Technician *  
| Safety Specialist *  
| Safety Engineer *  
| Industrial Hygienist *  |
| b. Fire Protection Engineering *  |

#### List 3: Facility Operations

| Facilities Technician *  
| Senior Facilities Technician *  
| Facility Operations Specialist *  
| Central Monitoring Room Operator *  
| Central Monitoring Room Specialist *  
| Operations Engineer  
| Senior Operations Engineer *  
| Facility Shift Manager  
| Operations Technical Coordinator *  |

#### List 4: Facility Engineering

| Senior Engineer *  |

#### List 5: General

| Equipment Custodian*  |

#### List 6: Security

| Security Protective *  
| Security Protective Supervisor *  |

#### List 8: Waste Handling

| Manager, Waste Operations  
| TRU-Waste Handler  |

#### List 9: Geotechnical Engineering

| Engineer Technician *  
| Associate Engineer *  
| Engineer *  
| Senior Engineer *  
| Principal Engineer*  |

#### List 10: Maintenance Operations

| Maintenance Technician *  
| Maintenance Specialist *  
| Senior Maintenance Specialist *  
| Contractor *  |

#### List 11: Emergency Services

| Qualified Emergency Services Personnel  
| Fire Protection Technician  |
Table E-1 (Continued)
Inspection Schedule/Procedures Notes

1. Inspection may be accomplished as part of or in addition to regularly scheduled preventive maintenance inspections for each item or system. Certain structural systems of the WHB, Waste Hoist and Station A are also subject to inspection following severe natural events including earthquakes, tornados, and severe storms. Structural systems include columns, beams, girders, anchor bolts and concrete walls.

2. Deterioration includes: obvious visible cracks, erosion, salt build-up, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

3. “Preoperational” signifies that inspections are required prior to the first use during a calendar day. For calendar days in which the equipment is not in use, no inspections are required. For an area this includes: area is clean and free of obstructions (for emergency equipment); adequate aisle space; emergency and communications equipment is readily available, properly located and sign-posted, visible, and operational. For equipment, this includes: checking fluid levels, pressures, valve and switch positions, battery charge levels, pressures, general cleanliness, and that all functional components and emergency equipment is present and operational.

4. These weekly inspections apply to container storage areas when containers of waste are present for a week or more.

5. In addition, the water tank levels are maintained by the CMR and level readouts are available at any time.

6. This organization is responsible for obtaining licenses for radios and frequency assignments. They do periodic checks of frequencies and handle repairs which are performed by a vendor.

7. Radios are not routinely “inspected.” They are operated daily and many are used in day-to-day operations. They are used until they fail, at which time they are replaced and repaired. Radios are used routinely by Emergency Services, Security, Environmental Monitoring, and Facility Operations.

8. Fire extinguisher inspection is paperless. Information is recorded into a database using barcodes. The database is then printed out.

9. Surface CH TRU mixed waste handling areas include the Parking Area Unit, the WHB unit, and unloading areas.

10. No log forms are used for daily readings. However, readings that are out of tolerance are reported to the CMR and logged by CMR operator. Inspection includes daily functional checks of portable equipment.

11. Mechanical Operability means that the equipment has been checked and is operating in accordance with site safety requirements (e.g. proper fluid levels and tire pressure; functioning lights, alarms, sirens, and power/battery units; and belts, cables, nuts/bolts, and gears in good condition), as appropriate.

12. Required Equipment means that the equipment identified in Table D-6 is available and usable (i.e. not expired/depleted and works as designed).

* Positions are not considered RCRA positions (i.e., personnel do not manage TRU mixed waste).
Table E-1a
RH TRU Mixed Waste Inspection Schedule/Procedures

<table>
<thead>
<tr>
<th>System/Equipment Name</th>
<th>Responsible Organization</th>
<th>Inspection a Frequency and Job Title of Personnel Normally Making Inspection (b)</th>
<th>Procedure Number (Latest Revision)</th>
<th>Inspection Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cask Transfer Car(s)</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1701 PM041187 (Semi-Annual)</td>
<td>Yes NA Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication</td>
</tr>
<tr>
<td>RH Bay Overhead Bridge Crane</td>
<td>Waste Operations</td>
<td>Preoperational (c,d,e) See List 1</td>
<td>WP05-WH1741 PM041232 (Quarterly) PM041117 (Annual)</td>
<td>Yes Yes Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication</td>
</tr>
<tr>
<td>Facility Cask Transfer Car</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1713 PM041201 (Annual) PM041203 (Annual)</td>
<td>Yes NA Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication Electrical PM.</td>
</tr>
<tr>
<td>RH Bay Cask Lifting Yoke</td>
<td>Waste Operations</td>
<td>Preoperational (c,d,e) See List 1</td>
<td>WP05-WH1741 PM041169 (Annual)</td>
<td>Yes NA Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication</td>
</tr>
<tr>
<td>Facility Cask Transfer Car</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1704 PM041186 (Quarterly) PM041195 (Annual)</td>
<td>Yes Yes Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication Electrical Inspection</td>
</tr>
<tr>
<td>Facility Cask Rotating Device</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1713 PM041175 (Annual) PM041176 (Annual)</td>
<td>Yes Yes Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication Electrical Inspection</td>
</tr>
<tr>
<td>Facility Grapple</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1721 PM041172 (Quarterly) PM041177 (Annual)</td>
<td>Yes NA Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear. Non-Destructive Examination</td>
</tr>
<tr>
<td>6.25-Ton Grapple Hoist</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1721 PM041173 (Annual)</td>
<td>Yes Yes Pre-evolution Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication</td>
</tr>
<tr>
<td>Transfer Cell Shuttle Car</td>
<td>Waste Operations</td>
<td>Pre-evolution (c,d,e) See List 1</td>
<td>WP05-WH1705 PM041184 (Semi-Annual) PM041222 (Annual)</td>
<td>Yes Yes Pre-evolution Pre-operational Checks and Operating Instructions. Mechanical Inspection for Wear and Lubrication Electrical Inspection</td>
</tr>
<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
<td>Inspection a Frequency and Job Title of Personnel Normally Making Inspection</td>
<td>Procedure Number (Latest Revision)</td>
<td>Inspection Criteria</td>
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<tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Deteriorationb Leaks/spills Other</td>
</tr>
<tr>
<td>Cask Unloading Room</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1744</td>
<td>Yes NA Floor integrity</td>
</tr>
<tr>
<td>Hot Cell</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1744</td>
<td>Yes NA Floor integrity</td>
</tr>
<tr>
<td>Hot Cell Overhead Powered Manipulator</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1743</td>
<td>Yes Yes Pre-operational Checks and Operating Instructions Mechanical Inspection for Wear and Lubrication Electrical Inspection Load Cell Calibration</td>
</tr>
<tr>
<td>Hot Cell Bridge Crane</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1742</td>
<td>Yes Yes Pre-operational Checks and Operating Instructions Mechanical Inspection for Wear and Lubrication Electrical Inspection Load Cell Calibration</td>
</tr>
<tr>
<td>Transfer Cell</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1744</td>
<td>Yes NA Floor integrity</td>
</tr>
<tr>
<td>Facility Cask Loading Room</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1744</td>
<td>Yes NA Floor integrity</td>
</tr>
<tr>
<td>Closed Circuit Television Camera</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1757</td>
<td>NA NA Operability</td>
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<td>Cask Unloading Room Crane</td>
<td>Waste Operations</td>
<td>Preoperational c,d,e,f,h,i See List 1</td>
<td>WP05-WH1719</td>
<td>Yes Yes Pre-operational Checks and Operating Instructions Mechanical Inspection for Wear and Lubrication Electrical Inspection Load Cell Calibration</td>
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<tr>
<td>System/Equipment Name</td>
<td>Responsible Organization</td>
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<td>Procedure Number (Latest Revision)</td>
<td>Inspection Criteria</td>
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<tr>
<td>Horizontal Emplacement and Retrieval Equipment or functionally equivalent equipment</td>
<td>Waste Operations</td>
<td>Pre-evolution (^{c,d,e,i}) See List 1</td>
<td>WP05-WH1700 PM052010 (Semi-Annual)(^b) PM052011 (Annual) PM052013 PM052012 PM052014 (Annual)</td>
<td>Yes</td>
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<tr>
<td>41-Ton Forklift</td>
<td>Waste Operations</td>
<td>Preoperational (^{c,d,e,i}) See List 1</td>
<td>WP05-WH1602 PM074061 PM052003 (Hours of Use) PM074027 (Quarterly) PM074029 &amp; PM074051 (Annual)</td>
<td>Yes</td>
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<tr>
<td>RH Bay</td>
<td>Waste Operations</td>
<td>Preoperational (^{c,d,e,i}) See List 1</td>
<td>WP05-WH1744</td>
<td>Yes</td>
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<tr>
<td>Surface RH TRU Mixed Waste Handling Area</td>
<td>Waste Operations</td>
<td>Preoperational (^{c,d,e,i}) See List 1</td>
<td>WP-05 WH1744</td>
<td>Yes</td>
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<td>List 1: Waste Operations</td>
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<td>1</td>
<td>RH Waste Handling Engineer</td>
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<td>Qualified TRU-Waste Handler</td>
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<td>2</td>
<td>List 2: Radiological Control</td>
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<td>Radiological Control Technician</td>
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</table>

**Table E-1a (Continued)**

**RH TRU Mixed Waste Inspection Schedule/Procedures Lists**
Table E-1a (Continued)
RH TRU Mixed Waste Inspection Schedule/Procedures Notes

a Inspection may be accomplished as part of or in addition to regularly scheduled preventive maintenance inspections for each item or system. Certain structural systems of the WHB are also subject to inspection following severe natural events including earthquakes, tornados, and severe storms. Structural systems include columns, beams, girders, anchor bolts, and concrete walls.

b Deterioration includes: visible cracks, erosion, salt build-up, damage, corrosion, loose or missing parts, malfunctions, and structural deterioration.

c "Pre-evolution" signifies that inspections are required prior to equipment use in the waste handling process. (An evolution is considered to be from the receipt of a cask into the RH Bay through canister emplacement in the underground.) For an area, preoperational inspection includes: area is clean and free of obstructions (for emergency equipment); adequate aisle space; emergency and communications equipment is readily available, properly located and sign-posted, visible, and operational. For equipment, this includes: checking fluid levels, pressures, valve and switch positions, battery charge levels, pressures, general cleanliness, and that functional components and emergency equipment are present and operational. When the equipment is not in use, no inspections are required.

d When equipment needs to be inspected while handling waste (i.e., during waste unloading or transfer operations), general cleanliness and functional components will be inspected to detect any problem that may harm human health or the environment. The inspection will verify that emergency equipment is present.

e Inspection of RH TRU mixed waste equipment and areas in the RH Complex applies only after RH TRU mixed waste receipt begins.

f The inspection/maintenance activities associated with these pieces of equipment are performed when the RH Complex is empty of RH TRU mixed waste. If contamination is present, a radiation work permit may be needed.

g For the Hot Cell and Transfer Cell, if RH TRU mixed waste is present, camera inspections will be performed in lieu of physical inspection.

h The integrity of the floor coating will be inspected weekly if RH TRU mixed waste is present.

i "Preoperational" signifies that inspections are required prior to the first use in a calendar day.

j Responsible organizations refers to the organization that owns the equipment. Preventive Maintenance (PM) procedures are conducted by either mine maintenance or surface operations maintenance personnel and Instrument Calibration (IC) procedures are conducted by instrument and calibration maintenance personnel.

k Inspection will be performed after 250 evolutions (actual and training emplacements), if such usage occurs prior to the semi-annual inspection.

l Inspections and PM's are not required for equipment that is out of service.
### Table E-2

**Monitoring Schedule**

<table>
<thead>
<tr>
<th>System/Equipment Name</th>
<th>Responsible Organization</th>
<th>Monitoring Frequency</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geomechanical (^b)</td>
<td>Geotechnical Engineering</td>
<td>Monthly</td>
<td>To evaluate the geotechnical performance of the underground facility and to detect ground conditions that could affect operational safety</td>
</tr>
<tr>
<td>Central Monitoring System</td>
<td>Facility Operations</td>
<td>System Dependent</td>
<td>Monitor and provide status for the following facility parameters: Electrical Power Status (^d), Fire Alarm System (^e), Ventilation System Status (^f), Meteorological Data System (^g), Facility Systems (compressors (^g), pumps (^h), water tank levels (^i), waste hoists (^j))</td>
</tr>
</tbody>
</table>

\(^b\) Equipment is listed as Underground-Geomechanical Instrumentation System (GIS) in Table E-1.

\(^d\) Equipment listed as Backup Power Supply Diesel Generator in Table E-1.

\(^e\) Equipment listed as Fire Detection and Alarm System in Table E-1.

\(^f\) Equipment listed as Ventilation Exhaust in Table E-1.

\(^g\) Not RCRA equipment.

\(^h\) Equipment listed as Fire Pumps in Table E-1.

\(^i\) Equipment listed as Water Tank Level in Table E-1.

\(^j\) Equipment listed as Waste Hoist in Table E-1.
ATTACHMENT G1

WIPP PANEL CLOSURE (WPC) DESCRIPTION AND SPECIFICATIONS

Adapted from the October 2012 Design Report for a Panel Closure System at the Waste Isolation Pilot Plant
# ATTACHMENT G1

## WIPP PANEL CLOSURE (WPC) DESCRIPTION AND SPECIFICATIONS

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G1-1</strong></td>
<td><strong>WPC Description</strong></td>
</tr>
<tr>
<td>G1-1a</td>
<td>Permit Design Requirements</td>
</tr>
<tr>
<td>G1-1b</td>
<td>Design Component Descriptions</td>
</tr>
<tr>
<td>G1-1b(1)</td>
<td>Steel Bulkhead</td>
</tr>
<tr>
<td>G1-1b(2)</td>
<td>ROM Salt</td>
</tr>
<tr>
<td><strong>G1-2</strong></td>
<td>Technical Specifications</td>
</tr>
<tr>
<td><strong>G1-3</strong></td>
<td>Drawings</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td></td>
</tr>
</tbody>
</table>

Appendix G1-A — Technical Specifications
Appendix G1-B — Drawings
**LIST OF TABLES**

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table G1-1</td>
<td>Technical Specification for the WIPP Panel Closure System</td>
</tr>
<tr>
<td>Table G1-2</td>
<td>WIPP Panel Closure System Drawings</td>
</tr>
</tbody>
</table>

**LIST OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure G1-1</td>
<td>Typical Bulkhead for the WPC</td>
</tr>
</tbody>
</table>
ATTACHMENT G1

WIPP PANEL CLOSURE (WPC) DESCRIPTION AND SPECIFICATIONS

Introduction

An important aspect of repository operations at the WIPP facility is the closure of filled waste disposal panels. Each panel consists, among other things, of a panel air-intake drift and a panel air-exhaust drift. After completion of waste disposal activities in a panel, that panel must be closed. The closure of individual panels during the operational period is conducted in compliance with the requirements in this Permit (Permit). The WIPP Panel Closure (WPC) design has been selected to close filled panels at the WIPP facility in compliance with Permit requirements.

This attachment presents the applicable specifications and requirements for fabrication, installation and maintenance of the WPC in the WIPP facility and the information presented here is taken primarily from the Design Report for a Panel Closure System at the Waste Isolation Plant (RockSol, 2012).

WPC Description

Engineering drawings of the WPC design are presented in Appendix B. The WPC design consists of a minimum of 100 feet of emplaced run-of-mine (ROM) salt configured between two steel bulkheads for panels that do not have explosion-isolation walls installed in them. For panels with installed explosion-isolation walls, an alternate WPC configuration consists of one steel bulkhead, a minimum of 100 feet of emplaced ROM salt and one block wall. The minimum 100 feet of ROM salt shall be emplaced to completely fill the drift from side to side and top to bottom. The construction methods and materials used in the design represent available technologies. No special requirements are identified for these components during the operational period of the repository. The fabrication, installation and maintenance of ventilation bulkheads are standard practice. Salt can be pushed tight to the underground surfaces of the drifts.

After completion of waste emplacement operations in future active panels, steel bulkheads shall be installed in the intake and exhaust panel entries. Next, the minimum 100 feet of ROM salt shall be emplaced using conventional mining equipment. After ROM salt emplacement, the outer (accessible) steel bulkhead is installed.

The performance of the WPC design has been numerically modeled. The model results show that an air gap forms between the excavation roof and the top of the ROM salt fill due to the settlement of the emplaced ROM salt. The model predicts that an air gap above the emplaced ROM salt remains until creep closure of the salt closes the air gap. This process is expected to take 23 years after panel closure. While the air gap is present, restriction to release of volatile organic compounds (VOCs) through the WPC is controlled in part by the accessible bulkhead. After closure of the air gap, the resistance to release of VOCs through the WPC is dominated by the 100 feet of emplaced ROM salt. Until closure of the air gap, maintenance of the accessible bulkhead shall be conducted, as necessary, to restrict the release of VOCs from the panel.
G1-1a  Permit Design Requirements

The applicable design requirements are provided in Permit Attachment G, Section G-1e(1). The WPC was designed and evaluated to be compliant with these requirements.

G1-1b  Design Component Descriptions

This section presents a description of the components of the WPC to be installed (i.e., steel bulkheads and ROM salt). Technical specifications and drawings for the WPC are provided in Appendices A and B, respectively. Individual specifications address shaft and underground access and materials handling, construction quality control, treatment of surfaces in the closure areas, and applicable design and construction standards. Bulkheads are not included in the specifications since they are routinely constructed and used at the WIPP facility.

G1-1b(1)  Steel Bulkhead

The steel bulkhead (Figure G1-1) serves to block ventilation at the intake and exhaust of the panel and prevents personnel access. This use of a bulkhead is a standard practice and will be constructed as a typical WIPP bulkhead with no access. The bulkhead will consist of a noncombustible steel member frame covered with sheet metal. Telescoping tubular steel or functionally equivalent material is used to bolt the bulkhead to the floor and roof. Flexible flashing material such as a rubber conveyor belt (or other appropriate material) will be attached to the steel frame and the salt as a gasket, thereby providing an effective yet flexible blockage to ventilation air. The steel bulkheads need to be maintained for air flow resistance and the accommodation of panel entry salt creep during the approximately 23-year period following each individual panel closure installation. The WPC relies upon bulkheads for approximately 23 years to control VOC flow. During this period, accessible steel bulkheads may need to be maintained or replaced and the surrounding DRZ may need to be treated or removed to provide air flow resistance as intended. The maintenance activities will include repair and/or replacement of bulkhead components or may include construction of a new accessible bulkhead in front of the existing one.

The WPC design was evaluated assuming an air flow resistance value for the accessible bulkhead during the 23 years after installation. Instead of monitoring each accessible WPC bulkhead for air flow resistance, the performance of accessible WPC bulkheads will be monitored using a two component approach as follows:

- Inspection of accessible WPC bulkheads for integrity and deterioration as required in Permit Attachment E. Corrective actions will be taken in accordance with associated operational procedures to repair observed deterioration as needed. General inspection requirements pertaining to WPC bulkhead inspections (e.g., schedule, frequency, log forms, records, etc.) are as specified in Permit Part 2, Section 2.7.

- Monitoring closed panel emissions of VOCs through a system wide approach utilizing the running annual averages for VOCs derived from the Repository VOC Monitoring Program (Permit Attachment N). Running annual trends will be used to initiate corrective actions that may include additional VOC monitoring activities around specific panels to better locate the source of the increased emissions, corrective actions to limit VOC emissions from the active panel, and/or repair/replacement of accessible WPC bulkheads. Associated Repository VOC Monitoring requirements (e.g., reporting, notification, remedial action, etc.) are as specified in Permit Part 4, Section 4.6.2.
G1-1b(2) **ROM Salt**

ROM salt material from mining operations is delivered by haul truck or load haul dump (LHD) units to the panel closure area in a loose state. As such, it is a noncombustible natural material that is completely compatible with the repository environment. The ROM salt shall be emplaced over a minimum length of 100 feet.

The ROM salt can be emplaced using conventional mining equipment in such a manner that will result in a slope at the ends. The ROM salt shall be emplaced as is from the mining operations or from a storage pile. The ROM salt shall be emplaced up to the block wall in panels with existing block walls installed.

Attachment G, Figure G-4 illustrates the design for panels with and without block walls. Variations in entry height are expected for individual WPCs. For WPCs emplaced in panel entries with block walls, the end slope for the ROM salt may be steepened to accommodate the full length of ROM salt. The emplacement of ROM salt will avoid putting significant lateral pressure on bulkheads.

**G1-2 Technical Specifications**

The technical specifications are included in Appendix A and are summarized in Table G1-31. The specifications cover the general requirements of the system, quality assurance and quality control, site work, and ROM salt emplaced in the panel entries. Bulkheads are not included in the specifications since they are routinely constructed and used at the WIPP facility.

**Table G1-1 Technical Specifications for the WIPP Panel Closure System**

<table>
<thead>
<tr>
<th>Division 1 – General Requirements</th>
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<td>Material and Equipment</td>
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<td>Mobilization and Demobilization</td>
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<td>Section 02222</td>
<td>Excavation</td>
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<td>Section 04100</td>
<td>Run-of-Mine-Salt</td>
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</table>
The Drawings (Appendix B) are summarized in Table G1-42. The drawings illustrate and describe the construction and details for the WPC.

Table G1-2
WIPP Panel Closure System Drawings

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<tr>
<th>Drawing Number</th>
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<tr>
<td>262-001</td>
<td>WIPP Panel Closure System Title Sheet</td>
</tr>
<tr>
<td>262-002</td>
<td>WIPP Panel Closure System, Underground Waste Disposal Panel Configurations (3, 4, 6, 7, 8)</td>
</tr>
<tr>
<td>262-003</td>
<td>WIPP Panel Closure System, Underground Waste Disposal Panel Configurations (1, 2, 5)</td>
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<td>262-004</td>
<td>WIPP Panel Closure System, Construction Details</td>
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References

Figure G1-1
Typical Bulkhead for the WPC
ATTACHMENT G1

DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

Adapted from DOE/WIPP-96-2150
ATTACHMENT G1

DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

TABLE OF CONTENTS

Executive Summary .................................................................................................................... 1

1.0 Introduction ..................................................................................................................... 5
  1.1 Scope .................................................................................................................. 5
  1.2 Design Classification ............................................................................................ 6
  1.3 Regulatory Requirements .................................................................................... 6
    1.3.1 Resource Conservation and Recovery Act (40 CFR §264 and §270) ............. 6
    1.3.2 Protection of the Environment and Human Health ....................................... 6
    1.3.3 Closure Requirements 20.4.1.500 NMAC ............................................... 7
    1.3.4 Mining Safety and Health Administration ................................................... 7
  1.4 Report Organization ............................................................................................. 7

2.0 Design Evaluations ........................................................................................................... 8

3.0 Design Description .......................................................................................................... 9
  3.1 Design Concept ................................................................................................... 9
  3.2 Design Options .................................................................................................... 9
  3.3 Design Components .......................................................................................... 10
    3.3.1 Concrete Barrier ............................................................................... 10
    3.3.2 Explosion- and Construction-Isolation Walls ..................................... 11
    3.3.3 Interface Grouting ............................................................................. 11
  3.4 Panel Closure System Construction ................................................................... 11

4.0 Design Calculations ....................................................................................................... 13

5.0 Technical Specifications ................................................................................................ 14

6.0 Drawings ....................................................................................................................... 15

7.0 Conclusions ................................................................................................................... 16

8.0 References ..................................................................................................................... 22
*Appendix A—Derivation of Relationships for the Air-Flow Models
*Appendix B—Calculations in Support of Panel Gas Pressurization Due to Creep Closure
*Appendix C—FLAC Modeling of the Panel Closure System
*Appendix D—Brine/Cement Interactions
*Appendix E—Previous Studies of Panel-Closure System Materials
*Appendix F—Heat Transfer Model, Derivation Methane Explosion
Appendix G1-G—Technical Specifications
Appendix G1-H—Design Drawings

*Appendices A through F are not included in the Permit.
LIST OF TABLES

Table  
Table G1-1  Constructability Design Calculations Index  
Table G1-2  Technical Specifications for the WIPP Panel-Closure System  
Table G1-3  Panel-Closure System Drawings  
Table G1-4  Compliance of the Design with the Design Requirements

LIST OF FIGURES

Figure  
Figure G1-1  Typical Facilities—Typical Disposal Panel  
Figure G1-2  Main Barrier with Wall Combinations  
Figure G1-3  Design Process for the Panel-Closure System  
Figure G1-4  Design Classification of the Panel-Closure System  
Figure G1-5  Concrete Barrier with DRZ Removal  
Figure G1-6  Explosion-Isolation Wall  
Figure G1-7  Grouting Details
# LIST OF ABBREVIATIONS/ACRONYMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
</tr>
<tr>
<td>AISC</td>
<td>American Institute for Steel Construction</td>
</tr>
<tr>
<td>*CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>cm</td>
<td>centimeter</td>
</tr>
<tr>
<td>°C</td>
<td>degrees Celsius</td>
</tr>
<tr>
<td>°F</td>
<td>degrees Fahrenheit</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>DRZ</td>
<td>disturbed rock zone</td>
</tr>
<tr>
<td>EEP</td>
<td>Excavation Effects Program</td>
</tr>
<tr>
<td>ESC</td>
<td>expansive salt-saturated concrete</td>
</tr>
<tr>
<td>FLAC</td>
<td>Fast Lagrangian Analysis of Continua</td>
</tr>
<tr>
<td>ft</td>
<td>foot (feet)</td>
</tr>
<tr>
<td>GPR</td>
<td>ground-penetrating radar</td>
</tr>
<tr>
<td>Kips</td>
<td>1,000 pounds</td>
</tr>
<tr>
<td>m</td>
<td>meter(s)</td>
</tr>
<tr>
<td>MB-139</td>
<td>Marker Bed 139</td>
</tr>
<tr>
<td>MOC</td>
<td>Management and Operating Contractor (Permit Section 1.5.3)</td>
</tr>
<tr>
<td>MPa</td>
<td>megapascal(s)</td>
</tr>
<tr>
<td>MSHA</td>
<td>Mine Safety and Health Administration</td>
</tr>
<tr>
<td>NMAC</td>
<td>New Mexico Administrative Code</td>
</tr>
<tr>
<td>NMED</td>
<td>New Mexico Environment Department</td>
</tr>
<tr>
<td>NaCl</td>
<td>sodium chloride</td>
</tr>
<tr>
<td>NMVP</td>
<td>no-migration variance petition</td>
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<tr>
<td>psi</td>
<td>pound(s) per square inch</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
</tr>
<tr>
<td>SMC</td>
<td>Salado Mass Concrete</td>
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<tr>
<td>TRU</td>
<td>transuranic</td>
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<tr>
<td>VOC</td>
<td>volatile organic compound(s)</td>
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<td>Waste Isolation Pilot Plant</td>
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ATTACHMENT G1

DETAILED DESIGN REPORT FOR AN OPERATION PHASE PANEL CLOSURE SYSTEM

Executive Summary

Scope. Under contract to the Management and Operating Contractor (MOC), 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. 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.

The report was modified to make it a part of the RCRA Permit issued by the New Mexico Environment Department. The primary change required in the original report was to specify that Panel Closure Design Options A, B, C and E are not approved as part of the facility Permit. Option D is the most robust of the original group of options, and it was specified in the Permit as the design to be constructed for all panel-closures. The concrete to be used for panel closures is salt-saturated Salado Mass Concrete as specified in Permit Attachment G1, Appendix G, instead of the proposed plain concrete. The Permittees may submit proposals to modify the Permit (Part 2), the Closure Plan (Permit Attachment G) and this Appendix (identified as Permit Attachment G1) in the future, as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

Other changes included in this version of the report revised for the permit are minor edits to regulatory citations, deletion of references to the No Migration Variance Petition (no longer required under 40 CFR §268.6), and movement of all figures to the end of the document. Appendices A through F in the original document are not included in this Permit Attachment. Although those Appendices were important in demonstrating that the panel closures will meet the performance standards in the hazardous waste regulations, they do not provide design details or plans to be implemented as Permit requirements. References to these original Appendices were modified to indicate that they were part of the permit application, but are not included in the Permit. In contrast, Appendix G (Technical Specifications) and Appendix H (Design Drawings) are necessary components of future activities and are retained as parts of this Permit Attachment.

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 G1-1). 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 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 an enlarged tapered concrete barrier which will be grouted at the interface and an explosion-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 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.

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 G1-2 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. As noted earlier, Option D is the only option approved for construction as part of the facility permit issued by the NMED.

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. A concrete block wall of sufficient thickness will be used to resist dynamic and salt creep loads.

It was shown (DOE, 1995) that an explosive atmosphere may exist after approximately 20 years.

**Design Components.** The enlarged concrete barrier location within the air-intake and air-exhaust drifts will be determined following observation of subsurface conditions. The enlarged concrete barrier will be composed of salt-saturated Salado Mass 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) repository, a U.S. Department of Energy (DOE) research facility located near Carlsbad, New Mexico, 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. The WIPP facility will be used to dispose transuranic (TRU)-mixed waste.

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 G1-1). 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 G1-1). 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) (see citations in
Section 1.3 below).

Figure G1-3 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
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 G1-4 shows the decision flow logic process used to designate the panel-closure system
as a Class IIIIB 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 and §270)

In accordance with 20.4.1.500 NMAC, incorporating Title 40, Code of Federal Regulations
(CFR), Part 264, Subpart X (40 CFR §264, Subpart X), “Miscellaneous Units,” and 20.4.1.900
NMAC, incorporating 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.

1.3.2 Protection of the Environment and Human Health

The WIPP RCRA Part B permit application indicates that VOCs must not exceed health-based
standards beyond the WIPP site boundary. Worker exposure to VOCs, and VOC emissions to
non waste workers or to the nearest resident will not pose greater than a $10^{-6}$ excess cancer risk
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 20.4.1.500 NMAC

The Permittees 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.

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 in the Part B permit application presented 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. These evaluations were important in demonstrating that the panel closures will adequately restrict releases of VOCs and will be structurally stable during the operations phase of the WIPP. However, these evaluations are not necessary as part of the facility permit and have been deleted from this edited document.
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 proposed in the permit application included (1) a standard concrete barrier, rectangular in shape, or (2) an enlarged tapered concrete barrier. Options (1) and (2) were both proposed to be grouted along the interface and may contain explosion- or construction-isolation walls. Figure G1-2 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 was intended to 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 and explosion-isolation wall is the only option approved in the RCRA facility Permit. 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 approved panel-closure system includes 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:

- 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
  (This is the only option approved in the RCRA facility Permit.)

- 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 to compensate for any void space between the top of the barrier and the salt. The process for selecting these options was proposed to depend on the subsurface conditions at the panel-closure system locations described in the following subsections.

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.

Since the enlarged barrier is required to be constructed for all panel closures, the proposed DRZ investigations are not required as part of the RCRA facility Permit.

3.3 Design Components

The following subsections present system and components design features.

3.3.1 Concrete Barrier

The enlarged concrete barrier consists of Salado Mass 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 G1-5). 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.
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 G1-6).

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 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 was proposed to 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. The construction-isolation wall was not approved as part of the RCRA facility Permit.

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 G1-7). 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, (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. (Step 2 above is not required as part of the RCRA facility Permit, because there are no design options to choose between.)

The explosion-isolation wall will be located approximately 30 feet 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 (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 time for completing one section not to exceed 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 G1-1 summarizes calculations to support the construction details for an explosion-isolation wall, construction-isolation wall, and structural steel formwork for concrete barriers up to 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>
<thead>
<tr>
<th>Section</th>
<th>Design Area</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Explosion-isolation wall</td>
<td>W</td>
</tr>
<tr>
<td>2.0</td>
<td>Explosion-isolation wall seismic-check</td>
<td>S</td>
</tr>
<tr>
<td>3.0</td>
<td>Formwork design</td>
<td>F</td>
</tr>
</tbody>
</table>

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/m³) 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 the MOC. These specifications are included as an attachment in Appendix G and summarized in Table G1-2.

Table G1-2
Technical Specifications for the WIPP Panel-Closure System

<table>
<thead>
<tr>
<th>Division 1 - General Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 01010</td>
</tr>
<tr>
<td>Section 01090</td>
</tr>
<tr>
<td>Section 01400</td>
</tr>
<tr>
<td>Section 01600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division 2 - Site Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 02010</td>
</tr>
<tr>
<td>Section 02222</td>
</tr>
<tr>
<td>Section 02722</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division 3 - Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 03100</td>
</tr>
<tr>
<td>Section 03300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division 4 - Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 04100</td>
</tr>
<tr>
<td>Section 04300</td>
</tr>
</tbody>
</table>
6.0 Drawings

The drawings (Appendix H) are in the engineering file room at the WIPP and are the property of the MOC and summarized in Table G1-3.

### Table G1-3
Panel-Closure System Drawings

<table>
<thead>
<tr>
<th>Drawing Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>762447-E1</td>
<td>Title Sheet</td>
</tr>
<tr>
<td>762447-E2</td>
<td>Underground Waste Disposal Plan</td>
</tr>
<tr>
<td>762447-E3</td>
<td>Air Intake Drift Construction Details</td>
</tr>
<tr>
<td>762447-E4</td>
<td>Air Exhaust Drift Construction Details</td>
</tr>
<tr>
<td>762447-E5</td>
<td>Construction and Explosion Barrier Construction Details</td>
</tr>
<tr>
<td>762447-E6</td>
<td>Grouting and Miscellaneous Details</td>
</tr>
</tbody>
</table>
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 G1-4 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.

- 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.
## Table G1-4
Compliance of the Design with the Design Requirements

<table>
<thead>
<tr>
<th>Type of Requirement</th>
<th>Requirement</th>
<th>Section(s)</th>
<th>Compliance with Requirement</th>
<th>Notes on Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational</strong></td>
<td>Individual panels shall be closed in accordance with the schedule of actual waste emplacement.</td>
<td>2.1.1</td>
<td>Complies</td>
<td>Gas-flow models used for design are based on the waste-emplacement operational schedule.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>2.1.1, 2.1.2</td>
<td>Complies</td>
<td>Gas-flow modeling shows that the VOC flow is less than the design migration limit.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>2.1.2, 4.0</td>
<td>Complies</td>
<td>Stress analyses and design calculations show that the panel-closure system performs as intended.</td>
</tr>
<tr>
<td></td>
<td>The panel-closure system shall comply with its intended functional requirements under a postulated methane explosion.</td>
<td>2.2.3, 2.2.4, 4.0</td>
<td>Complies</td>
<td>The methane explosion studies, fracture propagation studies, and supporting design calculations show that the panel-closure system performs as intended.</td>
</tr>
<tr>
<td></td>
<td>The operational life of the panel-closure system shall be at least 35 years.</td>
<td>2.1.1</td>
<td>Complies</td>
<td>Gas-flow modeling and analyses shows satisfactory performance for at least 35 years.</td>
</tr>
<tr>
<td></td>
<td>The panel-closure system for each individual panel shall not require routine maintenance during its operational life.</td>
<td>3.2</td>
<td>Complies</td>
<td>Passive design components require no routine maintenance.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>2.1.1, 2.1.3, 3.2</td>
<td>Complies</td>
<td>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.</td>
</tr>
<tr>
<td>Type of Requirement</td>
<td>Requirement</td>
<td>Section</td>
<td>Compliance with Requirement</td>
<td>Notes on Compliance</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------</td>
<td>------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Design configuration and essential features</td>
<td>The panel-closure system shall be emplaced in the air-intake and air-exhaust drifts identified by Westinghouse (1995c)</td>
<td>3.2</td>
<td>Complies</td>
<td>The design shows placement in the designated areas for panel closure.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>3.2, 3.3</td>
<td>Complies</td>
<td>The panel-closure system design uses the identified components with dimensions to satisfy the operational requirements of the system.</td>
</tr>
<tr>
<td>Safety</td>
<td>The design class for the panel-closure system shall be IIIb. Design and construction shall follow conventional mining and construction practices.</td>
<td>3.4</td>
<td>Complies</td>
<td>Components are designed according to Class IIIb. The construction sequence for the design followed conventional mining practices.</td>
</tr>
<tr>
<td></td>
<td>The structural analysis for the underground shall use the empirical data acquired from the WIPP Excavation Effects Program.</td>
<td>2.1.2</td>
<td>Complies</td>
<td>The structural analysis uses properties that model creep closure for stress analyses from data acquired in the WIPP Excavation Effects Program.</td>
</tr>
<tr>
<td>Structural and material</td>
<td>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.</td>
<td>2.2.1</td>
<td>Complies</td>
<td>The material compatibility studies showed no degradation of materials and no need for surface treatment.</td>
</tr>
<tr>
<td></td>
<td>The selection and placement of concrete in the concrete barrier shall address potential thermal cracking due to the heat of hydration.</td>
<td>2.2.2</td>
<td>Complies</td>
<td>The heat generation studies show that hydration temperatures are controlled by appropriate selection of cement type and placement temperature.</td>
</tr>
<tr>
<td></td>
<td>The panel-closure system shall sustain the dynamic pressure and subsequent temperature generated by a postulated methane explosion.</td>
<td>2.2.3, 2.2.4, 4.0</td>
<td>Complies</td>
<td>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.</td>
</tr>
<tr>
<td>Type of Requirement</td>
<td>Requirement</td>
<td>Section</td>
<td>Compliance with Requirement</td>
<td>Notes on Compliance</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>---------</td>
<td>-----------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Construction</td>
<td>The panel-closure system shall use to the extent possible normal construction practices according to existing standards.</td>
<td>3.4</td>
<td>Complies</td>
<td>The specifications include normal construction practices used in the underground at WIPP and according to the most current steel and concrete specifications.</td>
</tr>
<tr>
<td></td>
<td>During construction of the panel-closure system, a quality assurance/quality control program shall be established to verify material properties and construction practices.</td>
<td>3.4</td>
<td>Complies</td>
<td>The specifications include materials testing to verify material properties and construction practices.</td>
</tr>
<tr>
<td></td>
<td>The construction specification shall take into account the shaft and underground access capacities and services for materials handling.</td>
<td>3.4</td>
<td>Complies</td>
<td>The specifications allow construction within the capacities of underground access.</td>
</tr>
</tbody>
</table>
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 proposed 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. Only the enlarged barrier with an explosion-isolation wall is approved as part of the RCRA facility Permit.

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 was proposed to 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 may be used to select
the optimum location within each entry and exhaust drift for the enlarged barrier 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.
8.0 References


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Figure G1-1
Typical Facilities—Typical Disposal Panel
Main Barrier with Wall Combinations

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
Design Process for the Panel-Closure System

PERMIT ATTACHMENT G1
Page G1-27 of 31
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 component(s)?

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 NO

C. YES NO

D. YES NO

E. YES N/A NO

F. YES NO

G. YES NO

H. YES NO

I. YES NO

---

**Figure G1-4**

Design Classification of the Panel-Closure System
Figure G1-5
Concrete Barrier with DRZ Removal
Figure G1-6
Explosion-Isolation Wall
Figure G1-7
Grouting Details
ATTACHMENT G1
APPENDIX A

TECHNICAL SPECIFICATIONS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO
Section 01010

Summary of Work

Part 1 - General

1.1 Scope

This section includes:

- Scope of Work
- Definitions and Abbreviations
- List of Drawings
- Work by Others
- Contractors Use of Site
- Contractors Use of Facilities
- Work Sequence
- Work Plan
- Health and Safety Plan (HASP)
- Contractor Quality Control Plan (CQCP)
- Submittals

1.2 Scope of Work

The Contractor shall furnish all labor, materials, equipment and tools to construct two (2) WIPP panel closure systems for Panels 1 through 10. Each WIPP Panel closure system consists of two steel bulkheads or one steel bulkhead and one block wall and ROM salt, one of each to be installed in the air-intake drift and the air-exhaust drift of a waste disposal panel, as shown on the Drawings and described in these Specifications. Unless otherwise agreed by Nuclear Waste Partnership, the Contractor shall use Nuclear Waste Partnership supplied equipment underground. Such use shall be coordinated with Nuclear Waste Partnership and may include the use of Nuclear Waste Partnership qualified operators.

The scope of work shall include but not necessarily be limited to the following units of work:

- Develop work plan, health and safety plan (HASP) and contractors quality control plan (CQCP) and submit it to the designated WIPP authority for approval
- Mobilize to site
- Coordinate construction with WIPP operations
- Perform the following operations for the air-intake entry and the air-exhaust entries that do not contain block walls:
  1. Prepare the surfaces for the ROM salt
  2. Construct the inner steel bulkhead
  3. Place ROM salt material in multiple layers
  4. Construct the outer steel bulkhead
5. Clean up construction areas in underground and above ground
6. Submit all required record documents
7. Demobilize from site

- Perform the following operations for the air-intake entry and the air-exhaust entries that contain block walls:
  1. Prepare the surfaces for the ROM salt
  2. Place ROM salt material in multiple layers
  3. Construct the outer steel bulkhead
  4. Clean up construction areas in underground and above ground
  5. Submit all required record documents
  6. Demobilize from site

1.3 Definitions and Abbreviations

Definitions

Block wall—Existing mortared concrete brick wall adjacent to the panel waste disposal area as shown in the drawings.

Creep—Viscoplastic deformation of salt under deviatoric stress.

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.

Run-of-Mine Salt (ROM)—Salt obtained from mining operations or a storage pile emplaced in an uncompacted state.

Volatile organic compound (VOC)—Any VOC with Hazardous Waste Facility Permit emission limits.

Nuclear Waste Partnership—Nuclear Waste Partnership LLC as the construction management authority.

Abbreviations/Acronyms

ACI American Concrete Institute
ANSI American National Standards Institute
ASTM American Society for Testing and Materials
CFR Code of Federal Regulations
CQCP Contractor Quality Control Plan
DOE U.S. Department of Energy
dwg drawing
EPA U.S. Environmental Protection Agency
HASP Health and Safety Plan
1.4 List of Drawings

The following drawings are made a part of this specification:

- DWG 262-001 WIPP Panel Closure System Title Sheet
- DWG 262-002 WIPP Panel Closure System, Underground Waste Disposal Panel Configurations (3,4,6,7,8)
- DWG 262-003 WIPP Panel Closure System, Underground Waste Disposal Panel Configurations (1,2,5)
- DWG 262-004 Construction Details

1.5 Work by Others

Survey

Survey work to locate, control, confirm, and complete the work will be performed by Nuclear Waste Partnership. Survey work for record purposes will be performed by Nuclear Waste Partnership. The Contractor shall be responsible for developing the ROM salt to fit the excavation.

Nuclear Waste Partnership may elect to perform certain portions or all of the work. The work performed by the Nuclear Waste Partnership will be defined prior to the contract. Unless otherwise agreed by Nuclear Waste Partnership, the Contractor shall use underground equipment furnished by Nuclear Waste Partnership for construction of the steel bulkheads and placement of ROM salt. Underground mining personnel who are qualified for the operation of such underground construction equipment may be made available to the Contractor. The use of WIPP facility government furnished equipment shall be coordinated with Nuclear Waste Partnership.

1.6 Contractor’s Use of Site

Site Conditions

The WIPP site is located near Carlsbad in southeastern New Mexico, as shown on the Drawings. The underground arrangements and location of the WIPP waste disposal panels are shown on the Drawings. The work is to construct steel bulkheads and place ROM salt in the air-intake and air-exhaust drifts of one of the panels upon completion of the disposal phase of that panel. The waste disposal panels are located approximately 2,150 ft (655 m) below the ground.
surface. The Contractor shall visit the site and become familiar with the site and site conditions prior to preparing a bid proposal.

**Contractor’s Use of Site and Coordination of Contractor’s Work**

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 so designated.

Limited space within the underground area will be designated for the Contractor's use for storage of material and setup of equipment.

### 1.7 Contractor’s Use of Facilities

Existing facilities at the site available for use by the Contractor are:

- Waste shaft conveyance
- Salt skip hoist
- 460 volt AC, 3 phase power
- Water (underground, at waste shaft only) (above ground, at location designated by Nuclear Waste Partnership)
- Fuel underground and above ground at fueling stations

Contractor will only enter areas of the underground designated by NWP.

NWP will provide mine safety inspection services and will release areas for work after determining that such areas are safe for the work to be performed. Remediation of areas prior to performing work is the responsibility of NWP.

NWP will establish the ventilation needed for the contractor to perform work. The Contractor will not enter areas of the underground that have insufficient ventilation.

Additional information on mobilization and demobilization to these facilities is presented in Section 02010.

### 1.8 Work Sequence

Work Sequence shall be as shown on the Drawings and as directed by Nuclear Waste Partnership.

### 1.9 Work Plans

The Contractor shall prepare Work Plans fully describing the proposed fabrication, installation and construction for each WIPP Panel Closure System. The work plan shall define proposed materials, equipment and construction methods. The Work Plan shall state supporting processes, procedures, materials safety data sheets, and regulations by reference. The work plans shall address precautions related to the Job Hazards Check List. The Work Plan shall
address limitations such as hold and witness points. The Work Plans shall address prerequisites for work. Nuclear Waste Partnership shall approve the Work Plan and 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. The Contractor shall prepare a project-specific HASP taking into account all applicable sections of the WIPP Safety Manual. Personnel shall be qualified to work underground as necessary. Personnel operating heavy construction equipment shall be qualified to operate such equipment. The Contractor shall also perform a Job Hazard Analysis (JHA) in accordance with applicable NWP procedures. Nuclear Waste Partnership shall approve the HASP and JHA and no work shall be performed prior to approval of the HASP and JHA.

1.11 Contractor Quality Control Plan (CQCP)

The Contractor shall prepare a CQCP identifying personnel and procedures necessary to produce an end product, which complies with the contract requirements. The CQCP shall comply with applicable Nuclear Waste Partnership requirements, including operator training and qualification; and Section 01400, Contractor Quality Control, of this Specification. Nuclear Waste Partnership shall approve the CQCP and no work shall be performed prior to approval of the CQCP.

1.12 Submittals

Submittals shall be in accordance with Nuclear Waste Partnership Submittal Procedures and as required by the individual Specifications.

Part 2 - Products

Not used.

Part 3 - Execution

Not Used.

End of Section
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

1.2 Quality Assurance

For products or workmanship specified by association, trade, or Federal Standards, the Contractor shall 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, at his own expense, a copy of the standards referenced in the individual Specification sections and shall maintain that copy at the job site until completion and acceptance of the work.

Should specified Reference Standards conflict with the contract documents, the Contractor shall request clarification from Nuclear Waste Partnership before proceeding.

1.3 Schedule of References

Various publications referenced in other sections of the Specifications establish requirements for the work. These references are identified by document number and title. The addresses of the organizations responsible for these publications are listed below.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Name</th>
<th>Address</th>
<th>Phone</th>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
<td>25 West 43rd St. New York NY 10036</td>
<td>212-642-4900</td>
<td>212-398-0023</td>
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<tr>
<td>ASTM</td>
<td>ASTM International</td>
<td>100 Barr Harbor Drive, P.O. Box C700 West Conshohocken, PA 19428-2959</td>
<td>610-832-9585</td>
<td>610-832-9555</td>
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</table>
Waste Isolation Pilot Plant
DRAFT Hazardous Waste Permit
February 2014

CFR
Code of Federal Regulations
Government Printing Office
732 N. Capital Street, NW
Washington, DC 20402-0002
Ph: 202-512-1530
Fax: 202 512-1262

EPA
Environmental Protection Agency (Region VI)
1455 Ross Avenue
Suite 1200
Dallas, TX 75202-2733
Ph: 214-665-2200
Fax: 800-887-6063

FTM-STD
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

NIST
National Institute of Standards and Technology
100 Bureau Drive, Stop 1000
Gaithersburg, MD 20899-1000
Ph: 301-975-6478
Fax: 301-975-8295

NTIS
National Technical Information Service
U.S. Department of Commerce
5301 Shawnee Rd
Alexandria, VA 22312
Ph: 703-605-6000
Fax: 703-321-8547

End of Section
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
- 04100 - Run-of-Mine Salt

1.3 Contractor Quality Control Plan (CQCP)

The Contractor shall prepare a Contractor Quality Control Plan (CQCP) describing the methods to be used to verify the performance of the engineered components of the Panel Closure System. The quality control plan for the run-of-mine (ROM) salt shall detail the methods the Contractor proposes to meet the minimum requirements, and the standard quality control test methods to be used to verify compliance with minimum requirements. Equipment methods employed shall be traceable to standard quality control tests as approved in the CQCP. No work shall be performed prior to Nuclear Waste Partnership approval of the CQCP.

1.4 References and Standards

Refer to individual specification sections for standards referenced therein, and to Section 01090, Reference Standards, for general listing. Additional standards will be identified in the CQCP.

Standards referenced in this section are as follows:

ASTM E 329-01b  Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

ASTM E 543-02  Standard Practice for Agencies Performing Nondestructive Testing
### 1.5 Quality Assurance

The Contractor shall:

- Monitor 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 with qualified persons to produce required and specified quality.

### 1.6 Tolerances

The Contractor shall:

- Monitor excavation, fabrication, and tolerances in order to produce acceptable work. The Contractor shall not permit tolerances to accumulate.

### 1.7 Testing Services

Unless otherwise agreed by Nuclear Waste Partnership, the Contractor shall employ an independent firm qualified to perform the testing services and other services specified in the individual Specification sections, and as may otherwise be required by Nuclear Waste Partnership. Testing and source quality control may occur on or off the project site. An independent firm is one that is not associated with the firm performing the work being tested.

The testing laboratory shall comply with applicable sections of the Reference Standards and shall be authorized to operate in the State of New Mexico.

Testing equipment shall be calibrated at reasonable intervals traceable to either the National Institute of Standards and Technology or accepted values of natural physical constants.

### 1.8 Inspection Services

The Contractor may employ an independent individual(s) to perform inspection services as a supplement to the Contractor's quality control as specified in the individual Specification sections, and as may be required by Nuclear Waste Partnership. Inspection may occur on or off the project site. An independent individual is one that did not perform the work being inspected.

The inspectors shall comply with applicable sections of the Reference Standards.

### 1.9 Submittals

The Contractor shall submit a CQCP 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 as well as 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 Institute of Standards and Technology.
Standards and Technology with memorandum of remedies of any deficiencies reported by the inspection.

The Contractor shall submit the names and qualifications of personnel proposed to perform the required inspections, along with their individual qualifications and certifications. Once approved by Nuclear Waste Partnership these personnel shall be available as may be required to promptly and efficiently complete the work.

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 is the individual with the responsibility for the overall management of the project, including quality and production.

3.2 Contractor Quality Control Plan

3.2.1 General

The Contractor shall supply, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control Plan (CQCP) which implements the requirements of the Contract. The CQCP shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. Construction shall not begin until the CQCP is approved by Nuclear Waste Partnership.

3.2.2 Content of the Contractor Quality Control Plan (CQCP)

The CQCP shall cover applicable construction operations, both on site and off site, including work by subcontractors, fabricators, suppliers, and purchasing agents and shall include, as a minimum, the following items:

- A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the Contractor Quality Control (CQC) staff shall implement the control system for aspects of the work specified.

- The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

- A description of CQCP responsibilities and a delegation of authority to adequately perform the functions described in the CQCP, including authority to stop work.
• 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 Nuclear Waste Partnership submittal procedures.

• Control, verification, and acceptance testing procedures as may be necessary to ensure that the work is completed to the requirements of the Drawings and Specifications.

• Procedures for tracking deficiencies from identification, through acceptable corrective action, to verification that identified deficiencies have been corrected.

• Reporting procedures, including proposed reporting formulas.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is conditional. Nuclear Waste Partnership reserves the right to require the Contractor to make changes in the CQCP and operations, including removal of personnel, if necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQCP, the Contractor shall notify Nuclear Waste Partnership in writing of any proposed change. Proposed changes are subject to acceptance by Nuclear Waste Partnership prior to implementation.

3.3 Tests

3.3.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to complete the work to contract requirements. Upon request, the Contractor shall furnish, at his own expense, duplicate samples of test specimens for testing by Nuclear Waste Partnership. The Contractor shall perform, as necessary, the following activities and permanently record the results:

• Verify that testing procedures comply with contract requirements and are the most current version of such procedures.

• 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 the applicable test documentation requirements, have been prepared.

• Record the results of tests taken, both passing and failing. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. If approved by Nuclear Waste Partnership, 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 offsite or commercial test facility will be provided directly to Nuclear Waste Partnership.

- The Contractor may elect to develop an equipment specification with construction parameters based upon test results of a test section of emplaced ROM salt. The equipment specification based upon construction parameters shall be traceable to standard test results identified in the CQCP. Specification paragraph reference, location where construction parameters were taken, and the sequential control number identifying the construction parameters will be given. If approved by Nuclear Waste Partnership, actual construction parameter reports may be submitted later with a reference to the recording of construction parameters, location, time and date taken.

3.4 Testing Laboratory

The testing laboratory shall provide qualified personnel to perform specified sampling and testing of products in accordance with specified standards, and the requirements of Contract Documents.

Reports indicating results of tests, and compliance or noncompliance with the contract documents will be submitted in accordance with Nuclear Waste Partnership submittal procedures. Testing by an independent firm does not relieve the Contractor of the responsibility to perform the work to the contract requirements.

3.5 Inspection Services

The inspection firm shall provide qualified personnel to perform specified inspection of products in accordance with specified standards.

Reports indicating results of the inspection and compliance or noncompliance with the contract documents will be submitted in accordance with Nuclear Waste Partnership submittal procedures.

Inspection by the independent individual(s) does not relieve the Contractor of the responsibility to perform the work to the contract requirements.

3.6 Completion Inspection

3.6.1 Pre-Final Inspection

At appropriate times and at the completion of all work, the Contractor shall conduct an inspection of the work and develop a list of items which do not conform to the Drawings and Specifications. The Contractor shall then notify Nuclear Waste Partnership that the work is ready for inspection. Nuclear Waste Partnership will perform this inspection to verify that the work is satisfactory and appropriately complete. A final list will be developed as a result of this inspection. The Contractor shall ensure that all items on this list are corrected and notify Nuclear Waste Partnership 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.
3.6.2 Final Acceptance Inspection

The final acceptance inspection will be formally scheduled by Nuclear Waste Partnership based upon notice from the Contractor. This notice will be given to Nuclear Waste Partnership at least 14 days prior to the final acceptance inspection. The Contractor shall ensure that specific items previously identified as unacceptable, along with remaining work performed under the contract, will be complete and acceptable prior to the final acceptance inspection.

3.7 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 approved by Nuclear Waste Partnership.

3.8 Notification of Noncompliance

Nuclear Waste Partnership will notify the Contractor of any 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, Nuclear Waste Partnership 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 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
- 04100 - Run-of-Mine Salt

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 appropriate for use underground at the WIPP site.

1.4 Products

The Contractor shall specify in the Work Plan, or in subsequently required submittals, the proposed products including, but not limited to steel bulkheads and ROM salt. The proposed products shall be supported by laboratory test results as required by the Specifications. Products shall be subject to approval by Nuclear Waste Partnership.

1.5 Transportation and Handling

The Contractor shall:

- Transport and handle products in accordance with manufacturers’ 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

The Contractor shall:

• 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.

• Provide ventilation to prevent condensation and degradation of products.

• Store loose granular materials on solid flat surfaces in a well-drained area and 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 and 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 Nuclear Waste Partnership approval.

1.7.2 Product Substitutions

The Contractor may not substitute products after the proposed products have been approved by Nuclear Waste Partnership 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 Nuclear Waste Partnership for approval.

Part 2 - Products

Not used.

Part 3 - Execution

Not used.

End of section.
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.

Nuclear Waste Partnership will provide utilities 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 Contractor Use of Site

The Contractor shall use only those areas specifically designated for his use by Nuclear Waste Partnership. The Contractor shall limit his on-site travel to the specific routes required for performance of his work, and designated by Nuclear Waste Partnership.
3.3 Use of Existing Facilities

Existing facilities available for use by the Contractor are:

- Waste shaft conveyance
- Salt skip hoist
- 460 Volt AC, 3 phase power
- Water underground at waste shaft only
- Water on surface at location designated by Nuclear Waste Partnership
- Fuel for construction equipment on the surface and underground

The Contractor shall arrange for use of the facilities with Nuclear Waste Partnership and coordinate his actions and requirements with ongoing Nuclear Waste Partnership operations.

Use of water in the underground will be restricted. No washout or cleanup will be permitted in the underground except as designated by Nuclear Waste Partnership. Above ground washout or cleanup of equipment will be allowed in the areas designated by Nuclear Waste Partnership.

The Contractor is cautioned to be aware of the physical dimensions of the waste conveyance and the air lock.

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 Nuclear Waste Partnership 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. Contractor’s equipment and materials shall be removed and disturbed areas restored. Utilities shall be removed to their connection points unless otherwise directed by Nuclear Waste Partnership.

3.5 Site Cleanup

At conclusion of the work, the Contractor shall remove trash, waste, debris, excess construction materials, and restore the affected areas as close to their prior condition as practical, to the satisfaction of Nuclear Waste Partnership. A final inspection will be conducted by Nuclear Waste Partnership and the Contractor before final payment is approved.

End of section.
Section 02222

Excavation

Part 1 - General

1.1 Scope

This section includes:

- Excavation for surface preparation and leveling of surrounding areas for ROM salt
- Disposition of excavated materials
- Field measurement and survey

1.2 Related Sections

- 01010 - Summary of Work
- 01600 - Material and Equipment

1.3 Reference Documents


1.4 Field Measurements and Survey

Survey required for performance of the work will be provided by Nuclear Waste Partnership.

Part 2 - Products

Not used.

Part 3 - Execution

3.1 Excavation for Surface Preparation and Leveling of Surrounding Areas for Salt

The Contractor shall inspect the panel entry excavations and perform any necessary ground control to ensure worker safety. The contractor may install ground support, as necessary, to address loose material (rock slabs). The surface preparation of the floor shall produce a surface suitable for placing the first layer of ROM salt.

3.2 Disposition of Excavated Materials

The Contractor shall dispose of excavated materials as directed by Nuclear Waste Partnership.

3.3 Field Measurements and Survey

Survey required for performance of the work will be provided by Nuclear Waste Partnership. The Contractor shall protect survey control points, benchmarks, etc., from damage by his
operations. Nuclear Waste Partnership will verify that the Contractor has excavated to the required lines and grades. No salt shall be emplaced until approved by Nuclear Waste Partnership.

End of section.
Section 04100
Run-of-Mine Salt

Part 1 - General

1.1 Scope
This section includes:

- Salt Placement

1.2 Related Sections

- 01010 - Summary of Work
- 01400 - Contractor Quality Control
- 01600 - Material and Equipment

1.3 Submittals for Review and Approval

The salt emplacement method, dust control plan and other safety-related material shall be approved by Nuclear Waste Partnership.

1.4 Quality Assurance

The Contractor shall perform the work in accordance with the CQCP.

Part 2 - Products

2.1 Salt Material

The salt is ROM salt and requires no grading or compaction. The salt shall be free of organic material that could impact performance of the closure such as trash, wood, plastic, rubber, and other organic debris.

Part 3 - Execution

3.1 General

The Contractor shall furnish labor, material, equipment and tools to handle and place the salt.

The Contractor shall use underground equipment and underground mine personnel as required in Part 1.5, Work by Others in Section 01010 Summary of Work. Nuclear Waste Partnership will supply ROM salt. The Contractor shall make suitable arrangements for transporting and placing the ROM salt.

3.2 Installation

ROM salt shall be transported to the panel closure area after the construction of the inner steel bulkhead for those panels that do not already have walls constructed. The ROM salt is not
required to achieve a specified density. The salt shall be free of organic material that could impact performance of the closure, such as trash, wood, plastic, rubber, and other organic debris.

Salt may be emplaced in layers to facilitate the construction. The ROM salt is emplaced in layers with an appropriate slope near the ends of the WIPP Panel Closure System. The inner and outer salt emplacements are designated on the drawings.

For the inner emplacement of the ROM salt, the salt is emplaced at an appropriate angle of repose. Initially, there shall be no gap left between salt and roof or sidewalls. Hand placement or the use of push plates can be used to fill the voids if necessary. ROM salt will be pushed up to the roof against explosion isolation walls in Panels 1, 2, and 5 as designated in the drawings.

### 3.3 Field Quality Control

The Contractor shall provide a Quality Control Inspector to inspect the emplacement of salt.

End of Section.
ATTACHMENT G1
APPENDIX B

DESIGN DRAWINGS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO
## DESIGN DRAWINGS

### PANEL CLOSURE SYSTEM

**WASTE ISOLATION PILOT PLANT**  
**CARLSBAD, NEW MEXICO**

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<thead>
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<th>Title</th>
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<td>262-001</td>
<td>WIPP Panel Closure System Title Sheet</td>
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<td>262-002</td>
<td>WIPP Panel Closure System, Underground Waste Disposal Panel</td>
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<td>Configurations (3, 4, 6, 7, 8)</td>
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<td>262-004</td>
<td>WIPP Panel Closure System, Construction Details</td>
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CONSTRUCTION SEQUENCE

1. CONTRACTORshall install the new closure system and test it for deep penetration with lab closure fluid for 15 days

2. CONTRACTORshall install the new closure system and test it for deep penetration with lab closure fluid for 15 days

3. CONTRACTORshall install the new closure system and test it for deep penetration with lab closure fluid for 15 days

4. THE NEW CLOSURE SYSTEM shall be maintained for 15 days after installation

5. SALT shall be installed flush with the slab

6. THE VENTILATION SYSTEM shall be on test 1200 PPM.
ATTACHMENT G1
APPENDIX B

DESIGN DRAWINGS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO
ATTACHMENT G1
APPENDIX B

DESIGN DRAWINGS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>262-001</td>
<td>WIPP Panel Closure System Title Sheet</td>
</tr>
<tr>
<td>262-002</td>
<td>WIPP Panel Closure System, Underground Waste Disposal Panel Configurations (3, 4, 6, 7, 8)</td>
</tr>
<tr>
<td>262-003</td>
<td>WIPP Panel Closure System, Underground Waste Disposal Panel Configurations (1, 2, 5)</td>
</tr>
<tr>
<td>262-004</td>
<td>WIPP Panel Closure System, Construction Details</td>
</tr>
</tbody>
</table>
ATTACHMENT G1
APPENDIX G

TECHNICAL SPECIFICATIONS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO
# ATTACHMENT G1

## APPENDIX G

## TECHNICAL SPECIFICATIONS

### PANEL CLOSURE SYSTEM

#### WASTE ISOLATION PILOT PLANT

#### CARLSBAD, NEW MEXICO

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Division</th>
<th>Section</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 1 - GENERAL REQUIREMENTS</td>
<td>Section 01010</td>
<td>Summary of Work</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Part 1 - General</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>Scope</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>Scope of Work</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>Definitions and Abbreviations</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1.4</td>
<td>List of Drawings</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>Work by Others</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1.6</td>
<td>Contractor’s Use of Site</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>Contractor’s Use of Facilities</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>1.8</td>
<td>Work Sequence</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>1.9</td>
<td>Work Plan</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>1.10</td>
<td>Submittals</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Part 2 - Products</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Part 3 - Execution</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Section 01090</td>
<td>Reference Standards</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Part 1 - General</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>Scope</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>Quality Assurance</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>Schedule of References</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Section 01400</td>
<td>Contractor Quality Control</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Part 1 - General</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>Scope</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>Related Sections</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>Contractor Quality Control Plan</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>1.4</td>
<td>References and Standards</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>Quality Assurance</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>1.6</td>
<td>Tolerances</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>Testing Services</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>1.8</td>
<td>Inspection Services</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>1.9</td>
<td>Submittals</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Part 2 - Products</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Part 3 - Execution</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>3.1</td>
<td>General</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td>Quality Control Plan</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>3.3</td>
<td>Quality Control Organization</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>Tests</td>
<td>17</td>
</tr>
</tbody>
</table>
3.5 Testing Laboratory ......................................................... 18
3.6 Inspection Services ..................................................... 18
3.7 Completion Inspection ................................................ 19
3.8 Documentation .......................................................... 19
3.9 Notification of Noncompliance ..................................... 20
Section 01600 – Material and Equipment ............................. 21
Part 1 – General ............................................................. 21
1.1 Scope ........................................................................... 21
1.2 Related Sections ......................................................... 21
1.3 Equipment ..................................................................... 21
1.4 Products ........................................................................ 21
1.5 Transportation and Handling ....................................... 21
1.6 Storage and Protection ................................................ 22
1.7 Substitutions ................................................................ 22
Part 2 – Products ............................................................. 22
Part 3 – Execution ............................................................. 22
DIVISION 2 – SITE WORK .................................................. 23
Section 02010 – Mobilization and Demobilization ................ 25
Part 1 – General ............................................................. 25
1.1 Scope ........................................................................... 25
1.2 Related Sections ......................................................... 25
Part 2 – Products ............................................................. 25
Part 3 – Execution ............................................................. 25
3.1 Mobilization of Equipment and Facilities to Site ............. 25
3.2 Use of Site ...................................................................... 25
3.3 Use of Existing Facilities .............................................. 26
3.4 Demobilization of Equipment and Facilities .................. 26
3.5 Site Cleanup ................................................................... 26
Section 02222 – Excavation ................................................ 27
Part 1 – General ............................................................. 27
1.1 Scope ........................................................................... 27
1.2 Related Sections ......................................................... 27
1.3 Reference Documents ................................................ 27
1.4 Field Measurements and Survey .................................. 27
Part 2 – Products ............................................................. 27
Part 3 – Execution ............................................................. 27
3.1 Excavating for Concrete Barrier .................................... 27
3.2 Excavating for Surface Preparation and leveling of Base Areas for Isolation Walls ...................................................... 28
3.3 Disposition of Excavated Materials ................................ 28
3.4 Field Measurements and Survey .................................. 28
Section 02722 – Grouting .................................................. 29
Part 1 – General ............................................................. 29
1.1 Scope ........................................................................... 29
1.2 Related Sections ......................................................... 29
1.3 References ..................................................................... 29
1.4 Submittals for Review and Approval ................................ 29
1.5 Submittals for Construction ......................................... 29
Part 2 – Products ............................................................. 30
Waste Isolation Pilot Plant
Hazardous Waste Permit
October 1, 2012

Part 1 - General ........................................................................................................ 51
  1.1 Scope ........................................................................................................... 51
  1.2 Related Sections ...................................................................................... 51
  1.3 References ............................................................................................... 51
  1.4 Submittals for Review and Approval .................................................. 51
  1.5 Submittals at Completion ....................................................................... 51
  1.6 Quality Assurance .................................................................................. 52
  1.7 Delivery Storage Handling ..................................................................... 52
Part 2 - Products .................................................................................................. 52
  2.1 Mortar Mix ................................................................................................. 52
Part 3 - Execution ................................................................................................. 52
  3.1 General ....................................................................................................... 52
  3.2 Mortar Mixing ........................................................................................... 52
  3.3 Installation .................................................................................................. 52
  3.4 Field Quality Control .............................................................................. 53
Section 04300 - Unit Masonry System ................................................................. 55
Part 1 - General ...................................................................................................... 55
  1.1 Scope .......................................................................................................... 55
  1.2 Related Sections ........................................................................................ 56
  1.3 References ................................................................................................ 55
  1.4 Submittals for Revision and Approval .................................................. 55
  1.5 Quality Assurance ................................................................................... 55
Part 2 - Products .................................................................................................. 55
  2.1 Concrete Masonry Units ........................................................................ 55
  2.2 Mortar .......................................................................................................... 56
Part 3 - Execution .................................................................................................. 56
  3.1 General ....................................................................................................... 56
  3.2 Installation .................................................................................................. 56
  3.3 Field Quality Control .............................................................................. 56
LIST OF FIGURES

Figure G1G-1 Plan Variations
Figure G1G-2 Waste Handling Shaft Cage Dimensions
Figure G1G-3 Waste Shaft Collar and Airlock Arrangement
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 G1-1 “Plan Variations.”

- Concrete barrier without disturbed rock zone (DRZ) removal in combination with construction isolation wall (Sketch A).
- Concrete barrier without DRZ removal in combination with an explosion isolation wall (Sketch B).
- Concrete barrier with DRZ removal up through clay seam G and down through marker bed 139 (MB 139) in combination with a construction isolation wall (Sketch C).
- Concrete barrier with DRZ removal in combination with an explosion isolation wall (Sketch D) (This is the only approved configuration in this Permit).

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 isolation wall
  — Construct the explosion isolation wall
  — Excavate the DRZ
  — 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 steel frame 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 is at least 1 order of magnitude below the health-based 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 concentration level for a VOC in air that must not be exceeded at the point of compliance during the WIPP operational period.
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 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 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 levels at the WIPP, which is the 16-section land withdrawal boundary.

Remote-handled waste—Any of the various forms of high beta-gamma defense TRU waste requiring remote handling and with 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.

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. Mine Safety and Health Administration
NMAC New Mexico Administrative Code
NMED New Mexico Environment Department
MOC Management and Operating Contractor (Permit Section 1.5.3)
RCRA Resource Conservation and Recovery Act
SMC Salado Mass Concrete
USACE U.S. Army Corps of Engineers
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 the Permittees. All survey measurements for record purposes will also be performed/supplied by the Permittees. The Contractor shall be responsible for verifying the excavation dimensions to develop the form work to fit the excavation.

Excavation

The Permittees may elect to perform certain portions of the work, notably the excavation. The work performed by the Permittees 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 the Engineer.

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 the Engineer.

1.9 Work Plan

The Contractor shall prepare and submit for approval by the Engineer 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 Submittals

Submittals to the Permittees shall be in accordance with the Permittees’ Submittal Procedures and as required by the individual specifications. Approval by the Permittees shall not constitute approval by NMED. Any submittals that propose a change to the panel closure requirements of this Permit (e.g., changes in grout composition, detailed design, etc.) shall be submitted to NMED as required by 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

Part 2 - Products

Not used.
Part 3 – Execution

Not Used.

End of Section
Section 01090 - Reference Standards

Part 1 - General

1.1 Scope

This section includes:

- Provision of Reference Standards at Site.

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 agreement between the Permittees and the contractor.

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 60601-2004
<table>
<thead>
<tr>
<th>Agency</th>
<th>Address</th>
<th>Ph.</th>
<th>Fax.</th>
</tr>
</thead>
</table>
| ANSI    | American National Standards Institute  
11 West 42nd St.  
New York, NY 10036 | 212-642-4900 | 212-302-1286 |
| API     | American Petroleum Institute  
1220 L. St., NW  
Washington, DC 20005 | 202-682-8375 | 202-962-4776 |
| ASTM    | American Society for Testing and Materials  
1916 Race St.  
| AWS     | American Welding Society  
550 LeJeune Road  
Miami, FL 33135 | 800-443-9353 | 305-443-7559 |
Washington, DC 20402 | 202-783-3238 | 202-223-7703 |
| EPA     | Environmental Protection Agency Public Information Center  
Ariel Rios Building  
1200 Pennsylvania Avenue, NW  
Washington, DC 20460 | 202-272-0167 | |
| FTM-STO | Federal Test Method Standards Standardization Documents Order Desk Bldg. 4D  
700 Robbins Ave.  
| NRMCA   | National Ready Mixed Concrete Association  
900 Spring St. | | |
End of Section
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 the Engineer, 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 – Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- ASTM C1093 – Practice for Accreditation of Testing Agencies for Unit Masonry
- ASTM E329 – Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction
ASTM E543 —— Practice for Determining the Qualification of Nondestructive Testing Agencies

ASTM E548 —— 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 the Engineer, 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 the Engineer. 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 the Engineer. 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 the Engineer, 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 the Permittees’ 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 the Engineer.)

- 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 agreed upon by the Engineer.

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 Permittees reserve 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 the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

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 the Engineer.

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 shall be on the site at all times during construction and 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; be physically present at the construction site during work on their areas of responsibility; 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 the Engineer 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 the Engineer duplicate samples of test specimens for possible testing.
by the Engineer. 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 the Engineer, 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 the Engineer. 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 the Engineer 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 the Permittees’ 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, the Engineer 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 the Permittees’ 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 the Engineer that the facility is complete and is ready for the “Prefinal” inspection. The Engineer 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 the Engineer 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 the Engineer based upon notice from the Contractor. This notice will be given to the Engineer 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 the Engineer 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

The Engineer 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, the Engineer 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 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 the Engineer.

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 the Engineer'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 the Engineer 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 the Engineer 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.
DIVISION 2—SITE WORK
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 the Engineer. Facilities shall be located as near as practical to the existing utilities.

The Permittees 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 the Engineer.

The Contractor shall limit his on-site travel to the specific routes required for performance of his work, and designated by the Engineer.
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 the Engineer).

The Contractor shall arrange for use of the facilities with the Engineer 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 the Engineer.

The Contractor is cautioned to be aware of the physical dimensions of the waste conveyance and the air lock (see Figures G1-2 and G1-3, 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 the Engineer 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 the Engineer.

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 the Engineer. A final inspection of the areas will be conducted by the Engineer and the Contractor before final payment is approved.

End of section.
Section 02222 – Excavation

Part 1 – General

1.1 Scope

This section includes:

- Excavation for main concrete barrier
- Excavation for surface preparation and leveling 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


1.4 Field Measurements and Survey

All surveys required for performance of the work will be provided by the Permittees. 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 the Engineer 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 the Engineer. 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 the Engineer.

3.4 Field Measurements and Survey

All survey required for performance of the work will be provided by the Permittees. The Contractor shall protect all survey control points, bench marks, etc., from damage by his operations. MOC 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 the Engineer at least 24 hours prior to the time surveying is required.

End of section.
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 Standard Specification for Nonshrink Grout

1.4 Submittals for Review and Approval

Thirty days prior to the initiation of grouting, the Contractor shall submit to the Engineer 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 the Engineer, 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.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percent of total Mass (wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class H Cement</td>
<td>48.3</td>
</tr>
<tr>
<td>Class C Fly Ash</td>
<td>16.2</td>
</tr>
<tr>
<td>Cal Seal (Plaster – from Halliburton)</td>
<td>5.7</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>7.9</td>
</tr>
<tr>
<td>Dispersant</td>
<td>0.78</td>
</tr>
<tr>
<td>Defoamer</td>
<td>0.02</td>
</tr>
<tr>
<td>Water</td>
<td>21.1</td>
</tr>
</tbody>
</table>

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 the Engineer.

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 no free water
discharges or spills are permitted 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 adequate containment for potential spills. 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 the Engineer, 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
cement 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 the Engineer.

The placing of grout, unless otherwise directed by the Engineer 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 the Engineer, 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 the Engineer.

The location, direction, and depth of each grout hole shall be as directed by the Engineer. 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 the Engineer.

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 the Engineer.

The requirements as to location, depth, spacing, and direction of the holes shall be as directed by the Engineer.

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 the Engineer. 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 the Engineer. 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, inaugurated 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 the Engineer.

As a safeguard against concrete displacement, excessive grout travel, or while grout leaks are being caulked, the Engineer 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 the Engineer, 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, the Engineer 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 the Engineer. 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.
DIVISION 3 - CONCRETE
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 Specifications for Structural Concrete for Buildings
ACI 318 Building Code Requirements for Reinforced Concrete
ACI 347 Recommended Practice for Concrete Formwork
ASTM A-36 Standard Specification for Structural Steel
ASTM A-53 Standard Specification for Pipe, Steel, Black, and Hot-Dipped Zinc Coated
ASTM A-325 High Strength, Structural Bolts
ASTM A-615 Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete
Reinforcement
AWS A3.0 Welding Terms and Definitions
AWS A5.1 Specification for Mild Steel Covered Arc Welding Electrodes
AWS D1.1 Structural Welding Code-Steel
AISC Manual of Steel Construction Latest Edition

1.4 Submittals

The Contractor shall submit the following 30 days prior to initiation of work at site:

Shop detail drawings with appropriate calculations to support the adequacy or 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

Design and detail the formwork under direct supervision of a professional structural Engineer experienced in design of this work and licensed in the state of New Mexico.

Perform work in accordance with ACI 301, 318, and 347, AISC and AWS standards. Maintain one copy of all standards at site.

Perform all fabrication in accordance with AISC manual of steel construction.

Perform all welding in accordance with AWS D1.1 structural welding code.

Perform all bolting in accordance with AISC specification for structural joints using ASTM A325 or A490 bolts.

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.

The Contractor may, at his option submit an alternate design or modify the design shown on the drawings, subject to the approval of the Engineer. 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 the Engineer 30 days prior to initiating work. The contractor shall incorporate all Engineer’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 the Engineer. 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 the Engineer for his approval prior to installation. Installation of the formwork shall be reviewed and approved by the Engineer prior to proceeding with concrete installation.

The Contractor shall provide a sealant or gasket material on mating surfaces to provide mortar-tite joints.

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 before delivering to the mine for installation. Damaged components will be rejected by the inspector and replaced by the contractor at his cost.

End of section.
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 Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete
- ACI 318.1 Building Code Requirements for Structural Plain Concrete
- ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
- ASTM C 33 Standard Specification for Concrete Aggregates
- ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- ASTM C 94 Standard Specification for Ready-Mixed Concrete
- ASTM C 143 Standard Specification for Slump of Portland Cement Concrete
- ASTM C 150 Standard Specification for Portland Cement
- ASTM C 403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
- ASTM C 618 Fly ash and Raw or Calcined Natural Pozzolan for Use as an Admixture in Portland Cement Concrete
1.4 Submittals for Review/Approval

The Contractor shall submit the following for approval 30 days prior to initiating any work at the site.

Specific sources of supply and detailed product information for each component of the concrete mix is specified in Section 2.6 below.

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 API 10 Class H oil well cements. 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 modules in the range of 2.80 to 3.00.

Coarse aggregate maximum size shall be 1 ½ 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 (Cl\(^{-}\)): 250 ppm maximum
- Sulfate ions (SO\(_4^{2-}\)): 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.

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 Concrete Mix Properties

The Contractor shall develop and proportion a Salado Mass Concrete mix for use in constructing the concrete barrier. Cement utilized in the mix shall be Class H. The Contractor shall demonstrate by trial mix that the proposed concrete meets the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-hr working time</td>
<td>Indicated by 8-inch slump (ASTM C 142) after 3-hr intermittent mixing. Max 10-inch slump at mixing.</td>
</tr>
<tr>
<td>Nonsegregating</td>
<td>Aggregates do not readily separated from cement paste during handling</td>
</tr>
<tr>
<td>Less than 25°F heat rise prior to placement</td>
<td>Difference between initial condition and temperature after 4 hr.</td>
</tr>
<tr>
<td>4,500 psi compressive strength (f ′c)</td>
<td>At 28 days after casting (ASTM C39)</td>
</tr>
<tr>
<td>Volume stability</td>
<td>Length change between +0.05 percent and -0.02 percent (ASTM C 490)</td>
</tr>
<tr>
<td>Minimal entrained air</td>
<td>2 percent to 3 percent air</td>
</tr>
</tbody>
</table>

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 shall utilize the Salado Mass concrete. 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:
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.

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 the Engineer.

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. The time for concreting one section will not exceed ten hours.

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 G1-2 and G1-3, attached).
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 the Engineer 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 the Engineer 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:

- Maximum slump at mixing – 10 inches
- Maximum slump at delivery to pump – 8 inches
- Maximum mix 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.

### 3.3 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 the Engineer.

### 3.4 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 the Engineer.
3.5 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.
DIVISION 4 — MASONRY
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 Standard Specification for Masonry Cement
- ASTM C144 Standard Specification for Aggregate for Masonry Mortar
- ASTM C150 Standard Specification for Portland Cement
- ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
- ASTM C270 Standard Specification for Mortar for Unit Masonry
- ASTM C7805 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
- ASTM C1142 Ready Mixed Mortar for Unit Masonry
- ASTM E447 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 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 Standard Specification for Concrete Building Brick
ASTM C140 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 the Engineer.

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 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 the Engineer. 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
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 G1G-2
Waste Handling Shaft Cage Dimensions
Figure G1G-3
Waste Shaft Collar and Airlock Arrangement
ATTACHMENT G1
APPENDIX H

DESIGN DRAWINGS

PANEL CLOSURE SYSTEM
WASTE ISOLATION PILOT PLANT
CARLSBAD, NEW MEXICO
<table>
<thead>
<tr>
<th>Drawing</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>762447-E1</td>
<td>Panel closure system, air intake and exhaust drifts, title sheet</td>
</tr>
<tr>
<td>762447-E2</td>
<td>Panel closure system, underground waste-emplacement panel plan</td>
</tr>
<tr>
<td>762447-E3</td>
<td>Panel closure system, air intake drift, construction details</td>
</tr>
<tr>
<td>762447-E4</td>
<td>Panel closure system, air exhaust drift, construction details</td>
</tr>
<tr>
<td>762447-E5</td>
<td>Panel closure system, construction and explosion walls, construction details</td>
</tr>
<tr>
<td>762447-E6</td>
<td>Panel closure system, air intake and exhaust drifts, grouting and miscellaneous details</td>
</tr>
</tbody>
</table>
ATTACHMENT G2

WASTE ISOLATION PILOT PLANT
SHAFT SEALING SYSTEM COMPLIANCE
SUBMITTAL DESIGN REPORT
Abstract

This report describes a shaft sealing system design for the Waste Isolation Pilot Plant (WIPP), a proposed nuclear waste repository in bedded salt. The system is designed to limit entry of water and release of contaminants through the four existing shafts after the WIPP is decommissioned. The design approach applies redundancy to functional elements and specifies multiple, common, low-permeability materials to reduce uncertainty in performance. The system comprises 13 elements that completely fill the shafts with engineered materials possessing high density and low permeability. Laboratory and field measurements of component properties and performance provide the basis for the design and related evaluations. Hydrologic, mechanical, thermal, and physical features of the system are evaluated in a series of calculations. These evaluations indicate that the design guidance is addressed by effectively limiting transport of fluids within the shafts, thereby limiting transport of hazardous material to regulatory boundaries. Additionally, the use or adaptation of existing technologies for placement of the seal components combined with the use of available, common materials assure that the design can be constructed.

This report was modified to make it a part of the RCRA Facility Permit issued by the New Mexico Environment Department (NMED). The modifications included removal of Appendices C and D from the original document. Although they were important to demonstrate compliance with the performance standards in the hazardous waste regulations, they do not provide plans or procedures that will be implemented under the authority of the Permit. Appendices A, B and E are retained as Attachments to the Permit (Attachments G2-A, G2-B and G2-E). The Figures
in this report, which were interspersed in the text in the original document, have been moved to a common section following the References.

**Acknowledgments**

The work presented in this document represents the combined effort of a number of individuals at Sandia National Laboratories, Parsons Brinckerhoff (under contract AG-4909), INTERA (under contract AG-4910), RE/SPEC (under contract AG-4911), and Tech Reps. The Sandian responsible for the preparation of each section of the report and the lead individual(s) at firms under contract to Sandia that provided technical expertise are recognized below.

<table>
<thead>
<tr>
<th>Section</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>F. D. Hansen, Sandia</td>
</tr>
<tr>
<td>Section 1, Introduction</td>
<td>J. R. Tillerson, Sandia</td>
</tr>
<tr>
<td>Section 2, Site Geologic, Hydrologic, &amp; Geochemical Setting</td>
<td>A. W. Dennis and S. J. Lambert, Sandia</td>
</tr>
<tr>
<td>Section 3, Design Guidance</td>
<td>A. W. Dennis, Sandia</td>
</tr>
<tr>
<td>Section 4, Design Description</td>
<td>A. W. Dennis, Sandia</td>
</tr>
<tr>
<td>Section 5, Material Specifications</td>
<td>F. D. Hansen, Sandia</td>
</tr>
<tr>
<td>Section 6, Construction Techniques</td>
<td>E. H. Ahrens, Sandia</td>
</tr>
<tr>
<td>Section 7, Structural Analyses of Shaft Seals</td>
<td>L. D. Hurtado, Sandia; M. C. Loken and L.L. Van Sambeek, RE/SPEC</td>
</tr>
<tr>
<td>Section 8, Hydrologic Evaluation of the Shaft Seal System</td>
<td>M. K. Knowles, Sandia; V.A. Kelley, INTERA</td>
</tr>
<tr>
<td>Section 9, Conclusions</td>
<td>J. R. Tillerson and A. W. Dennis, Sandia</td>
</tr>
<tr>
<td>Appendix A, Material Specifications</td>
<td>F. D. Hansen, Sandia</td>
</tr>
<tr>
<td>Appendix B, Shaft Sealing Construction Procedures</td>
<td>E. H. Ahrens, Sandia, with the assistance of Parsons Brinckerhoff Construction and Scheduling staff</td>
</tr>
<tr>
<td>Appendix C, Fluid Flow Analyses</td>
<td>M. K. Knowles, Sandia; V.A. Kelley, INTERA</td>
</tr>
<tr>
<td>Appendix D, Structural Analyses</td>
<td>L. D. Hurtado, Sandia; M. C. Loken and L. L. Van Sambeek, RE/SPEC</td>
</tr>
</tbody>
</table>
Appendix E, Design Drawings

A. W. Dennis, Sandia; C. D. Mann, Parsons
Brinckerhoff, with the assistance of the Parsons
Brinckerhoff Design staff

Design reviews provided by Malcolm Gray, Atomic Energy Canada Ltd., Whiteshell Laboratory; Stephen Phillips, Phillips Mining, Geotechnical & Grouting, Inc.; and John Tinucci, Itasca Consulting Group. Inc. are appreciated, as are document reviews provided by Don Galbraith, U.S. Department of Energy Carlsbad Area Office; William Thompson, Carlsbad Area Office Technical Assistance Contractor; Robert Stinebaugh, Palmer Vaughn, Deborah Coffey, and Wendell Weart, Sandia.

T. P. Peterson and S. B. Kmetz, Tech Reps, served as technical editors of this document.
# TABLE OF CONTENTS

**Executive Summary** .................................................................................................................... 1  
**Introduction** ..................................................................................................................... 1  
**Site Setting** ...................................................................................................................... 1  
**Design Guidance** ............................................................................................................. 1  
**Design Description** .......................................................................................................... 2  
**Structural Analysis** ........................................................................................................... 3  
**Concluding Remarks** ....................................................................................................... 7  

1. **Introduction** ..................................................................................................................... 7  
   1.1 Purpose of Compliance Submittal Design Report................................................. 7  
   1.2 WIPP Description ................................................................................................. 7  
   1.3 Performance Objective for WIPP Shaft Seal System ........................................... 8  
   1.4 Sealing System Design Development Process .................................................... 8  
   1.5 Organization of Document ................................................................................... 9  
   1.6 Systems of Measurement .................................................................................. 10  

2. **Site Geologic, Hydrologic, and Geochemical Setting** ..................................................... 11  
   2.1 Introduction ........................................................................................................ 11  
   2.2 Site Geologic Setting .......................................................................................... 11  
      2.2.1 Regional WIPP Geology and Stratigraphy ........................................ 11  
      2.2.2 Local WIPP Stratigraphy ................................................................... 12  
      2.2.3 Rock Mechanics Setting ................................................................... 12  
   2.3 Site Hydrologic Setting....................................................................................... 13  
      2.3.1 Hydrostratigraphy ............................................................................. 13  
      2.3.2 Observed Vertical Gradients ............................................................. 17  
   2.4 Site Geochemical Setting ................................................................................... 18  
      2.4.1 Regional and Local Geochemistry in Rustler Formation and Shallowers Units ................................................................................. 18  
      2.4.2 Regional and Local Geochemistry in the Salado Formation .............. 20  

3. **Design Guidance** ........................................................................................................... 23  
   3.1 Introduction ........................................................................................................ 23  
   3.2 Design Guidance and Design Approach ............................................................ 23  

4. **Design Description** ........................................................................................................ 25  
   4.1 Introduction ........................................................................................................ 25  
   4.2 Existing Shafts ................................................................................................... 25  
   4.3 Sealing System Design Description ................................................................... 29  
      4.3.1 Salado Seals .......................................................................................... 30  
      4.3.1.1 Compacted Salt Column ................................................................ 30  
      4.3.1.2 Upper and Lower Salado Compacted Clay Columns .................. 31  
      4.3.1.3 Upper, Middle, and Lower Concrete-Asphalt Waterstops .......... 32  
      4.3.1.4 Asphalt Column .......................................................................... 32  
      4.3.1.5 Shaft Station Monolith .................................................................. 33  
      4.3.2 Rustler Seals ......................................................................................... 33  
      4.3.2.1 Rustler Compacted Clay Column ............................................. 33  
      4.3.2.2 Rustler Concrete Plug .................................................................. 34  
      4.3.3 Near-Surface Seals ............................................................................... 34
4.3.3.1 Near-Surface Upper Compacted Earthen Fill .............. 34
4.3.3.2 Near-Surface Concrete Plug ....................................... 34
4.3.3.3 Near-Surface Lower Compacted Earthen Fill .............. 35

5. Material Specification .................................................................................................... 36
5.1 Longevity ........................................................................................................... 37
5.2 Materials ............................................................................................................ 38
   5.2.1 Mass Concrete ................................................................................. 38
   5.2.2 Compacted Clay ............................................................................... 39
   5.2.3 Asphalt ............................................................................................. 39
   5.2.4 Compacted Salt Column ................................................................... 40
   5.2.5 Cementitious Grout ........................................................................... 41
   5.2.6 Earthen Fill ....................................................................................... 42
5.3 Concluding Remarks .......................................................................................... 42

6. Construction Techniques ............................................................................................... 43
6.1 Multi-Deck Stage ................................................................................................ 43
6.2 Salado Mass Concrete (Shaft Station Monolith and Shaft Plugs) ....................... 43
6.3 Compacted Clay Columns (Salado and Rustler Formations) ............................. 44
6.4 Asphalt Waterstops and Asphaltic Mix Columns ................................................ 44
6.5 Compacted WIPP Salt ................................................................................. 44
6.6 Grouting of Shaft Walls and Removal of Liners ................................................ 45
6.7 Earthen Fill ......................................................................................................... 46
6.8 Schedule ............................................................................................................ 46

7. Structural Analyses of Shaft Seals ................................................................................. 47
7.1 Introduction ........................................................................................................ 47
7.2 Analysis Methods ............................................................................................... 47
7.3 Models of Shaft Seals Features ......................................................................... 47
   7.3.1 Seal Material Models ........................................................................ 48
   7.3.2 Intact Rock Lithologies ...................................................................... 48
   7.3.3 Disturbed Rock Zone Models ............................................................ 48
7.4 Structural Analyses of Shaft Seal Components .................................................. 48
   7.4.1 Salado Mass Concrete Seals ............................................................ 48
      7.4.1.1 Thermal Analysis of Concrete Seals ......................................... 49
      7.4.1.2 Structural Analysis of Concrete Seals ....................................... 49
      7.4.1.3 Thermal Stress Analysis of Concrete Seals .............................. 49
      7.4.1.4 Effect of Dynamic Compaction on Concrete Seals .................. 50
      7.4.1.5 Effect of Clay Swelling Pressures on Concrete Seals ............... 50
   7.4.2 Crushed Salt Seals ........................................................................... 50
      7.4.2.1 Structural Analysis of Compacted Salt Seal ......................... 50
      7.4.2.2 Pore Pressure Effects on Reconsolidation of Crushed Salt Seals ..................................................... 50
   7.4.3 Compacted Clay Seals ..................................................................... 51
   7.4.4 Asphalt Seals ................................................................................... 51
      7.4.4.1 Thermal Analysis .......................................................................... 51
      7.4.4.2 Structural Analysis .............................................................. 51
      7.4.4.3 Shrinkage Analysis ....................................................................... 52
7.5 Disturbed Rock Zone Considerations ................................................................... 52
# 7.5.1 General Discussion of DRZ
### 7.5.2 Structural Analyses
- **7.5.2.1 Salado Salt**
- **7.5.2.2 Salado Anhydrite Beds**
- **7.5.2.3 Near-Surface and Rustler Formations**

### 7.6 Other Analyses
- **7.6.1 Asphalt Waterstops**
- **7.6.2 Shaft Pillar Backfilling**

# 8. Hydrologic Evaluation of the Shaft Seal System
- **8.1 Introduction**
- **8.2 Performance Models**
- **8.3 Downward Migration of Rustler Groundwater**
  - **8.3.1 Analysis Method**
  - **8.3.2 Summary of Results**
- **8.4 Gas Migration and Consolidation of Compacted Salt Column**
  - **8.4.1 Analysis Method**
  - **8.4.2 Summary of Results**
- **8.5 Upward Migration of Brine**
- **8.6 Intra-Rustler Flow**

# 9. Conclusions

# 10. References

---

**Appendix G2-A** Material Specifications  
**Appendix G2-B** Shaft Sealing Construction Procedures  
**Appendix C** Fluid Flow Analyses  
**Appendix D** Structural Analyses  
**Appendix G2-E** Design Drawings

* Appendices C and D are not included in the facility Permit.*
*FIGURES*

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure G2-1</td>
<td>View of the WIPP Underground Facility</td>
</tr>
<tr>
<td>Figure G2-2</td>
<td>Location of the WIPP in the Delaware Basin</td>
</tr>
<tr>
<td>Figure G2-3</td>
<td>Chart Showing Major Stratigraphic Divisions, Southeastern New Mexico</td>
</tr>
<tr>
<td>Figure G2-4</td>
<td>Generalized Stratigraphy of the WIPP Site Showing Repository Level</td>
</tr>
<tr>
<td>Figure G2-5</td>
<td>Arrangement of the Air Intake Shaft Sealing System</td>
</tr>
<tr>
<td>Figure G2-6</td>
<td>Multi-deck Stage Illustrating Dynamic Compaction</td>
</tr>
<tr>
<td>Figure G2-7</td>
<td>Multi-deck Stage Illustrating Excavation for Asphalt Waterstop</td>
</tr>
<tr>
<td>Figure G2-8</td>
<td>Drop Pattern for 6-m-Diameter Shaft Using a 1.2-m-Diameter Tamper</td>
</tr>
<tr>
<td>Figure G2-9</td>
<td>Plan and Section Views of Downward Spin Pattern of Grout Holes</td>
</tr>
<tr>
<td>Figure G2-10</td>
<td>Plan and Section Views of Upward Spin Pattern of Grout Holes</td>
</tr>
<tr>
<td>Figure G2-11</td>
<td>Example of Calculation of an Effective Salt Column Permeability from the Depth-Dependent Permeability at a Point in Time</td>
</tr>
<tr>
<td>Figure G2-12</td>
<td>Effective Permeability of the Compacted Salt Column using the 95% Certainty Line</td>
</tr>
</tbody>
</table>

*NOTE: All Figures are attached following References*

*TABLES*

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table G2-1</td>
<td>Salado Brine Seepage Intervals(^{(1)})</td>
</tr>
<tr>
<td>Table G2-2</td>
<td>Permeability and Thickness of Hydrostratigraphic Units in Contact with Seals</td>
</tr>
<tr>
<td>Table G2-3</td>
<td>Freshwater Head Estimates in the Vicinity of the Air Intake Shaft</td>
</tr>
<tr>
<td>Table G2-4</td>
<td>Chemical Formulas, Distributions, and Relative Abundance of Minerals in the Rustler and Salado Formations (after Lambert, 1992)</td>
</tr>
<tr>
<td>Table G2-5</td>
<td>Major Solutes in Selected Representative Groundwater from the Rustler Formation and Dewey Lake Redbeds, in mg/L (after Lambert, 1992)</td>
</tr>
<tr>
<td>Table G2-6</td>
<td>Variations in Major Solutes in Brines from the Salado Formation, in mg/L (after Lambert, 1992)</td>
</tr>
<tr>
<td>Table G2-7</td>
<td>Shaft Sealing System Design Guidance</td>
</tr>
<tr>
<td>Table G2-8</td>
<td>Drawings Showing Configuration of Existing WIPP Shafts (Drawings are in Appendix G2-E)</td>
</tr>
<tr>
<td>Table G2-9</td>
<td>Summary of Information Describing Existing WIPP Shafts</td>
</tr>
<tr>
<td>Table G2-10</td>
<td>Drawings Showing the Sealing System for Each Shaft (Drawings are in Appendix G2-E)</td>
</tr>
<tr>
<td>Table G2-11</td>
<td>Drawings Showing the Shaft Station Monoliths (Drawings are in Appendix G2-E)</td>
</tr>
<tr>
<td>Table G2-12</td>
<td>Summary of Results from Performance Model</td>
</tr>
</tbody>
</table>
**ACRONYMS**

<table>
<thead>
<tr>
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<td>AIS</td>
<td>Air Intake Shaft</td>
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<tr>
<td>AMM</td>
<td>asphalt mastic mix</td>
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<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
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<td>DOE</td>
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</tr>
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</tr>
<tr>
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</tr>
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</tr>
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</table>
Executive Summary

Introduction

This report documents a shaft seal system design developed as part of a submittal to the Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) that will demonstrate regulatory compliance of the Waste Isolation Pilot Plant (WIPP) for disposal of transuranic waste. The shaft seal system limits entry of water into the repository and restricts the release of contaminants. Shaft seals address fluid transport paths through the opening itself, along the interface between the seal material and the host rock, and within the disturbed rock surrounding the opening. The entire shaft seal system is described in this Permit Attachment and its three appendices, which include seal material specifications, construction methods, rock mechanics analyses, fluid flow evaluations, and the design drawings. The design represents a culmination of several years of effort that has most recently focused on providing to the EPA and NMED a viable shaft seal system design. Sections of this report and the appendices explore function and performance of the WIPP shaft seal system and provide well-documented assurance that such a shaft seal system could be constructed using available materials and methods. The purpose of the shaft seal system is to limit fluid flow within four existing shafts after the repository is decommissioned. Such a seal system would not be implemented for several decades, but to establish that regulatory compliance can be achieved at that future date, a shaft seal system has been designed that exhibits excellent durability and performance and is constructable using existing technology. The design approach is conservative, applying redundancy to functional elements and specifying various common, low-permeability materials to reduce uncertainty in performance. It is recognized that changes in the design described here will occur before construction and that this design is not the only possible combination of materials and construction strategies that would adequately limit fluid flow within the shafts.

Site Setting

One of the U.S. Department of Energy’s (DOE’s) site selection criteria is a favorable geologic setting which minimizes fluid flow as a transport mechanism. Groundwater hydrology in the proximity of the WIPP site is characterized by geologic strata with low transmissivity and low hydrologic gradients, both very positive features with regard to sealing shafts. For purposes of performance evaluations, hydrological analyses divide lithologies and requirements into the Rustler Formation (and overlying strata) and the Salado Formation, comprised mostly of salt. The principal design concern is fluid transport phenomena of seal materials and lithologies within the Salado Formation. The rock mechanics setting is an important consideration in terms of system performance. Rock properties affect hydrologic response of the shaft seal system. The stratigraphic section contains lithologies that exhibit brittle and ductile behavior. A zone of rock around the shafts is disturbed owing to the creation of the opening. The disturbed rock zone (DRZ) is an important design consideration because it possesses higher permeability than intact rock. Host rock response and its potential to fracture, flow, and heal around WIPP shaft openings are relevant to the performance of the shaft seal system.

Design Guidance

Use of both engineered and natural barriers to isolate wastes from the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §191.14(d). The use of engineered barriers to prevent or substantially delay movement of water,
hazardous constituents, or radionuclides toward the accessible environment is required by 1
20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §194.44. 2
Hazardous constituent release performance standards are specified in Permit Part 5 and 3
20.4.1.500 NMAC (incorporating 40 CFR §§264.111(b), 264.601(a), and 264 Subpart F). 4
Radionuclide release limits are specified in 40 CFR §191 for the entire repository system (EPA, 5
1996a; 1996b). Design guidance for the shaft seal system addresses the need for the WIPP to 6
comply with system requirements and to follow accepted engineering practices using 7
demonstrated technology. Design guidance is categorized below:

- limit hazardous constituents reaching regulatory boundaries,
- restrict groundwater flow through the sealing system,
- use materials possessing mechanical and chemical compatibility,
- protect against structural failure of system components,
- limit subsidence and prevent accidental entry, and
- utilize available construction methods and materials.

Discussions of the design presented in the text of this report and the details presented in the 15
appendices respond to these qualitative design guidelines. The shaft seal system design was 16
completed under a Quality Assurance program that includes review by independent, qualified 17
experts to assure the best possible information is provided to the DOE on selection of 18
engineered barriers (40 CFR §194.27). Technical reviewers examined the complete design 19
including conceptual, mathematical, and numerical models and computer codes (40 CFR 20
§194.26). The design reduces the impact of uncertainty associated with any particular element 21
by using multiple sealing system components and by using components constructed from 22
different materials.

**Design Description**

The shaft sealing system comprises 13 elements that completely fill the shaft with engineered 25
materials possessing high density and low permeability. Salado Formation components provide 26
the primary regulatory barrier by limiting fluid transport along the shaft during and beyond the 27
10,000-year regulatory period. Components within the Rustler Formation limit commingling 28
between brine-bearing members, as required by state regulations. Components from the Rustler 29
to the surface fill the shaft with common materials of high density, consistent with good 30
engineering practice. A synopsis of each component is given below.

**Shaft Station Monolith.** At the bottom of each shaft a salt-saturated concrete monolith 32
supports the local roof. A salt-saturated concrete, called Salado Mass Concrete (SMC), is 33
specified and is placed using a conventional slickline construction procedure where the concrete 34
is batched at the surface. SMC has been tailored to match site conditions. The salt-handling 35
shaft and the waste-handling shaft have sumps which also will be filled with salt-saturated 36
concrete as part of the monolith.

**Clay Columns.** A sodium bentonite is used for three compacted clay components in the Salado 38
and Rustler Formations. Although alternative construction specifications are viable, labor-
intensive placement of compressed blocks is specified because of proven performance. Clay 39
columns effectively limit brine movement from the time they are placed to beyond the 40
10,000-year regulatory period. Stiffness of the clay is sufficient to promote healing of fractures in 41
the surrounding rock salt near the bottom of the shafts, thus removing the proximal DRZ as a

PERMIT ATTACHMENT G2
Page G2-2 of 80
potential pathway. The Rustler clay column limits brine communication between the Magenta and Culebra Members of the Rustler Formation.

**Concrete-Asphalt Waterstop Components.** Concrete-asphalt waterstop components comprise three elements: an upper concrete plug, a central asphalt waterstop, and a lower concrete plug. Three such components are located within the Salado Formation. These concrete-asphalt waterstop components provide independent shaft cross-section and DRZ seals that limit fluid transport, either downward or upward. Concrete fills irregularities in the shaft wall, while use of the salt-saturated concrete assures good bonding with salt. Salt creep against the rigid concrete components establishes a compressive stress state and promotes early healing of the salt DRZ surrounding the concrete plugs. The asphalt intersects the shaft cross section and the DRZ.

**Compacted Salt Column.** Each shaft seal includes a column of compacted WIPP salt with 1.5 percent weight water added to the natural material. Construction demonstrations have shown that mine-run WIPP salt can be dynamically compacted to a density equivalent to approximately 90% of the average density of intact Salado salt. The remaining void space is removed through consolidation caused by creep closure. The salt column becomes less permeable as density increases. The location of the compacted salt column near the bottom of the shaft assures the fastest achievable consolidation of the compacted salt column after closure of the repository. Analyses indicate that the salt column becomes an effective long-term barrier in under 100 years.

**Asphalt Column.** An asphalt-aggregate mixture is specified for the asphalt column, which bridges the Rustler/Salado contact and provides a seal essentially impermeable to brine for the shaft cross-section and the shaft wall interface. All asphalt is placed with a heated slickline.

**Concrete Plugs.** A concrete plug is located just above the asphalt column and keyed into the surrounding rock. Mass concrete is separated from the cooling asphalt column with a layer of fibercrete, which permits work to begin on the overlying clay column before the asphalt has completely cooled. Another concrete plug is located near the surface, extending downward from the top of the Dewey Lake Redbeds.

**Earthen Fill.** The upper shaft is filled with locally available earthen fill. Most of the fill is dynamically compacted (the same method used to construct the salt column) to a density approximating the surrounding lithologies. The uppermost earthen fill is compacted with a sheepsfoot roller or vibratory plate compactor.

**Structural Analysis**

Structural issues pertaining to the shaft seal system have been evaluated. Mechanical, thermal, physical, and hydrological features of the system are included in a broad suite of structural calculations. Conventional structural mechanics applications would normally calculate load on system elements and compare the loads to failure criteria. Several such conventional calculations have been performed and show that the seal elements exist in a favorable, compressive stress state that is low in comparison to the strength of the seal materials. Thermal analyses have been performed to examine the effects of concrete heat of hydration and heat transfer for asphalt elements. Coupling between damaged rock and fluid flow and between the density and permeability of the consolidating salt column is evaluated within the scope of structural calculations. The appendices provide descriptions of various structural calculations.
conducted as part of the design study. The purpose of each calculation varies; however, the calculations generally address one or more of the following concerns: (1) stability of the component, (2) influences of the component on hydrological properties of the seal and surrounding rock, or (3) construction methods. Stability calculations address:

- potential for thermal cracking of concrete;
- structural loads on seal components resulting from salt creep, gravity, swelling clay, dynamic compaction, or possible repository-generated gas pressures.

Structural calculations defining input conditions to hydrological calculations include:

- spatial extent of the DRZ within the Salado Formation salt beds as a function of depth, time, and seal material;
- fracturing and DRZ development within Salado Formation interbeds;
- shaft-closure induced consolidation of compacted salt columns; and
- impact of pore pressures on salt consolidation.

Construction analyses examine:

- placement and structural performance of asphalt waterstops, and
- potential subsidence reduction through backfilling the shaft station areas.

Structure calculations model shaft features including representation of the host rock and its damaged zone as well as the seal materials themselves. Two important structural calculations discussed below are unique to shaft seal applications.

**DRZ Behavior.** The development and subsequent healing of a DRZ that forms in the rock mass surrounding the WIPP shafts is a significant concern in the seal design. It is well known that a DRZ will develop in rock salt adjacent to the shaft upon excavation. Placement of rigid components in the shaft promotes healing within the salt DRZ as seal elements restrain inward creep and reduce the stress difference. Two computer models to calculate development and extent of the salt DRZ are used. The first model uses a ratio of stress invariants to predict fracture; the second approach uses a damage stress criterion. The temporal and spatial extent of the DRZ along the entire shaft length is evaluated. Several analyses are performed to examine DRZ behavior of the rock salt surrounding the shaft. The time-dependent DRZ development and subsequent healing in the Salado salt surrounding each of the four seal materials are considered. All seal materials below a depth of about 300 m provide sufficient rigidity to heal the DRZ, a phenomenon that occurs quickly around rigid components near the shaft bottom. An extensive calculation is made of construction effects on the DRZ during placement of the asphalt-concrete waterstops. The time-dependent development of the DRZ within anhydrite and polyhalite interbeds of the Salado Formation is calculated. For all interbeds, the factor of safety against shear or tensile fracturing increases with depth into the rock surrounding the shaft wall. These results indicate that a continuous DRZ will not develop in nonsalt Salado rocks. Rock mechanics analysis also determines which of the near surface...
lithologies fracture in the proximity of the shaft. Results from these rock mechanics analyses are used as input conditions for the fluid-flow analyses.

**Compacted Salt Behavior.** Unique application of crushed salt as a seal component required development of a constitutive model for salt reconsolidation. The model developed includes a nonlinear elastic component and a creep consolidation component. The nonlinear elastic modulus is density-dependent, based on laboratory test data performed on WIPP crushed salt. Creep consolidation behavior of crushed salt is based on three candidate models whose parameters are obtained from model fitting to hydrostatic and shear consolidation test data gathered for WIPP crushed salt. The model for consolidating crushed salt is used to predict permeability of the salt column. The seal system prevents fluid transport to the consolidating salt column to ensure that pore pressure does not unacceptably inhibit the reconsolidation process. Calculations made to estimate fractional density of the crushed salt seal as a function of time, depth, and pore pressure show consolidation time increases as pore pressure increases, as expected. At a constant pore pressure of one atmosphere, compacted salt will increase from its initial fractional density of 90% to 96% within 40, 80, and 120 years after placement at the bottom, middle, and top of the salt component, respectively. At a fractional density of 96%, the permeability of reconsolidating salt is approximately $10^{-18}$ m$^2$. A pore pressure of 2 MPa increases times required to achieve a fractional density of 96% to 92 years, 205 years, and 560 years at the bottom, middle, and top of the crushed salt column, respectively. A pore pressure of 4 MPa would effectively prevent reconsolidation of the crushed salt within 1,000 years. Fluid flow calculations show only minimal transport of fluids to the salt column, so pore pressure equilibrium in the consolidating salt does not occur before low permeabilities ($\leq 10^{-18}$ m$^2$) are achieved.

**Hydrologic Evaluations**

The ability of the shaft seal system to satisfy design guidance is determined by the performance of the actual seal components within the physical setting in which they are constructed. Important elements of the physical setting are hydraulic gradients of the region, properties of the lithologic units surrounding a given seal component, and potential gas generation within the repository. Hydrologic evaluations focus on processes that could result in fluid flow through the shaft seal system and the ability of the seal system to limit any such flow. Transport of radiological or hazardous constituents will be limited if the carrier fluids are similarly limited. Physical processes that could impact seal system performance have been incorporated into four models. These models evaluate: (1) downward migration of groundwater from the Rustler Formation, (2) gas migration and reconsolidation of the crushed salt seal component, (3) upward migration of brines from the repository, and (4) flow between water-bearing zones in the Rustler Formation.

**Downward Migration of Rustler Groundwater.** The shaft seal system is designed to limit groundwater flowing into and through the shaft sealing system. The principal source of groundwater to the seal system is the Culebra Member of the Rustler Formation. No significant sources of groundwater exist within the Salado Formation; however, brine seepage has been noted at a number of the marker beds and is included in the models. Downward migration of Rustler groundwater is limited to ensure that liquid saturation of the compacted salt column does not impact the consolidation process and to limit quantities of brine reaching the repository horizon. Consolidation of the compacted salt column will be most rapid immediately following seal construction. Simulations conducted for the 200-year period following closure demonstrate that, during this initial period, downward migration of Rustler groundwater is insufficient to
impact the consolidation process. Rock mechanics analyses show that this period encompasses the reconsolidation process. Lateral migration of brine through the marker beds is quantified in the analysis and shown to be inconsequential. At steady-state, the flow rate is most dependent on permeability of the system. Potential flow paths within the seal system consist of the seal material, an interface with the surrounding rock, and the host rock DRZ. Low permeability is specified for the engineered materials, and construction methods ensure a tight interface. Thus the flow path most likely to impact performance is the DRZ. Effects of the DRZ and sensitivity of the seal system performance to both engineered and host rock barriers show that the DRZ is successfully mitigated by the proposed design.

Gas Migration and Salt Column Consolidation. A multi-phase flow model of the lower seal system evaluates the performance of components extending from the middle concrete-asphalt waterstop located at the top of the salt column to the repository horizon for 200 years following closure. During this time period, the principal fluid sources to the model consist of potential gas generated by the waste and lateral brine migration within the Salado Formation. The predicted downward migration of a small quantity of Rustler groundwater (discussed above) is included in this analysis. Effects of gas generation are evaluated for three different repository repressurization scenarios, which simulate pressures as high as 14 MPa. Model results predict that high repository pressures do not produce appreciable differences in the volume of gas migration over the 200-year simulation period. Relatively low gas flow is a result of the low permeability and rapid healing of the DRZ around the lower concrete-asphalt waterstop.

Upward Migration of Brine. The Salado Formation is overpressurized with respect to the measured heads in the Rustler, and upward migration of contaminated brines could occur through an inadequately sealed shaft. Results from the model discussed above demonstrate that the crushed salt seal will reconsolidate to a very low permeability within 100 years following repository closure. Structural results show that the DRZ surrounding the long-term clay and crushed salt seal components will completely heal within the first several decades. Model calculations predict that very little brine flows from the repository to the Rustler/Salado contact.

Intra-Rustler Flow. Based on head differences between the various members of the Rustler Formation, nonhydrostatic conditions exist within the Rustler Formation. Therefore, the potential exists for vertical flow within water-bearing strata within the Rustler. The two units with the greatest transmissivity within the Rustler are the Culebra and the Magenta dolomites, which have the greatest potential for interflow. The relatively low undisturbed permeabilities of the mudstone and anhydrite units separating the Culebra and the Magenta naturally limit crossflow. However, the construction and subsequent closure of the shaft provide a potentially permeable vertical conduit connecting water-bearing units. The primary motivation for limiting formation crossflow within the Rustler is to prevent mixing of formation waters within the Rustler, as required by State of New Mexico statute. Commonly, such an undertaking would limit migration of higher dissolved solids (high-density) groundwater into lower dissolved solids groundwater. In the vicinity of the WIPP site, the Culebra has a higher density groundwater than the Magenta, and the potential for fluid migration between the two most transmissive units is from the unit with the lower total dissolved solids to the unit with the higher dissolved solids. This calculation shows that potential flow rates between the Culebra and the Magenta are insignificant. Under expected conditions, intra-Rustler flow is expected to be of such a limited quantity that (1) it will not affect either the hydraulic or chemical regime within the Culebra or the Magenta and (2) it will not be detrimental to the seal system itself.
Concluding Remarks

The principal conclusion is that an effective, implementable shaft seal system has been designed for the WIPP. Design guidance is addressed by limiting any transport of fluids within the shaft, thereby limiting transport of hazardous material to regulatory boundaries. The application or adaptation of existing technologies for placement of seal components combined with the use of available, common materials provide confidence that the design can be constructed. The structural setting for seal elements is compressive, with shear stresses well below the strength of seal materials. Because of the favorable hydrologic regime coupled with the low intrinsic permeability of seal materials, long-term stability of the shaft seal system is expected. Credibility of these conclusions is bolstered by the basic design approach of using multiple components to perform each sealing function and by using extensive lengths within the shafts to effect a sealing system. The shaft seal system adequately meets design requirements and can be constructed.

1. Introduction

1.1 Purpose of Compliance Submittal Design Report

This report documents the detailed design of the shaft sealing system for the Waste Isolation Pilot Plant (WIPP). The design documented in this report builds on the concepts and preliminary evaluations presented in the Sealing System Design Report issued in 1995 (DOE, 1995). The report contains a detailed description of the design and associated construction procedures, material specifications, analyses of structural and fluid flow performance, and design drawings. The design documented in this report forms the basis for the shaft sealing system which will be constructed under the authority of the hazardous waste facility Permit issued by NMED and as required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111(b) and 264.601(a)).

1.2 WIPP Description

The WIPP is designed as a full-scale, mined geological repository for the safe management, storage, and disposal of transuranic (TRU) radioactive wastes and TRU mixed wastes generated by US government defense programs. The facility is located near Carlsbad, New Mexico, in the southeastern portion of the state. The underground facility (Figure G2-1) consists of a series of shafts, drifts, panels, and disposal rooms. Four shafts, ranging in diameter from 3.5 to 6.1 m, connect the disposal horizon to the surface. Sealing of these four shafts is the focus of this report.

The disposal horizon is at a depth of approximately 655 m in bedded halite within the Salado Formation. The Salado is a sequence of bedded evaporites approximately 600 m thick that were deposited during the Permian Period, which ended about 225 million years ago. Salado salt has been identified as a good geologic medium to host a nuclear waste repository because of several favorable characteristics. The characteristics present at the WIPP site include very low permeability, vertical and lateral stratigraphic extent, tectonic stability, and the ability of salt to creep and ultimately entomb material placed in excavated openings. Creep closure also plays an important role in the shaft sealing strategy.

The WIPP facility must be determined to be in compliance with applicable regulations prior to the disposal of waste. After the facility meets the regulatory requirements, disposal rooms will be filled with containers holding TRU wastes of various forms. Wastes placed in the drifts and
disposal rooms will be at least 150 m from the shafts. Regulatory requirements include use of both engineered and natural barriers to limit migration of hazardous constituents from the repository to the accessible environment. The shaft seals are part of the engineered barriers.

1.3 Performance Objective for WIPP Shaft Seal System

Each of the four shafts from the surface to the underground repository must be sealed to limit hazardous material release to the accessible environment and to limit groundwater flow into the repository. Although the seals will be permanent, the regulatory period applicable to the repository system analyses is 10,000 years.

1.4 Sealing System Design Development Process

This report presents a conservative approach to shaft sealing system design. Shaft sealing system performance plays a crucial role in meeting regulatory radionuclide and hazardous constituents release requirements. Although all engineering materials have uncertainties in properties, a combination of available, low-permeability materials can provide an effective sealing system. To reduce the impact of system uncertainties and to provide a high level of assurance of compliance, numerous components are used in this sealing system. Components in this design include long columns of clay, densely compacted crushed salt, a waterstop of asphaltic material sandwiched between massive low-permeability concrete plugs, a column of asphalt, and a column of earthen fill. Different materials perform identical functions within the design, thereby adding confidence in the system performance through redundancy.

The design is based on common materials and construction methods that utilize available technologies. When choosing materials, emphasis was given to permeability characteristics and mechanical properties of seal materials. However, the system is also chemically and physically compatible with the host formations, enhancing long-term performance.

Recent laboratory experiments, construction demonstrations, and field test results have been added to the broad and credible database and have supported advances in modeling capability. Results from a series of multi-year, in situ, small-scale seal performance tests show that bentonite and concrete seals maintain very low permeabilities and show no deleterious effects in the WIPP environment. A large-scale dynamic compaction demonstration established that crushed salt can be successfully compacted. Laboratory tests show that compacted crushed salt consolidates through creep closure of the shaft from initial conditions achieved in dynamic compaction to a dense salt mass with regions where permeability approaches that of in situ salt. These technological advances have allowed more credible analysis of the shaft sealing system.

The design was developed through an interactive process involving a design team consisting of technical specialists in the design and construction of underground facilities, materials behavior, rock mechanics analysis, and fluid flow analysis. The design team included specialists drawn from the staff of Sandia National Laboratories, Parsons Brinckerhoff Quade and Douglas, Inc. (contract number AG-4909), INTERA, Inc. (contract number AG-4910), and RE/SPEC Inc. (contract number AG-4911), with management by Sandia National Laboratories. The contractors developed a quality assurance program consistent with the Sandia National Laboratories Quality Assurance Program Description for the WIPP project. All three contractors received quality assurance support visits and were audited through the Sandia National Laboratories audit and assessment program. Quality assurance (QA) documentation is maintained in the Sandia National Laboratories WIPP Central Files. Access to project files for
each contractor can be accomplished using the contract numbers specified above. In addition to
the contractor support, technical input was obtained from consultants in various technical
specialty areas.

Formal preliminary and final design reviews have been conducted on the technical information
documented in the report. In addition, technical, management, and QA reviews have been
performed on this report. Documentation is in the WIPP Central File.

It is recognized that additional information, such as on specific seal material or formation
characteristics, on the sensitivity of system performance to component properties, on placement
effectiveness, and on long-term performance, could be used to simplify the design and perhaps
reduce the length or number of components. Such design optimization and associated
simplifications are left to future research that may be used to update the compliance evaluations
completed between now and the time of actual seal emplacement.

1.5 Organization of Document

This report contains an Executive Summary, 10 sections, and 5 appendices. The body of the
report does not generally contain detailed backup information; this information is incorporated
by reference or in the appendices.

The Executive Summary is a synopsis of the design and the supporting discussions related to
seal materials, construction procedures, structural analyses, and fluid flow analyses.
Introductory material in Section 1 sets the stage for and provides a “road map” to the remainder
of the report.

Site characteristics that detail the setting into which the seals would be placed are documented
in Section 2. These characteristics include the WIPP geology and stratigraphy for both the
region and the shafts as well as a brief discussion of rock mechanics considerations of the site
that impact the sealing system. Regional and local characteristics of the hydrologic and
geochemical settings are also briefly discussed.

Section 3 presents the design guidance used for development of the shaft sealing system
design. Seal-related guidance from applicable regulations is briefly described. The design
guidance is then provided along with the design approach used to implement the guidance. The
guidance forms the basis both for the design and for evaluations of the sealing system
presented in other sections.

The shaft sealing system is documented in Section 4; detailed drawings for the design are
provided in Appendix G2-E. The seal components, their design, and their functions are
discussed for the Salado, the Rustler, and the overlying formations.

The sealing materials are described briefly in Section 5, with more detail provided in the
materials specifications (Appendix G2-A). The materials used in the various seal components
are discussed along with the reasons they are expected to function as intended. Material
properties including permeability, strength, and mechanical constitutive response are given for
each material. Brief discussions of expected compatibility, performance, construction
techniques, and other characteristics relevant to the WIPP setting are also given.
Section 6 contains a brief description of the construction techniques proposed for use. General site and sealing preparation activities are discussed, including construction of a multi-deck stage for use throughout the placement of the components. Construction procedures to be used for the various types of components are then summarized based on the more detailed discussions provided in Appendix G2-B.

Section 7 summarizes structural analyses performed to assess the ability of the shaft sealing system to function in accordance with the design guidance provided in Section 3 and to provide input to hydrological calculations. The methods and computer programs, the models used to simulate the behavior of the seal materials and surrounding salt, and the results of the analyses are discussed. Particular emphasis is placed on the evaluations of the behavior of the disturbed rock zone. Details of the structural analyses are presented in Appendix D of Waste Isolation Pilot Plant Shaft Sealing System Compliance Submittal Design Report (“Compliance Submittal Design Report”) (Sandia, 1996). Section 8 summarizes fluid flow analyses performed to assess the ability of the shaft sealing system to function in accordance with the design guidance provided in Section 3. Hydrologic evaluations are focused on processes that could result in fluid flow through the shaft seal system and the ability of the seal system to limit such flow. Processes evaluated are downward migration of groundwater from the overlying formation, gas migration and reconsolidation of the crushed salt component, upward migration of brines from the repository, and flow between water-bearing zones in the overlying formation. Hydrologic models are described and the results are discussed as they relate to satisfying the design guidance, with extensive reference to Appendix C of the Compliance Submittal Design Report (Sandia, 1996) that documents details of the flow analyses. Conclusions drawn about the performance of the WIPP shaft sealing system are described in Section 9. The principal conclusion that an effective, implementable design has been presented is based on the presentations in the previous sections. A reference list that documents principal references used in developing this design is then provided.

The three appendices that follow provide details related to the following subjects:

Appendix G2-A — Material Specification
Appendix G2-B — Shaft Sealing Construction Procedures
Appendix G2-E — Design Drawings (separate volume)

1.6 Systems of Measurement

Two systems of measurement are used in this document and its appendices. Both the System International d’Unites (SI) and English Gravitational (fps units) system are used. This usage corresponds to common practice in the United States, where SI units are used for scientific studies and fps units are used for facility design, construction materials, codes, and standards. Dual dimensioning is used in the design description and other areas where this use will aid the reader.
2. Site Geologic, Hydrologic, and Geochemical Setting

The site characteristics relevant to the sealing system are discussed in this section. The location and geologic setting of the WIPP are discussed first to provide background. The geology and stratigraphy, which affect the shafts, are then discussed. The hydrologic and geochemical settings, which influence the seals, are described last.

2.1 Introduction

The WIPP site is located in an area of semiarid rangeland in southeastern New Mexico. The nearest major population center is Carlsbad, 42 km west of the WIPP. Two smaller communities, Loving and Malaga, are about 33 km to the southwest. Population density close to the WIPP is very low: fewer than 30 permanent residents live within a 16-km radius.

2.2 Site Geologic Setting

Geologically the WIPP is located in the Delaware Basin, an elongated depression that extends from just north of Carlsbad southward into Texas. The Delaware Basin is bounded by the Capitan Reef (see Figure G2-2). The basin covers over 33,000 km² and is filled with sedimentary rocks to depths of 7,300 m (Hills, 1984). Rock units of the Delaware Basin (representing the Permian System through the Quaternary System) are listed in Figure G2-3.

Minimal tectonic activity has occurred in the region since the Permian Period (Powers et al., 1978). Faulting during the late Tertiary Period formed the Guadalupe and Delaware Mountains along the western edge of the basin. The most recent igneous activity in the area occurred during the mid-Tertiary Period about 35 million years ago and is evidenced by a dike in the subsurface 16 km northwest of the WIPP. Major volcanic activity last occurred more than 1 billion years ago during Precambrian time (Powers et al., 1978). None of these processes affected the Salado Formation at the WIPP. Therefore, seismic-related design criteria are not included in the current seal systems design guidelines.

2.2.1 Regional WIPP Geology and Stratigraphy

The Delaware Basin began forming with crustal subsidence during the Pennsylvanian Period approximately 300 million years ago. Relatively rapid subsidence over a period of about 14 million years resulted in the deposition of a sequence of deep-water sandstones, shales, and limestones rimmed by shallow-water limestone reefs such as the Capitan Reef (see Figure G2-2). Subsidence slowed during the late Permian Period. Evaporite deposits of the Castile Formation and the Salado Formation (which hosts the WIPP underground workings) filled the basin and extended over the reef margins. The evaporites, carbonates, and clastic rocks of the Rustler Formation and the Dewey Lake Redbeds were deposited above the Salado Formation near the end of the Permian Period. The Santa Rosa and Gatuña Formations were deposited after the close of the Permian Period.

From the surface downward to the repository horizon the stratigraphic units are the Quaternary surface sand sediments, Gatuña Formation, Santa Rosa Formation, Dewey Lake Redbeds, Rustler Formation, and Salado Formation. Three principal stratigraphic units (the Dewey Lake Redbeds, the Rustler Formation, and the Salado Formation) comprise all but the upper 15 to 30 m (50 to 100 ft) of the geologic section above the WIPP facility.
The Dewey Lake Redbeds consist of alternating layers of reddish-brown, fine-grained sandstone and siltstone cemented with calcite and gypsum (Vine, 1963). The Rustler Formation lies below the Dewey Lake Redbeds; this formation, the youngest of the Late Permian evaporite sequence, includes units that provide potential pathways for radionuclide migration from the WIPP. The five units of the Rustler, from youngest to oldest, are: (1) the Forty-niner Member, (2) the Magenta Dolomite Member, (3) the Tamarisk Member, (4) the Culebra Dolomite Member, and (5) an unnamed lower member.

The 250-million-year-old Salado Formation lies below the Rustler Formation. This unit is about 600 m thick and consists of three informal members. From youngest to oldest, they are: (1) an upper member (unnamed) composed of reddish-orange to brown halite interbedded with polyhalite, anhydrite, and sandstone, (2) a middle member (the McNutt Potash Zone) composed of reddish-orange and brown halite with deposits of sylvite and langbeinite; and (3) a lower member (unnamed) composed of mostly halite with lesser amounts of anhydrite, polyhalite, and glauberite, with some layers of fine clastic material. These lithologic layers are nearly horizontal at the WIPP, with a regional dip of less than one degree. The WIPP repository is located in the unnamed lower member of the Salado Formation, approximately 655 m (2150 ft) below the ground surface.

2.2.2 Local WIPP Stratigraphy

The generalized stratigraphy of the WIPP site, with the location of the repository, is shown in Figure G2-4. To establish the geologic framework required for the design of the WIPP facility shaft sealing system, an evaluation was performed to assess the geologic conditions existing in and between the shafts, where the individual shaft sealing systems will eventually be emplaced (DOE, 1995: Appendix G2-A). The study evaluated shaft stratigraphy, regional groundwater occurrence, brine occurrence in the exposed Salado Formation section, and the consistency between recorded data and actual field data.

Four shafts connect the WIPP underground workings to the surface, the (1) Air Intake Shaft (AIS), (2) Exhaust Shaft, (3) Salt Handling Shaft, and (4) Waste Shaft. Stratigraphic correlation and evaluation of the unit contacts show that lithologic units occur at approximately the same levels in all four shaft locations. Some stratigraphic contact elevations vary because of regional structure and stratigraphic thinning and thickening of units. However, the majority of the stratigraphic contacts used to date are suitable for engineering design reference because they intersect all four shafts.

2.2.3 Rock Mechanics Setting

The WIPP stratigraphy includes rock types that exhibit both brittle and ductile behaviors. The majority of the stratigraphy intercepted by the shafts consists of the Salado Formation, which is predominantly halite. The primary mechanical behavior of halitic rocks is creep. Except near free surfaces (such as the shaft wall), the salt rocks will remain tight and undisturbed despite the long-term creep deformation they sustain. The other rock types within the Salado Formation are anhydrites and polyhalites. These two rock types are typically brittle, stiff, and exhibit high strength in laboratory tests. The structural strength of particular anhydritic rock layers, however, depends on the thickness of the layers, which range from thin (<1 m) to fairly thick (10 m or more). Brittle failure of these noncreeping rocks can occur as they restrain, or attempt to restrain, the creep of the salt above and below the stiff layer. Although thick layers can resist the
induced stresses, thin layers are fractured in tension by the salt creep. Because the deformation in the bounding salt is time dependent, the damage in the brittle rock is also time dependent.

Above the Salado Formation, the Rustler Formation stratigraphy consists of relatively strong limestones and siltstones. The shaft excavation is the only significant disturbance to these rocks. Any subsurface subsidence (deformation) or loading induced by the presence of the repository are negligible in a rock mechanics sense.

Regardless of rock type, the shafts create a disturbed zone in the surrounding rock. Microfracturing will occur in the rock adjacent to the shaft wall, where confining stresses are low or nonexistent. The extent of the zone depends on the rock strength and the prevailing stress state, which is depth dependent. In the salt rocks, microfracturing occurs to form the disturbed zone both at the time of excavation and later as dilatant creep deformations occur. In the brittle rocks, the disturbance occurs at the time of excavation and does not worsen with time. The extent of disturbed zones in the salt and brittle rocks can be calculated, as will be described in Section 7 and Appendix D in the Compliance Submittal Design Report (Sandia, 1996).

Preventing the salt surrounding the shafts from creeping causes reintroduction of stresses that reverse the damage process and cause healing (Van Sambeek et al., 1993). The seal system design relies on this principle for sealing the disturbed zone in salt. In the brittle rocks, grouting of the damage is a viable means of reducing the interconnected fractures that increase the permeability of the rock.

2.3 Site Hydrologic Setting

The WIPP shafts penetrate approximately 655 m (2150 ft) of sediments and rocks. From a hydrogeologic perspective, relevant information includes the permeability of the water-bearing units, the thickness of the water-bearing units, and the observed vertical pressure (head) gradients expected to exist after shaft construction and ambient pressure recovery. This section will discuss these three aspects of the site hydrogeology. The geochemistry of the pore fluids adjacent to the shaft system is also important hydrogeologic information and will be provided in Section 2.4.

2.3.1 Hydrostratigraphy

The WIPP shafts penetrate Quaternary surface sediments, the Gatuña Formation, the Santa Rosa Formation, the Dewey Lake Redbeds, the Rustler Formation, and the Salado Formation. The Rustler Formation contains the only laterally-persistent water-bearing units in the WIPP vicinity. As a result, flow-field characterization, regional flow-modeling, and performance assessment off-site release scenarios focus on the Rustler Formation. The hydrogeology of the stratigraphic units in contact with the upper portion of the AIS sealing system is fairly well known from detailed hydraulic testing of the Rustler Formation at well H-16 located 17 m from the AIS (Beauheim, 1987). The H-16 borehole was drilled in July and August 1987 to monitor the hydraulic responses of the Rustler members to the drilling and construction of the AIS. During the drilling of H-16, each member of the Rustler Formation was cored. In addition, detailed drill-stem, pulse, and slug hydraulic tests were performed in H-16 on the members of the Rustler. Through the detailed testing program at H-16, the permeability of each of the Rustler members was estimated. Detailed mapping of the AIS by Holt and Powers (1990) and other investigators provided information on the location of wet zones and weeps within the Salado Formation. This
The reader, unless particularly interested in this subject, should proceed to Section 2.3.2.

Water-bearing zones have been observed in units above the Rustler Formation in the WIPP site vicinity. However, drilling in the Dewey Lake Redbeds has not identified any continuous saturated units at the WIPP site. Water-bearing units within stratigraphic intervals above the Rustler are typically perched saturated zones of very low yield. Thin perched groundwater intervals have been encountered in WIPP wells H-1, H-2, and H-3 (Mercer and Orr, 1979). The only Dewey Lake Redbed wells that have sufficient yields for watering livestock are the James Ranch wells, the Pocket well, and the Fairfield well (Brinster, 1991). These wells are located to the south of the WIPP and are not in the immediate vicinity of the WIPP shafts.

The Dewey Lake Redbeds overlie the Rustler Formation. The Rustler is composed of five members defined by lithology. These are, in ascending order, the unnamed lower member, the Culebra dolomite, the Tamarisk, the Magenta dolomite, and the Forty-niner (see Figure G2-4). Of these five members, the unnamed lower member, the Culebra, and the Magenta are the most transmissive units in the Rustler. The Tamarisk and the Forty-niner are aquitards within the Rustler and have very low permeabilities relative to the three members listed above.

To the east of the shafts in Nash Draw, the Rustler/Salado contact has been observed to be permeable and water-bearing. This contact unit has been referred to as the “brine aquifer” (Mercer, 1983). The brine aquifer is not reported to exist in the vicinity of the shafts. The hydraulic conductivity of the Rustler/Salado contact in the vicinity of the shafts is reported to be approximately $4 \times 10^{-11} \text{ m/s}$, which is equivalent to a permeability of $6 \times 10^{-18} \text{ m}^2$ using reference brine fluid properties (Brinster, 1991). The unnamed lower member was hydraulic tested at well H-16 in close proximity to the AIs. The maximum permeability of the unnamed lower member was interpreted to be $2.2 \times 10^{-18} \text{ m}^2$ and was attributed to the unnamed lower member claystone by Beauheim (1987), which correlates to the transition and bioturbated clastic zones of Holt and Powers (1990).

The Culebra Dolomite Member is the most transmissive member of the Rustler Formation in the vicinity of the WIPP site and is the most transmissive saturated unit in contact with the shaft sealing system. The Culebra is an argillaceous dolomicrite which contains secondary porosity in the form of abundant vugs and fractures. The permeability of the Culebra varies greatly in the vicinity of the WIPP and is controlled by the condition of the secondary porosity (fractures). The permeability of the Culebra in the vicinity of the shafts is approximately $2.1 \times 10^{-14} \text{ m}^2$.

The Tamarisk Member is composed primarily of massive, lithified anhydrite, including anhydrite 2, mudstone 3, and anhydrite 3. Testing of the Tamarisk at H-16 was unsuccessful. The estimated transmissivity of the Tamarisk at H-16 is one to two orders of magnitude lower than the least-transmissive unit successfully tested at H-16, which results in a permeability range from $4.6 \times 10^{-20}$ to $4.6 \times 10^{-19} \text{ m}^2$. Anhydrites in the Rustler have an approximate permeability of $1 \times 10^{-19} \text{ m}^2$. The permeability of mudstone 3 is $1.5 \times 10^{-19} \text{ m}^2$ (Brinster, 1991).

The Magenta is a dolomite that is typically less permeable than the Culebra. The Magenta Dolomite Member overlies the Tamarisk Member. The Magenta is an indurated, gypsiferous, arenaceous, dolomite that Holt and Powers (1990) classify as a dolarenite. The dolomite grains are primarily composed of silt to fine sand-sized clasts. Wavy to lenticular bedding and ripple cross laminae are prevalent through most of the Magenta. Holt and Powers (1990) estimate that
inflow to the shaft from the Magenta during shaft mapping was less than 1 gal/min. The Magenta has a permeability of approximately $1.5 \times 10^{-15}$ m$^2$ (Saulnier and Avis, 1988).

The Forty-niner Member is divided into three informal lithologic units. The lowest unit is anhydrite 4, a laminated anhydrite having a gradational contact with the underlying Magenta. Mudstone 4 overlies anhydrite 4 and is composed of multiple units containing mudstones, siltstones, and very fine sandstones. Anhydrite 5 is the uppermost informal lithologic unit of the Forty-niner Member. The permeability of mudstone 4, determined from the pressure responses in the Forty-niner interval of H-16 to the drilling of the AIS, is $3.9 \times 10^{-16}$ m$^2$ (referred to as the Forty-niner claystone by Avis and Saulnier, 1990).

The Salado Formation is a very low permeability formation that is composed of bedded halite, polyhalite, anhydrite, and mudstones. Inflows in the shafts have been observed over select intervals during shaft mapping, but flows are below the threshold of quantification. In some cases these weeps are individual, lithologically distinct marker beds, and in some cases they are not. Directly observable brine flow from the Salado Formation into excavated openings is a short-lived process. Table G2-1 lists the brine seepage intervals identified by Holt and Powers (1990) during their detailed mapping of the AIS. Seepage could be indicated by a wet rockface or by the presence of precipitate from brine evaporation on the shaft rockface. The zones listed in Table G2-1 make up less than 10% of the Salado section that is intersected by the WIPP shafts.

### Table G2-1

<table>
<thead>
<tr>
<th>Stratigraphic Unit</th>
<th>Lithology</th>
<th>Thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marker Bed 103</td>
<td>Anhydrite</td>
<td>5.0</td>
</tr>
<tr>
<td>Marker Bed 109</td>
<td>Anhydrite</td>
<td>7.7</td>
</tr>
<tr>
<td>Vaca Triste</td>
<td>Mudstone</td>
<td>2.4</td>
</tr>
<tr>
<td>Zone A</td>
<td>Halite</td>
<td>2.9</td>
</tr>
<tr>
<td>Marker Bed 121</td>
<td>Polyhalite</td>
<td>0.5</td>
</tr>
<tr>
<td>Union Anhydrite</td>
<td>Anhydrite</td>
<td>2.3</td>
</tr>
<tr>
<td>Marker Bed 124</td>
<td>Anhydrite</td>
<td>2.7</td>
</tr>
<tr>
<td>Zone B</td>
<td>Halite</td>
<td>0.9</td>
</tr>
<tr>
<td>Zone C</td>
<td>Halite</td>
<td>2.7</td>
</tr>
<tr>
<td>Zone D</td>
<td>Halite</td>
<td>3.2</td>
</tr>
<tr>
<td>Zone E</td>
<td>Halite</td>
<td>0.6</td>
</tr>
<tr>
<td>Zone F</td>
<td>Halite</td>
<td>0.9</td>
</tr>
<tr>
<td>Zone G</td>
<td>Halite</td>
<td>0.6</td>
</tr>
<tr>
<td>Zone H</td>
<td>Halite</td>
<td>1.8</td>
</tr>
<tr>
<td>Marker Bed 129</td>
<td>Polyhalite</td>
<td>0.5</td>
</tr>
<tr>
<td>Zone I</td>
<td>Halite</td>
<td>1.7</td>
</tr>
<tr>
<td>Zone J</td>
<td>Halite</td>
<td>1.2</td>
</tr>
</tbody>
</table>

To gain perspective into the important stratigraphic units from a hydrogeologic view, the permeability and thickness of the units adjacent to the shafts can be compared. Table G2-2 lists the lithologic units in the Rustler and the Salado Formations with their best estimate permeabilities and their thickness as determined from the AIS mapping. The stratigraphy of the units overlying the Rustler is not considered in Table G2-2 because these units are typically not saturated in the vicinity of the WIPP shafts. The overlying sediments account for approximately 25% of the stratigraphy column adjacent to the shafts.

Because permeability varies over several orders of magnitude, the log of the permeability is also listed to simplify comparison between units. Table G2-2 shows that by far the two most transmissive zones occur in the Rustler Formation; these are the Culebra and Magenta dolomites. These units are relatively thin when compared to the combined Rustler and Salado thickness adjacent to the shafts (3% of Rustler and Salado combined thickness). The Magenta and the Culebra are the only two units that are known to possess permeabilities higher than $1 \times 10^{-18}$ m$^2$.

<table>
<thead>
<tr>
<th>Formation</th>
<th>Member/Lithology</th>
<th>Undisturbed Permeability (m$^2$)</th>
<th>Thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rustler</td>
<td>Anhydrite$^{(1)}$</td>
<td>$1.0 \times 10^{-19}$</td>
<td>46.7</td>
</tr>
<tr>
<td>Rustler</td>
<td>Mudstone 4</td>
<td>$3.9 \times 10^{-16}$</td>
<td>4.4</td>
</tr>
<tr>
<td>Rustler</td>
<td>Magenta</td>
<td>$1.5 \times 10^{-15}$</td>
<td>7.8</td>
</tr>
<tr>
<td>Rustler</td>
<td>Mudstone 3</td>
<td>$1.5 \times 10^{-19}$</td>
<td>2.9</td>
</tr>
<tr>
<td>Rustler</td>
<td>Culebra</td>
<td>$2.1 \times 10^{-14}$</td>
<td>8.9</td>
</tr>
<tr>
<td>Rustler</td>
<td>Transition/ Bioturbated Clastics</td>
<td>$2.2 \times 10^{-18}$</td>
<td>18.7</td>
</tr>
<tr>
<td>Salado</td>
<td>Halite</td>
<td>$1.0 \times 10^{-21}$</td>
<td>356.6</td>
</tr>
<tr>
<td>Salado</td>
<td>Polyhalite</td>
<td>$3.0 \times 10^{-21}$</td>
<td>10.9</td>
</tr>
<tr>
<td>Salado</td>
<td>Anhydrite</td>
<td>$1.0 \times 10^{-19}$</td>
<td>28.2</td>
</tr>
</tbody>
</table>

$^{(1)}$ Anhydrite 5, Anhydrite 4, Anhydrite 3, and Anhydrite 2

The vast majority (97%) of the rocks adjacent to the shaft in the Rustler and the Salado Formations are low permeability ($<1 \times 10^{-18}$ m$^2$). The conclusion that can be drawn from reviewing Table G2-2 is that the shafts are located hydrogeologically in a low permeability, low groundwater flow regime. Inflow measurements have historically been made at the shafts, and observable flow is attributed to leakage from the Rustler Formation.

Flow modeling of the Culebra has demonstrated that depressurization has occurred as a result of the sinking of the shafts at the site. Maximum estimated head drawdown in the Culebra at the centroid of the shafts was estimated by Haug et al. (1987) to be 33 m in the mid-1980s. This drawdown in the permeable units intersected by the shafts is expected because the shafts act as long-term constant pressure (atmospheric) sinks. Measurements of fluid flow into the WIPP shafts when they were unlined show a range from a maximum of 0.11 L/s (3,469 m$^3$/yr) measured in the Salt Handling Shaft on September 13, 1981 to a minimum of 0.008 L/s (252 m$^3$/yr) measured at the Waste Handling Shaft on August 6, 1987 (LaVenue et al., 1990).
The following summary of shaft inflow rates from the Rustler is based on a review of LaVenue et al. (1990) and Cauffman et al. (1990). Shortly after excavation and prior to grouting and liner installation, the inflow into the Salt Handling Shaft was 0.11 L/s (3,469 m³/yr). The average flow rate measured after shaft lining for the period from mid-1982 through October 1992 was 0.027 L/s (851 m³/yr). The average flow rate into the Waste Handling Shaft during the time when the shaft was open and unlined was about 0.027 L/s (851 m³/yr). Between the first and second grouting events (July 1984 to November 1987) the average inflow rate was 0.016 L/s (505 m³/yr). No estimates were found after the second grouting. Inflow to the pilot holes for the Exhaust Shaft averaged 0.028 L/s (883 m³/yr). In December 1984 a liner plate was grouted across the Culebra. After this time, a single measurement of inflow from the Culebra was 0.022 L/s (694 m³/yr). After liner plate installation, three separate grouting events occurred at the Culebra. No measurable flow was reported after the third grouting event in the summer of 1987. Flow into the AIS when it was unlined and draining averaged 0.044 L/s (1,388 m³/yr). Since the Rustler has been lined, flow into the AIS has been negligible.

The majority of the flow represented by these shaft measurements originates from the Rustler. This is clearly evident by the fact that lining of the WIPP shafts was found to be unnecessary in the Salado Formation below the Rustler/Salado contact. When the liners were installed, flow rates diminished greatly. Under sealed conditions, hydraulic gradients in rocks adjacent to the shaft will diminish as the far-field pressures approach ambient conditions. The low-permeability materials sealing the shaft combined with the reduction in lateral hydraulic gradients will likely result in flow rates into the shaft that are several orders of magnitude less than observed under open shaft or lined shaft conditions.

2.3.2 Observed Vertical Gradients

Hydraulic heads within the Rustler and between the Rustler and Salado Formations are not in hydrostatic equilibrium. Mercer (1983) recognized that heads at the Rustler Salado transition (referred to as the brine aquifer and not present in the vicinity of the WIPP shafts) indicate an upward hydraulic gradient from that zone to the Culebra. Later, with the availability of more head measurements within the Salado and Rustler members, Beauheim (1987) provided additional insight into the potential direction of vertical fluid movement within the Rustler. He reported that the hydraulic data indicate an upward gradient from the Salado to the Rustler.

Formation pressures in the Salado Formation have been decreased in the near vicinity of the WIPP underground facility. The highest, and thought to be least disturbed, estimated formation fluid pressure from hydraulic testing is 12.55 MPa estimated from interpretation of testing within borehole SCP01 in Marker Bed 139 (MB139) just below the underground facility horizon (Beauheim et al., 1993). The fresh-water head within MB139, based on the estimated static formation pressure of 12.55 MPa, is 1,663.6 m (5,458 ft) above mean sea level (msl).

Hydraulic heads in the Rustler have also been impacted by the presence of the WIPP shafts. Impacts in the Culebra were significant in the 1980s with a large drawdown cone extending away from the shafts in the Culebra (Haug et al., 1987). The undisturbed head of the Rustler Salado contact in the vicinity of the AIS is estimated to be about 936.0 m (3,071 ft) msl (Brinster, 1991). The undisturbed head in the Culebra is estimated to be approximately 926.9 m (3,041 ft) msl in the vicinity of the AIS (LaVenue et al., 1990). The undisturbed head in the Magenta is estimated to be approximately 960.1 m (3,150 ft) msl (Brinster, 1991).
The disturbed and undisturbed heads in the Rustler are summarized in Table G2-3. Also included is the freshwater head of MB139 based on hydraulic testing in the WIPP underground. Consistent with the vertical flow directions proposed by previous investigators, estimated vertical gradients in the vicinity of the AIS before the shafts were drilled indicate a hydraulic gradient from the Magenta to the Culebra and from the Rustler/Salado contact to the Culebra. There is also the potential for flow from the Salado Formation to the Rustler Formation.

<table>
<thead>
<tr>
<th>Table G2-3</th>
<th>Freshwater Head Estimates in the Vicinity of the Air Intake Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrologic Unit</td>
<td>Freshwater Head (m asl)</td>
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<tr>
<td>---------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Culebra Member</td>
<td>926.9¹</td>
</tr>
<tr>
<td>Lower Unnamed Member</td>
<td>—</td>
</tr>
<tr>
<td>Rustler/Salado Contact</td>
<td>936.0 - 940.0¹</td>
</tr>
<tr>
<td>Salado MB139</td>
<td>1,663.6²</td>
</tr>
</tbody>
</table>

¹ Estimated from a contoured head surface plot based principally on well data collected prior to shaft construction. 
² Measured through hydraulic testing and/or long-term monitoring.

2.4 Site Geochemical Setting

2.4.1 Regional and Local Geochemistry in Rustler Formation and Shallower Units

The Rustler Formation, overlying the Salado Formation, consists of interbedded anhydrite/gypsum, mudstone/siltstone, halite east of the WIPP site, and two layers of dolomite. Principal occurrences of NaCl/MgSO₄ brackish to briny groundwater in the Rustler at the WIPP site and to the north, west, and south are found (1) at the lower member near its contact with the underlying Salado and (2) in the two dolomite members having a variable fracture-induced secondary porosity. The mineralogy of the Rustler Formation is summarized in Table G2-4.

The five members of the Rustler Formation are described as follows: (1) The Forty-niner Member is similar in lithology to the other non-dolomitic units but contains halite east of the WIPP site. (2) The Magenta Member is another variably fractured dolomite/sulfate unit containing sporadic occurrences of groundwater near and west of the WIPP site. (3) The Tamarisk Member is dominantly anhydrite (locally altered to gypsum) with subordinate fine-grained clastics, containing halite to the east of the WIPP site. (4) The Culebra Dolomite Member is dominantly dolomite with subordinate anhydrite and/or gypsum, having a variable fracture-induced secondary porosity containing regionally continuous occurrences of groundwater at the WIPP site and to the north, west, and south. (5) An unnamed lower member consists of sandstone, siltstone, mudstone, claystone, and anhydrite locally altered to gypsum, and containing halite under most of the WIPP site and occurrences of brine at its base, mostly west of the WIPP site.
### Table G2-4
Chemical Formulas, Distributions, and Relative Abundance of Minerals in the Rustler and Salado Formations (after Lambert, 1992)

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Formula</th>
<th>Occurrence/Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amesite</td>
<td>(Mg₄Al₂)(Si₂Al₂)O₁₀(OH)₈</td>
<td>S, R</td>
</tr>
<tr>
<td>Anhydrite</td>
<td>CaSO₄</td>
<td>SSS, RRR</td>
</tr>
<tr>
<td>Calcite</td>
<td>CaCO₃</td>
<td>S, RR</td>
</tr>
<tr>
<td>Carnallite</td>
<td>KMgCl₃•6H₂O</td>
<td>SS†</td>
</tr>
<tr>
<td>Chlorite</td>
<td>(Mg,Al,Fe)₁₂(Si,Al)₈O₂₀(OH)₁₆</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Corrensite</td>
<td>Mixed-layer chlorite/smectite</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Dolomite</td>
<td>CaMg(CO₃)₂</td>
<td>RR</td>
</tr>
<tr>
<td>Feldspar</td>
<td>(K,Na,Ca)(Si,Al)₄O₈</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Glauberite</td>
<td>Na₂Ca(SO₄)₂</td>
<td>S</td>
</tr>
<tr>
<td>Gypsum</td>
<td>CaSO₄•2H₂O</td>
<td>S, RRR</td>
</tr>
<tr>
<td>Halite</td>
<td>NaCl</td>
<td>SSS, RRR</td>
</tr>
<tr>
<td>Illite</td>
<td>K₁₋₁.₅Al₄(Si₋₇₋₆.₅Al₁₋₁.₅O₂₀)(OH)₄</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Kainite</td>
<td>KMgCISO₄•¾H₂O</td>
<td>SS†</td>
</tr>
<tr>
<td>Kieserite</td>
<td>MgSO₄•H₂O</td>
<td>SS†</td>
</tr>
<tr>
<td>Langbeinite</td>
<td>K₂Mg₂(SO₄)₃</td>
<td>S*</td>
</tr>
<tr>
<td>Magnesite</td>
<td>MgCO₃</td>
<td>S, R</td>
</tr>
<tr>
<td>Polyhalite</td>
<td>K₂Ca₂Mg(SO₄)₄•2H₂O</td>
<td>SS, R</td>
</tr>
<tr>
<td>Pyrite</td>
<td>FeS₂</td>
<td>S, R</td>
</tr>
<tr>
<td>Quartz</td>
<td>SiO₂</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Serpentine</td>
<td>Mg₃Si₂O₅(OH)₄</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Smectite</td>
<td>(Ca₁₂₋₇Na₀.₇(Al,Mg,Fe)₄(Si,Al)₈O₂₀(OH)₄•nH₂O</td>
<td>S‡, R‡</td>
</tr>
<tr>
<td>Sylvite</td>
<td>KCl</td>
<td>SS*</td>
</tr>
</tbody>
</table>

Key to Occurrence/Abundance notations:
S = Salado Formation; R = Rustler Formation; 3× = abundant, 2× = common, 1× = rare or accessory; * = potash-ore mineral (never near surface); † = potash-zone non-ore mineral; ‡ = in claystone interbeds.

The Dewey Lake Redbeds, overlying the Rustler Formation, are the uppermost Permian unit; they consist of siltstones and claystones locally transected by concordant and discordant fractures that may contain gypsum. The Dewey Lake Redbeds contain sporadic occurrences of groundwater that may be locally perched, mostly in the area south of the WIPP site. The Triassic Dockum Group (undivided) rests on the Dewey Lake Redbeds in the eastern half of the WIPP site and thickens eastward; it is a locally important source of groundwater for agricultural and domestic use.

The Gatuña Formation, overlying the Dewey Lake Redbeds, occurs locally as channel and alluvial pond deposits (sands, gravels, and boulder conglomerates). The pedogenic Mescalero caliche is commonly developed on top of the Gatuña Formation and on many other erosionally
truncated rock types. Surficial dune sand, which may be intermittently damp, covers virtually all outcrops at and near the WIPP site. Siliceous alluvial deposits southwest of the WIPP site also contain potable water. The geochemistry of groundwater found in the Rustler Formation and Dewey Lake Redbeds is summarized in Table G2-5.

2.4.2 Regional and Local Geochemistry in the Salado Formation

The Salado Formation consists dominantly of halite, interrupted at intervals of meters to tens of meters by beds of anhydrite, polyhalite, mudstone, and local potash mineralization (sylvite or langbeinite, with or without accessory carnallite, kieserite, kainite and glauberite, all in a halite matrix). Some uniquely identifiable non-halite units, 0.1 to 10 m thick, have been numbered from the top down (100 to 144) for convenience as marker beds to facilitate cross-basinal stratigraphic correlation. The WIPP facility was excavated just above Marker Bed 139 in the Salado Formation at a depth of about 655 m.

Although the most common Delaware Basin evaporite mineral is halite, the presence of less soluble interbeds (dominantly anhydrite, polyhalite, and claystone) and more soluble admixtures (e.g. sylvite, glauberite, kainite) has resulted in chemical and physical properties significantly different from those of pure NaCl. Under differential stress produced near excavations, brittle interbeds (anhydrite, polyhalite, magnesite, dolomite) may fracture, whereas under a similar stress regime pure NaCl would undergo plastic deformation. Fracturing of these interbeds has locally enhanced the permeability, allowing otherwise nonporous rock to carry groundwater (e.g., the fractured polyhalitic anhydrite of Marker Bed 139 under the floor of the WIPP excavations).

Groundwater in evaporites represents the exposure of chemical precipitates to fluids that may be agents (as in the case of dissolution) or consequences of postdepositional alteration of the

Table G2-5

<table>
<thead>
<tr>
<th>Well</th>
<th>Date</th>
<th>Zone</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIPP-30</td>
<td>July 1980</td>
<td>R/S</td>
<td>955</td>
<td>2770</td>
<td>121,000</td>
<td>2180</td>
<td>7390</td>
<td>192,000</td>
</tr>
<tr>
<td>WIPP-29</td>
<td>July 1980</td>
<td>R/S</td>
<td>1080</td>
<td>2320</td>
<td>36,100</td>
<td>1480</td>
<td>12,000</td>
<td>58,000</td>
</tr>
<tr>
<td>H-5B</td>
<td>June 1981</td>
<td>Cul</td>
<td>1710</td>
<td>2140</td>
<td>52,400</td>
<td>1290</td>
<td>7360</td>
<td>89,500</td>
</tr>
<tr>
<td>H-9B</td>
<td>November 1985</td>
<td>Cul</td>
<td>590</td>
<td>37</td>
<td>146</td>
<td>7</td>
<td>1900</td>
<td>194</td>
</tr>
<tr>
<td>H-2A</td>
<td>April 1986</td>
<td>Cul</td>
<td>743</td>
<td>167</td>
<td>3570</td>
<td>94</td>
<td>2980</td>
<td>5310</td>
</tr>
<tr>
<td>P-17</td>
<td>March 1986</td>
<td>Cul</td>
<td>1620</td>
<td>1460</td>
<td>28,300</td>
<td>782</td>
<td>6020</td>
<td>48,200</td>
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<tr>
<td>WIPP-29</td>
<td>December 1985</td>
<td>Cul</td>
<td>413</td>
<td>6500</td>
<td>94,900</td>
<td>23,300</td>
<td>20,000</td>
<td>179,000</td>
</tr>
<tr>
<td>H-3B1</td>
<td>July 1985</td>
<td>Mag</td>
<td>1000</td>
<td>292</td>
<td>1520</td>
<td>35</td>
<td>2310</td>
<td>3360</td>
</tr>
<tr>
<td>H-4C</td>
<td>November 1986</td>
<td>Mag</td>
<td>651</td>
<td>411</td>
<td>7110</td>
<td>85</td>
<td>7100</td>
<td>8460</td>
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<tr>
<td>Ranch</td>
<td>June 1986</td>
<td>DL</td>
<td>420</td>
<td>202</td>
<td>200</td>
<td>4</td>
<td>1100</td>
<td>418</td>
</tr>
</tbody>
</table>

Key to Zone:
R/S = “basal brine aquifer” near the contact between the Rustler and Salado Formations; Cul = Culebra Member, Rustler Formation; Mag = Magenta Member, Rustler Formation; DL = Dewey Lake Redbeds.
evaporites (as in the cases of dehydration of gypsum and diagenetic dewatering of other minerals). Early in the geological studies of the WIPP site, groundwater occurrences that could be hydrologically characterized were identified.

Since the beginning of conventional mining in the Delaware Basin, relatively short-lived seeps (pools on the floor, efflorescences on the walls, and stalactitic deposits on the ceiling) have been known to occur in the Salado Formation where excavations have penetrated. These brine occurrences are commonly associated with the non-halitic interbeds whose porosity is governed either by fracturing (as in brittle beds) or mineralogical discontinuities (as in “clay” seams).

The geochemistry of brines encountered in the Salado Formation is summarized in Table G2-6. The relative abundance of minerals was summarized in Table G2-4.
### Table G2-6

Variations in Major Solutes in Brines from the Salado Formation, in mg/L (after Lambert, 1992)

<table>
<thead>
<tr>
<th>Source of Brine</th>
<th>Date</th>
<th>Ca</th>
<th>Mg</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>SO(_4)</th>
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</thead>
<tbody>
<tr>
<td>Room G Seep</td>
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<tr>
<td></td>
<td>Sep-87</td>
<td>278</td>
<td>14800</td>
<td>15800</td>
<td>99000</td>
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<td>300</td>
<td>18700</td>
<td>15400</td>
<td>97100</td>
<td>190000</td>
<td>32000</td>
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<td></td>
<td>Feb-88</td>
<td>260</td>
<td>18200</td>
<td>17100</td>
<td>94100</td>
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<td>36200</td>
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<td>Mar-88</td>
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<td>16200</td>
<td>92100</td>
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<td>14800</td>
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<td>Marker Bed 139</td>
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<tr>
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<td>17000</td>
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<tr>
<td>Room Q</td>
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<tr>
<td></td>
<td>279</td>
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<td>22600</td>
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<tr>
<td>AIS Sump (accumulation</td>
<td>Jul-88</td>
<td>960</td>
<td>1040</td>
<td>1720</td>
<td>118000</td>
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<td>6170</td>
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<tr>
<td>in bottom of sump)</td>
<td>May-89</td>
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<td>500</td>
<td>600</td>
<td>83100</td>
<td>122700</td>
<td>7700</td>
</tr>
<tr>
<td>McNutt Potash Zone</td>
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<td>1100</td>
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<td>114200</td>
<td>8800</td>
</tr>
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<td>Duval mine</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>640</td>
<td>55400</td>
<td>30000</td>
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</tr>
<tr>
<td>Miss. Chem. mine</td>
<td>200</td>
<td>44200</td>
<td>45800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PERMIT ATTACHMENT G2
Page G2-22 of 80
3. Design Guidance

3.1 Introduction

The WIPP is subject to regulatory requirements contained in applicable portions of the New Mexico Hazardous Waste Act, specifically 20.4.1.500 NMAC and .900 (incorporating 40 CFR §264 and §270), and requirements contained in 40 CFR §191 and 40 CFR §194. The use of both engineered and natural barriers to isolate wastes from the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §191.14(d). The use of engineered barriers to prevent or substantially delay the movement of water, hazardous constituents, or radionuclides toward the accessible environment is required by 20.4.1.500 NMAC (incorporating 40 CFR §§264.111 and 264.601) and 40 CFR §194.44.

Hazardous constituent release performance standards are specified in Permit Part 5 and 20.4.1.500 NMAC (incorporating 40 CFR §§264.111(b), 264.601(a), and 264 Subpart F). Quantitative requirements for potential releases of radioactive materials from the repository system are specified in 40 CFR §191. The regulations impose quantitative release requirements on the total repository system, not on individual subsystems of the repository system, for example, the shaft sealing subsystem.

3.2 Design Guidance and Design Approach

The guidance described for the design of the shaft sealing system addresses the need for the WIPP to comply with system requirements and to follow accepted engineering practices using demonstrated technology. The design guidance addresses the need to limit:

1. radiological or other hazardous constituents reaching the regulatory boundaries,
2. groundwater flow into and through the sealing system,
3. chemical and mechanical incompatibility,
4. structural failure of system components,
5. subsidence and accidental entry, and
6. development of new construction technologies and/or materials.

For each element of design guidance, a design approach has been developed. Table G2-7 contains qualitative design guidance and the design approach used to implement it.
## Shaft Sealing System Design Guidance

<table>
<thead>
<tr>
<th>Qualitative Design Guidance</th>
<th>Design Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>The shaft sealing system shall limit:</td>
<td>The shaft sealing system shall be designed to meet the qualitative design guidance in the following ways:</td>
</tr>
<tr>
<td>1. the migration of radiological or other hazardous constituents from the repository horizon to the regulatory boundary during the 10,000-year regulatory period following closure;</td>
<td>1. In the absence of human intrusion, brine migrating from the repository horizon to the Rustler Formation must pass through a low permeability sealing system.</td>
</tr>
<tr>
<td>2. groundwater flowing into and through the shaft sealing system;</td>
<td>2. In the absence of human intrusion, groundwater migrating from the Rustler Formation to the repository horizon must pass through a low permeability sealing system.</td>
</tr>
<tr>
<td>3. chemical and mechanical incompatibility of seal materials with the seal environment;</td>
<td>3. Brine contact with seal elements is limited and materials possess acceptable mechanical properties.</td>
</tr>
<tr>
<td>4. the possibility for structural failure of individual components of the sealing system;</td>
<td>4. State of stress from forces expected from rock creep and other mechanical loads is favorable for seal materials.</td>
</tr>
<tr>
<td>5. subsidence of the ground surface in the vicinity of the shafts and the possibility of accidental entry after sealing;</td>
<td>5. The shaft is completely filled with low-porosity materials, and construction equipment would be needed to gain entry.</td>
</tr>
<tr>
<td>6. the need to develop new technologies or materials for construction of the shaft sealing system.</td>
<td>6. Construction of the shaft sealing system is feasible using available technologies and materials.</td>
</tr>
</tbody>
</table>
4. Design Description

4.1 Introduction

The design presented in this section was developed based on (1) the design guidance outlined in Section 3.0, (2) past design experience, and (3) a desire to reduce uncertainties associated with the performance of the WIPP sealing system. The WIPP shaft sealing system design has evolved over the past decade from the initial concepts presented by Stormont (1984) to the design concepts presented in this document. The past designs are:

- the plugging and sealing program for the WIPP (Stormont, 1984),
- the initial reference seal system design (Nowak et al., 1990),
- the seal design alternative study (Van Sambeek et al., 1993),
- the WIPP sealing system design (DOE, 1995).

The present design changes were implemented to take advantage of knowledge gained from small-scale seals tests conducted at the WIPP (Knowles and Howard, 1996), advances in the ability to predict the time-dependent mechanical behavior of compacted salt rock (Callahan et al., 1996), large-scale dynamic salt compaction tests and associated laboratory determination of the permeability of compacted salt samples (Hansen and Ahrens, 1996; Brodsky et al., 1996), field tests to measure the permeability of the DRZ surrounding the WIPP AIS (Dale and Hurtado, 1996), and around seals (Knowles et al., 1996). A summary paper (Hansen et al., 1996) describing the design has been prepared.

The shaft sealing system is composed of seals within the Salado Formation, the Rustler Formation, and the Dewey Lake Redbeds and overlying units. All components of the sealing system are designed to meet Items 3, 4, and 6 of the Design Guidance (Table G2-7.); that is, all sealing system components are designed to be chemically and mechanically compatible with the seal environment, structurally adequate, and constructable using currently available technology and materials. The seals in the Salado Formation are also designed to meet Items 1 and 2 of the Design Guidance. These seals will limit fluid migration upward from the repository to the Rustler Formation and downward from the Rustler Formation to the repository. Migration of brine upward and downward is discussed in Sections 8.5 and 8.4 respectively. The seals in the Rustler Formation are designed to meet Item 2 in addition to Items 3, 4, and 6 of the Design Guidance. The seals in the Rustler Formation limit migration of Rustler brines into the shaft cross-section and also limit cross-flow between the Culebra and Magenta members. The principal function of the seals in the Dewey Lake Redbeds and overlying units is to meet Item 5 of the Design Guidance, that is, to limit subsidence of the ground surface in the vicinity of the shafts and to prevent accidental entry after repository closure. Entry of water (surface water and any groundwater that might be present in the Dewey Lake Redbeds and overlying units) into the sealing system is limited by restraining subsidence and by placing high density fill in the shafts.

4.2 Existing Shafts

The WIPP underground facilities are accessed by four shafts commonly referred to as the Waste, Air Intake, Exhaust, and Salt Handling Shafts. These shafts were constructed between 1981 and 1988. All four shafts are lined from the surface to just below the contact of the Rustler and Salado Formations. The lined portion of the shafts terminates in a substantial concrete structure called the "key," which is located in the uppermost portion of the Salado Formation.
Drawings showing the configuration of the existing shafts are included in Appendix G2-E and listed below in Table G2-8. Table G2-9 contains a summary of information describing the existing shafts.

The upper portions of the WIPP shafts are lined. The Waste, Air Intake, and Exhaust shafts have concrete linings; the Salt Handling Shaft has a steel lining with grout backing. In addition, during shaft construction, steel liner plates, wire mesh, and pressure grouting were used to stabilize portions of the shaft walls in the Rustler Formation and overlying units. Seepage of groundwater into the lined portions of the shafts has been observed. This seepage was expected; in fact, the shaft keys (massive concrete structures located at the base of each shaft liner) were designed to collect the seepage and transport it through a piping system to collection points at the repository horizon. In general, the seepage originates in the Magenta and Culebra members of the Rustler Formation and in the interface zone between the Rustler and Salado formations. It flows along the interface between the shaft liner and the shaft wall and through the DRZ immediately adjacent to the shaft wall. In those cases where seepage through the liner occurred, it happened where the liner offered lower resistance to flow than the interface and DRZ, for example, at construction joints. Maintenance grouting, in selected areas of the WIPP shafts, has been utilized to reduce seepage.

<table>
<thead>
<tr>
<th>Shaft</th>
<th>Drawing Title</th>
<th>Sheet Number of Drawing SNL-007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>Near-Surface/Rustler Formation Waste Shaft Stratigraphy &amp; As-Built Elements</td>
<td>2 of 28</td>
</tr>
<tr>
<td>Waste</td>
<td>Salado Formation Waste Shaft Stratigraphy &amp; As-Built Elements</td>
<td>3 of 28</td>
</tr>
<tr>
<td>AIS</td>
<td>Near-Surface/Rustler Formation Air Intake Shaft Stratigraphy &amp; As-Built Elements</td>
<td>7 of 28</td>
</tr>
<tr>
<td>AIS</td>
<td>Salado Formation Air Intake Shaft Stratigraphy &amp; As-Built Elements</td>
<td>8 of 28</td>
</tr>
<tr>
<td>Exhaust</td>
<td>Near-Surface/Rustler Formation Exhaust Shaft Stratigraphy &amp; As-Built Elements</td>
<td>12 of 28</td>
</tr>
<tr>
<td>Exhaust</td>
<td>Salado Formation Exhaust Shaft Stratigraphy &amp; As-Built Elements</td>
<td>13 of 28</td>
</tr>
<tr>
<td>Salt Handling</td>
<td>Near-Surface/Rustler Formation Salt Handling Shaft Stratigraphy &amp; As-Built Elements</td>
<td>17 of 28</td>
</tr>
<tr>
<td>Salt Handling</td>
<td>Salado Formation Salt Handling Shaft Stratigraphy &amp; As-Built Elements</td>
<td>18 of 28</td>
</tr>
<tr>
<td>Table G2-9</td>
<td>Summary of Information Describing Existing WIPP Shafts</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Shafts</strong></td>
<td><strong>Salt Handling</strong></td>
<td><strong>Waste</strong></td>
</tr>
<tr>
<td>A. Construction Method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Sinking method</td>
<td>Blind bored</td>
<td>Initial 6’ pilot hole slashed by drill &amp; blast (smooth wall blasting)</td>
</tr>
<tr>
<td>iv. Sump construction</td>
<td>Drill &amp; blast</td>
<td>Drill &amp; blast</td>
</tr>
<tr>
<td>B. Upper Portion of Shaft *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Type of liner</td>
<td>Steel</td>
<td>Concrete</td>
</tr>
<tr>
<td>ii. Lining diameter (ID)</td>
<td>10'-0”</td>
<td>19'-0”</td>
</tr>
<tr>
<td>iii. Excavated diameter</td>
<td>11'-10”</td>
<td>20'-8” to 22'-4”</td>
</tr>
<tr>
<td>iv. Installed depth of liner</td>
<td>838.5’</td>
<td>812’</td>
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<tr>
<td>C. Key Portion of Shaft *</td>
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<td></td>
</tr>
<tr>
<td>i. Construction material</td>
<td>Reinf. conc. w/chem. seals</td>
<td>Reinf. concrete w/chem. seals</td>
</tr>
<tr>
<td>ii. Liner diameter (ID)</td>
<td>10'-0”</td>
<td>19'-0”</td>
</tr>
<tr>
<td>iii. Excavated diameter</td>
<td>15'-0” to 18'-0”</td>
<td>27'-6” to 31'-0”</td>
</tr>
<tr>
<td>iv. Depth-top of Key</td>
<td>844’</td>
<td>836’</td>
</tr>
<tr>
<td>iv. Depth-bottom of Key</td>
<td>883’</td>
<td>900’</td>
</tr>
<tr>
<td>vi. Dow Seal #1 depth</td>
<td>846’ to 848’</td>
<td>846’ to 849’</td>
</tr>
<tr>
<td>vii. Dow Seal #2 depth</td>
<td>853’ to 856’</td>
<td>856’ to 859’</td>
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<tr>
<td>viii. Dow Seal #3 depth</td>
<td>868 to 891’</td>
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<tr>
<td>ix. Top of salt (Rustler/Salado contact)</td>
<td>851’</td>
<td>843’</td>
</tr>
<tr>
<td></td>
<td>Salt Handling</td>
<td>Waste</td>
</tr>
<tr>
<td>----------</td>
<td>---------------</td>
<td>-------</td>
</tr>
<tr>
<td>D. Lower Shaft (Unlined) *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Type of support</td>
<td>Unlined</td>
<td>Chain link mesh</td>
</tr>
<tr>
<td>ii. Excavated diameter</td>
<td>11'-10&quot;</td>
<td>20'-0&quot;</td>
</tr>
<tr>
<td>iii. Depth-top of &quot;unlined&quot;</td>
<td>882'</td>
<td>900'</td>
</tr>
<tr>
<td>iv. Depth-bottom of &quot;unlined&quot;</td>
<td>2144'</td>
<td>2142'</td>
</tr>
<tr>
<td>E. Station *</td>
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</tr>
<tr>
<td>i. Type of support</td>
<td>Wire mesh</td>
<td></td>
</tr>
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<td>ii. Principal dimensions</td>
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<td>iii. Depth-top of station</td>
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<td>2142'</td>
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<td>iv. Depth-floor of station</td>
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<td>2160'</td>
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<tr>
<td>F. Sump *</td>
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<tr>
<td>Depth-top of sump</td>
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</tr>
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<td>Depth-bottom of sump</td>
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<td>2286'</td>
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<td>G. Shaft Duty</td>
<td>Construction hoisting of excavated salt; personnel hoisting</td>
<td>Hoisting shaft for lowering waste containers; personnel hoisting until waste receipt</td>
</tr>
</tbody>
</table>

*This information is from the MOC drawings identified on Sheets 2, 3, 7, 8, 12, 13, 17, and 18 of Drawing SNL-007 (see Appendix G2-E).
4.3 Sealing System Design Description

This section describes the shaft sealing system design, components, and functions. The shaft sealing system consists of three essentially independent parts:

1. The seals in the Salado Formation provide the primary regulatory barrier. They will limit fluid flow into and out of the repository throughout the 10,000-year regulatory period.

2. The seals in the Rustler Formation will limit flow from the water-bearing members of the Rustler Formation and limit commingling of Magenta and Culebra groundwaters.

3. The seals in the Dewey Lake Redbeds and the near-surface units will limit infiltration of surface water and preclude accidental entry through the shaft openings.

The same sealing system is used in all four shafts. Therefore an understanding of the sealing system for one shaft is sufficient to understand the sealing system in all shafts. Only minor differences exist in the lengths of the components, and the component diameters differ to accommodate the existing shaft diameters.

The shaft liner will be removed in four locations in each shaft. All of these locations are within the Rustler Formation. Additionally, the upper portion of each shaft key will be eliminated. The portion of the shaft key that will be eliminated spans the Rustler/Salado interface and extends into the Salado Formation.

1. from 10 ft above the Magenta Member to the base of the Magenta (removal distances vary from 34–39 ft because of different member thickness at shaft locations),

2. for a distance of 10 ft in the anhydrite of the Tamarisk Member,

3. through the full height of the Culebra (17–24 ft), and

4. from the top anhydrite unit in the unnamed lower member to the top of the key (67–85 ft).

Additionally, the concrete will be removed from the top of the key to the bottom of the key’s lower chemical seal ring (23 to 29 ft). Drawing SNL-007, Sheets 4, 9, 14, and 19 in Appendix G2-E show shaft liner removal plans, and Sheet 23 shows key removal plans.

The decision to abandon portions of the shaft lining and key in place is based on two factors. First, no improvements in the performance of the sealing system associated with removal of these isolated sections of concrete have been identified. Second, because the keys are thick and heavily reinforced, their removal would be costly and time consuming. No technical problems are associated with the removal of this concrete; thus, if necessary, its removal can be incorporated in any future design.

The DRZ will be pressure grouted throughout the liner and key removal areas and for a distance of 10 ft above and below all liner removal areas. The pressure grouting will stabilize the DRZ during liner removal and shaft sealing operations. The grouting will also control groundwater seepage during and after liner removal. The pressure grouting of the DRZ has not been
assigned a sealing function beyond the construction period. It is likely that this grout will seal the
DRZ for an extended period of time. However, past experience with grout in the mining and
tunneling industries demonstrates that groundwater eventually opens alternative pathways
through the media and reestablishes seepage patterns (maintenance grouting is common in
both mines and tunnels). Therefore, post-closure sealing of the DRZ in the Rustler Formation
has not been assumed in the design.

The compacted clay sealing material (bentonite) will seal the shaft cross-section in the Rustler
Formation. In those areas where the shaft liner has been removed, the compacted clay will
confine the vertical movement of groundwater in the Rustler to the DRZ. Sealing the shaft DRZ
is accomplished in the Salado Formation. It is achieved initially through the interruption of the
halite DRZ by concrete-asphalt waterstops and on a long-term basis through the natural
process of healing the halite DRZ. The properties of the compacted clay are discussed in
Section 5.3.2. The concrete-asphalt waterstops and DRZ healing in the Salado are discussed in
Sections 7.6.1 and 7.5.2 respectively.

Reduction of the uncertainty associated with long-term performance is addressed by replacing
the upper and lower Salado Formation salt columns used in some of the earlier designs with
compacted clay columns and by adding asphalt sealing components in the Salado Formation.
Use of disparate materials for sealing components reduces the uncertainty associated with a
common-mode failure.

The compacted salt column provides a seal with an initial permeability several orders of
magnitude higher than the clay or asphalt columns; however, its long-term properties will
approach those of the host rock. The permeability of the compacted salt, after consolidation, will
be several orders of magnitude lower than that of the clay and comparable to that of the asphalt.
The clay provides seals of known low permeability at emplacement, and asphalt provides an
independent low permeability seal of the shaft cross-section and the shaft wall interface at the
time of installation. Sealing of the DRZ in the Rustler Formation during the construction period is
accomplished by grouting, and initial sealing of the DRZ in the Salado Formation is
accomplished by three concrete-asphalt waterstops.

In the following sections, each component of each of the three shaft segments is identified by
name and component number (see Figure G2-5 for nomenclature). Associated drawings in
Appendix G2-E are also identified. Drawings showing the overall system configurations for each
shaft are listed in Table G2-10.

4.3.1 Salado Seals

The seals placed in the Salado Formation are composed of (1) consolidated salt, clay, and
asphalt components that will function for very long periods, exceeding the 10,000-year
regulatory period; and (2) salt saturated concrete components that will function for extended
periods. The specific components that comprise the Salado seals are described below.

4.3.1.1 Compacted Salt Column

The compacted salt column (Component 10 in Figure G2-5, and shown in Drawing SNL-007,
Sheet 25) will be constructed of crushed salt taken from the Salado Formation. The length of the
salt column varies from 170 to 172 m (556 to 564 ft) in the four shafts. The compacted salt
column is sized to allow the column and concrete-asphalt waterstops at either end to be placed
between the Vaca Triste Unit and Marker Bed 136. The salt will be placed and compacted to a density approaching 90% of the average density of intact Salado salt. The effects of creep closure will cause this density to increase with time, further reducing permeability.

The salt column will offer limited resistance to fluid migration immediately after emplacement, but it will become less permeable as creep closure further compacts the salt. Salt creep increases rapidly with depth; therefore, at any time, creep closure of the shaft will be greater at greater depth. The location and initial compaction density of the compacted salt column were chosen to assure consolidation of the compacted salt column in the 100 years following repository closure. The state of salt consolidation, results of analyses predicting the creep closure of the shaft, consolidation and healing of the compacted salt, and healing of the DRZ surrounding the compacted salt column are presented in Sections 7.5 and 8.4 of this document. These results indicate that the salt column will become an effective long-term barrier within 100 years.

### Table G2-10

<table>
<thead>
<tr>
<th>Shaft</th>
<th>Drawing Title</th>
<th>Sheet Number of Drawing SNL 007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>Near-Surface/Rustler Formation Waste Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>4 of 28</td>
</tr>
<tr>
<td>Waste</td>
<td>Salado Formation Waste Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>5 of 28</td>
</tr>
<tr>
<td>AIS</td>
<td>Near-Surface/Rustler Formation Air Intake Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>9 of 28</td>
</tr>
<tr>
<td>AIS</td>
<td>Salado Formation Air Intake Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>10 of 28</td>
</tr>
<tr>
<td>Exhaust</td>
<td>Near-Surface/Rustler Formation Exhaust Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>14 of 28</td>
</tr>
<tr>
<td>Exhaust</td>
<td>Salado Formation Exhaust Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>15 of 28</td>
</tr>
<tr>
<td>Salt Handling</td>
<td>Near-Surface/Rustler Formation Salt Handling Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>19 of 28</td>
</tr>
<tr>
<td>Salt Handling</td>
<td>Salado Formation Salt Handling Shaft Stratigraphy &amp; Sealing Subsystem Profile</td>
<td>20 of 28</td>
</tr>
</tbody>
</table>

4.3.1.2 Upper and Lower Salado Compacted Clay Columns

The upper and lower Salado compacted clay columns (Components 8 and 12 respectively in Figure G2-5) are shown in detail on Drawing SNL-007, Sheet 24. A commercial well-sealing grade sodium bentonite will be used to construct the upper and lower Salado clay columns. These clay columns will effectively limit fluid movement from the time they are placed and will provide an effective barrier to fluid migration throughout the 10,000-year regulatory period and thereafter. The upper clay column ranges in length from 102 to 107 m (335 to 351 ft), and the lower clay column ranges in length from 29 to 33 m (94 to 107 ft) in the four shafts. The locations for the upper and lower clay columns were selected based on the need to limit fluid migration into the compacting salt column. The lower clay column stiffness is sufficient to
promote early healing of the DRZ, thus removing the DRZ as a potential pathway for fluids (Appendix D in the Compliance Submittal Design Report (Sandia, 1996), Section 5.2.1).

4.3.1.3 Upper, Middle, and Lower Concrete-Asphalt Waterstops

The upper, middle, and lower concrete-asphalt waterstops (Components 7, 9, and 11 respectively in Figure G2-5) are identical and are composed of three elements: an upper concrete plug, a central asphalt waterstop, and a lower concrete plug. These components are also shown on Drawing SNL-007, Sheet 22. The concrete specified is a specially developed salt-saturated concrete called Salado Mass Concrete (SMC). In all cases the component’s overall design length is 15 m (50 ft).

The upper and lower concrete plugs of the concrete-asphalt waterstop are identical. They fill the shaft cross-section and have a design length of 7 m (23 ft). The plugs are keyed into the shaft wall to provide positive support for the plug and overlying sealing materials. The interface between the concrete plugs and the surrounding formation will be pressure grouted. The upper plug in each component will support dynamic compaction of the overlying sealing material if compaction is specified. Dynamic compaction of the salt column is discussed in Section 6.

The asphalt waterstop is located between the upper and lower concrete plugs. In all cases a kerf extending one shaft radius beyond the shaft wall is cut in the surrounding salt to contain the waterstop. The kerf is 0.3 m (1 ft) high at its edge and 0.6 m (2 ft) high at the shaft wall. The kerf, which cuts through the existing shaft DRZ, will result in the formation of a new DRZ along its perimeter. This new DRZ will heal shortly after construction of the waterstop, and thereafter the waterstop will provide a very low permeability barrier to fluid migration through the DRZ. The formation and healing of the DRZ around the waterstop are addressed in Section 7.6.1. The asphalt fill for the waterstop extends two feet above the top of the kerf to assure complete filling of the kerf. The construction procedure used assures that shrinkage of the asphalt from cooling will not result in the creation of voids within the kerf and will minimize the size of any void below the upper plug.

Concrete-asphalt waterstops are placed at the top of the upper clay column, the top of the compacted salt column, and the top of the lower clay column. The concrete-asphalt waterstops provide independent seals of the shaft cross-section and the DRZ. The SMC plugs (and grout) will fill irregularities in the shaft wall, bond to the shaft wall, and seal the interface. Salt creep against the rigid concrete components will place a compressive load on the salt and promote early healing of the salt DRZ surrounding the SMC plugs. The asphalt waterstop will seal the shaft cross-section and the DRZ.

The position of the concrete components was first determined by the location of the salt and clay columns. The components were then moved upward or downward from their initial design location to assure the components were located in regions where halite was predominant. This positioning, coupled with variations in stratigraphy, is responsible for the variations in the lengths of the salt and clay columns.

4.3.1.4 Asphalt Column

An asphalt-aggregate mixture is specified for the asphalt column (Component 6 in Figure G2-5). This column is 42 to 44 m (138 to 143 ft) in length in the four shafts, as shown in Drawing SNL-007, Sheet 23. The asphalt column is located above the upper concrete-asphalt waterstop; it
extends approximately 5 m (16 ft) above the Rustler/Salado interface. A 6-m (20-ft) long concrete plug (part of the Rustler seals) is located just above the asphalt column.

The existing shaft linings will be removed from a point well above the top of the asphalt column to the top of the shaft keys. The concrete shaft keys will be removed to a point just below the lowest chemical seal ring in each key. The asphalt column is located at the top of the Salado Formation and provides an essentially impermeable seal for the shaft cross section and along the shaft wall interface. The length of the asphalt column will decrease slightly as the column cools. The procedure for placing the flowable asphalt-aggregate mixture is described in Section 6.

4.3.1.5 Shaft Station Monolith

A shaft station monolith (Component 13) is located at the base of the each shaft. Because the configurations of each shaft differ, drawings of the shaft station monoliths for each shaft were prepared. These drawings are identified in Table G2-11. The shaft station monoliths will be constructed with SMC. The monoliths function to support the shaft wall and adjacent drift roof, thus preventing damage to the seal system as the access drift closes from natural processes.

Table G2-11
Drawings Showing the Shaft Station Monoliths (Drawings are in Appendix G2-E)

<table>
<thead>
<tr>
<th>Shaft</th>
<th>Drawing Title</th>
<th>Sheet Number of Drawing SNL-007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>Waste Shaft Shaft Station Monolith</td>
<td>6 of 28</td>
</tr>
<tr>
<td>AIS</td>
<td>Air Intake Shaft Shaft Station Monolith</td>
<td>11 of 28</td>
</tr>
<tr>
<td>Exhaust</td>
<td>Exhaust Shaft Shaft Station Monolith</td>
<td>16 of 28</td>
</tr>
<tr>
<td>Salt Handling</td>
<td>Salt Handling Shaft Shaft Station Monolith</td>
<td>21 of 28</td>
</tr>
</tbody>
</table>

4.3.2 Rustler Seals

The seals in the Rustler Formation are composed of the Rustler compacted clay column and a concrete plug. The concrete plug rests on top of the asphalt column of the Salado seals. The clay column extends from the concrete plug through most of the Rustler Formation and terminates above the Rustler's highest water-bearing zone in the Forty-niner Member.

4.3.2.1 Rustler Compacted Clay Column

The Rustler compacted clay column (Component 4 in Figure G2-5) is shown on Drawing SNL-007, Sheet 27 for each of the four shafts. A commercial well-sealing-grade sodium bentonite will be used to construct the Rustler clay column, which will effectively limit fluid movement from the time of placement and provide an effective barrier to fluid migration throughout the 10,000-year regulatory period and thereafter. Design length of the Rustler clay column is about 71 m (234 to 235 ft) in the four shafts.

The location for the Rustler clay columns was selected to limit fluid migration into the shaft cross-section and along the shaft wall interface and to limit mixing of Culebra and Magenta waters. The clay column extends from above the Magenta Member to below the Culebra
Member of the Rustler Formation. The Magenta and Culebra are the water-bearing units of the Rustler. The members above the Magenta (the Forty-niner), between the Magenta and Culebra (the Tamarisk), and below the Culebra (the unnamed lower member) are aquitards in the vicinity of the WIPP shafts.

4.3.2.2 Rustler Concrete Plug

The Rustler concrete plug (Component 5 in Figure G2-5) is constructed of SMC. The plugs for the four shafts are shown on Drawing SNL-007, Sheet 26. The plug is 6 m (20 ft) long and will fill the shaft cross-section. The plug is placed directly on top of the asphalt column of the Salado seals. The plug will be keyed into the surrounding rock and grouted. The plug permits work to begin on the overlying clay column before the asphalt has completely cooled. The option of constructing the overlying clay columns using dynamic compaction (present planning calls for construction using compressed clay blocks) is also maintained by keying the plug into the surrounding rock.

4.3.3 Near-Surface Seals

The near-surface region is composed of dune sand, the Mescalero caliche, the Gatuña Formation, the Santa Rosa Formation, and the Dewey Lake Redbeds. This region extends from the ground surface to the top of the Rustler Formation—a distance of about 160 m (525 ft). All but about 15 m (50 ft) of this distance is composed of the Dewey Lake Redbeds Formation. The near-surface seals are composed of two earthen fill columns and a concrete plug. The upper earthen fill column (Component 1) extends from the shaft collar through the surficial deposits downward to the top of the Dewey Lake Redbeds. The concrete plug (Component 2) is placed in the top portion of the Dewey Lake Redbeds, and the lower earthen fill column (Component 3) extends from the concrete plug into the Rustler Formation. These components are shown on Drawing SNL-007, Sheet 28.

This seal will limit the amount of surface water entering the shafts and will limit the potential for any future groundwater migration into the shafts. The near surface seals will also completely close the shafts and prevent accidental entry and excessive subsidence in the vicinity of the shafts. As discussed in Section 4.3.2, the existing shaft linings will be abandoned in place throughout the near-surface region.

4.3.3.1 Near-Surface Upper Compacted Earthen Fill

This component (Component 1 in Figure G2-5) will be constructed using locally available fill. The fill will be compacted to a density near that of the surrounding material to inhibit the migration of surface waters into the shaft cross-section. The length of this column varies from 17 to 28 m (56 to 92 ft) in the four shafts. In all cases, this portion of the WIPP sealing system may be modified as required to facilitate decommissioning of the WIPP surface facilities.

4.3.3.2 Near-Surface Concrete Plug

Current plans call for an SMC plug (Component 2 in Figure G2-5). However, freshwater concrete may be used if found to be desirable at a future time, and if approved by NMED through the Permit modification process specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42). The plug extends 12 m (40 ft) downward from the top of the Dewey Lake Redbeds. It is placed inside the existing shaft lining, and the interface is grouted.
4.3.3.3 Near-Surface Lower Compacted Earthen Fill

This component (Component 3 in Figure G2-5) will be constructed using locally available fill, which will be placed using dynamic compaction (the same method used to construct the salt column). The fill will be compacted to a density equal to or greater than the surrounding materials to inhibit the migration of surface waters into the shaft cross-section. The length of this column varies from 136 to 148 m (447 to 486 ft) in the four shafts.
5. Material Specification

Appendix G2-A provides a body of technical information for each of the WIPP shaft seal materials. The materials specification characterizes each seal material, establishes the adequacy of its function, states briefly the method of component placement, and quantifies expected characteristics (particularly permeability) pertinent to a WIPP-specific shaft seal design. The goal of the materials specifications is to substantiate why materials used in this seal system design will limit fluid flow within the shafts and thereby limit releases of hazardous constituents from the WIPP site at the regulatory boundary.

This section summarizes materials characteristics for shaft seal system components designed for the WIPP. The shaft seal system will not be constructed for decades; however, if it were to be constructed in the near term, materials specified could be placed in the shaft and meet performance specifications using current materials and construction techniques. Construction methods are described in Appendix G2-B. Materials specifications and construction specifications are not to be construed as the only materials or methods that would suffice to seal the shafts effectively. Undoubtedly, the design will be modified, perhaps simplified, and construction alternatives may prove to be advantageous during the years before seal construction proceeds. Nonetheless, a materials specification is necessary to establish a frame of reference for shaft seal design and analysis, to guide construction specifications, and to provide a basis for seal material parameters.

Design detail and other characteristics of the geologic, hydrologic, and chemical setting are provided in the text, appendices, and references. The four shafts will be entirely filled with dense materials possessing low permeability and other desirable engineering and economic attributes. Seal materials include concrete, clay, asphalt, and compacted salt. Other construction and fill materials include cementitious grout and earthen fill. Concrete, clay, and asphalt are common construction materials used extensively in sealing applications. Their descriptions, drawn from literature and site-specific references, are given in Appendix G2-A. Compaction and natural reconsolidation of crushed salt are uniquely applied here. Therefore, crushed salt specification includes discussion of constitutive behavior and sealing performance, specific to WIPP applications. Cementitious grout is also specified in some detail. Only rudimentary discussion of earthen fill is given here and in Appendices A and B. Specifications for each material are discussed in the following order:

- functions,
- material characteristics,
- construction,
- performance requirements,
- verification methods.

Seal system components are materials possessing high durability and compatibility with the host rock. The system contains functional redundancy and uses differing materials to reduce uncertainty in performance. All materials used in the shaft seal system are expected to maintain their integrity for very long periods. Some sealing components reduce fluid flow soon after placement while other components are designed to function well beyond the regulatory period.
5.1 Longevity

A major environmental advantage of the WIPP locale is an overall lack of groundwater to seal against. Even though very little regional water is present in the geologic setting, the seal system reflects great concern for groundwater’s potential influence on the shaft seal system. If the hydrologic system sustained considerable fluid flow, brine geochemistry could impact engineered materials. Brine would not chemically change the compacted salt column, but mechanical effects of pore pressure are of concern to reconsolidation. The geochemical setting, as further discussed in Section 2.4, will have little influence on concrete, asphalt, and clay shaft seal materials. Each material is durable because the potential for degradation or alteration is very low.

Materials used to form the shaft seals are the same as those identified in the scientific and engineering literature as appropriate for sealing deep geologic repositories for radioactive wastes. Durability or longevity of seal components is a primary concern for any long-term isolation system. Issues of possible degradation have been studied throughout the international community and within waste isolation programs in the USA. Specific degradation studies are not detailed in this document because longevity is one of the over-riding attributes of the materials selected and degradation is not perceived to be likely. However, it is acknowledged here that microbial degradation, seal material interaction, mineral transformation, such as silicification of bentonite, and effects of a thermal pulse from asphalt or hydrating concrete are areas of continuing investigations.

Among longevity concerns, degradation of concrete is the most recognized. At this stage of the design, it is established that only small volumes of brine ever reach the concrete elements (see Section C4 of the Compliance Submittal Design Report (Sandia, 1996)). Further analysis concerned with borehole plugging using cementitious materials shows that at least 100 pore volumes of brine in an open system would be needed to begin degradation processes. In a closed system, such as the hydrologic setting in the WIPP shafts, phase transformations create a degradation product of increased volume. Net volume increase owing to phase transformation in the absence of mass transport would decrease rather than increase permeability of concrete seal elements.

Asphalt has existed for thousands of years as natural seeps. Longevity studies specific to DOE’s Hanford site have utilized asphalt artifacts buried in ancient ceremonies to assess long-term stability (Wing and Gee, 1994). Asphalt used as a seal component deep in the shaft will inhabit a benign environment, devoid of ultraviolet light or an oxidizing atmosphere. Additional assurance against possible microbial degradation in asphalt elements is provided with addition of lime. For these reasons, it is believed that asphalt components will possess their design characteristics well beyond the regulatory period.

Natural bentonite is a stable material that generally will not change significantly over a period of ten thousand years. Bentonitic clays have been widely used in field and laboratory experiments concerned with radioactive waste disposal. As noted by Gray (1993), three internal mechanisms, illitization, silicification and charge change, could affect sealing properties of bentonite. Illitization and silicification are thermally driven processes and, following discussion by Gray (1993), are not possible in the environment or time-frame of concern at the WIPP. The naturally occurring Wyoming bentonite which is the specified material for the WIPP shaft seal is well over a million years old. It is, therefore, highly unlikely that the metamorphism of bentonite enters as a design concern.
5.2 Materials

5.2.1 Mass Concrete

Concrete has low permeability and is widely used for hydraulic applications. The specification for mass concrete presents a special design mixture of a salt-saturated concrete called Salado Mass Concrete (SMC). Performance of SMC and similar salt-saturated mixtures has been established through analogous industrial applications and in laboratory and field testing. The documentation substantiates adequacy of SMC for concrete applications within the WIPP shafts.

The function of the concrete is to provide durable components with small void volume, adequate structural compressive strength, and low permeability. SMC is used as massive plugs, a monolith at the base of each shaft, and in tandem with asphalt waterstops. Concrete is a rigid material that will support overlying seal components while promoting natural healing processes within the salt DRZ. Concrete is one of the redundant components that protects the reconsolidating salt column. The salt column will achieve low permeabilities in fewer than 100 years, and concrete will no longer be needed at that time. However, concrete will continue to provide good sealing characteristics for a very long time.

Salt-saturated concrete contains sufficient salt as an aggregate to saturate hydration water with respect to NaCl. Salt-saturated concrete is required for all uses within the Salado Formation because fresh water concrete would dissolve part of the host rock. The concrete specified for the shaft seal system has been tailored for the service environment and includes all the engineering properties of high quality concrete, as described in Appendix G2-A. Among these are low heat of hydration, high compressive strength, and low permeability. Because SMC provides material characteristics of high-performance concrete, it will likely be the concrete of choice for all seal applications at the WIPP.

Construction involves surface preparation and slickline placement. A batching and mixing operation on the surface will produce a wet mixture having low initial temperatures. Placement uses a tremie line, where the fresh concrete exits the slickline below the surface level of the concrete being placed. Placed in this manner, the SMC will have low porosity (about 5%) with or without vibration. Tremie line placement is a standard construction method in mining operations.

Specifications of concrete properties include mixture proportions and characteristics before and after hydration. SMC strength is much greater than required for shaft seal elements, and the state of stress within the shafts is compressional with little shear stress developing. Volume stability of the SMC is also excellent; this, combined with salt-saturation, assures a good bond with the salt. Permeability of SMC is very low, consistent with most concrete (Pfeifle et al., 1996). Because of a favorable state of stress and isothermal conditions, the SMC will remain intact. Because little brine is available to alter concrete elements, minimal degradation is possible. These favorable attributes combine to assure concrete elements within the Salado will remain structurally sound and possess very low permeability (between $2 \times 10^{-21}$ and $1 \times 10^{-17}$ m²) for exceedingly long periods. A permeability distribution function and associated discussion are given in Appendix G2-A.

Standard ASTM specifications are made for the green and hydrated concrete properties. Quality control and a history of successful use in both civil construction and mining applications assure proper placement and performance.
5.2.2 Compacted Clay

Compacted clays are commonly proposed as primary sealing materials for nuclear waste repositories and have been extensively investigated against rigorous performance requirements. Advantages of clays for sealing purposes include low permeability, demonstrated longevity in many types of natural environments, deformability, sorptive capacity, and demonstrated successful utilization in practice for a variety of sealing purposes.

Compacted clay as a shaft sealing component functions as a barrier to brine flow and possibly to gas flow (see alternative construction methods in Appendix G2-B). Compacted bentonitic clay can generate swelling pressure and clays have sufficient rigidity to promote healing of any DRZ in the salt. Wetted swelling clay will seal fractures as it expands into available space and will ensure tightness between the clay seal component and the shaft walls.

The Rustler and Salado compacted clay columns are specified to be constructed of dense sodium bentonite blocks. An extensive experimental data base exists for the permeability of sodium bentonites under a variety of conditions. Many other properties of sodium bentonite, such as strength, stiffness, and chemical stability, are established. Bentonitic clays heal when fractured and can penetrate small fractures or irregularities in the host rock. Further, bentonite is stable in the seal environment. These properties, noted by international waste isolation programs, make bentonite a widely accepted seal material.

From the bottom clay component to the top earthen fill, different methods will be used to place clay materials in the shaft. Seal performance within the Salado Formation is far more important to regulatory compliance of the seal system than is performance of clay and earthen fill in the overlying formations. Therefore, more time and effort will be expended on placement of Salado clay components. Three potential construction methods could be used to place clay in the shaft, as discussed in Appendix G2-B: compacted blocks, vibratory roller, and dynamic compaction. Construction of Salado clay components specifies block assembly.

Required sealing performance of compacted clay elements varies with location. For example, Component 4 provides separation of water-bearing zones, while the lowest clay column (Component 12) limits fluid flow to the reconsolidating salt column. If liquid saturation in the clay column of 85% can be achieved, it would serve as a gas barrier. In addition, compacted clay seal components promote healing of the salt DRZ. To achieve low permeabilities, the dry density of the emplaced bentonite should be about 1.8 g/cm³. A permeability distribution function for performance assessment and the logic for its selection are given in Appendix G2-A.

Verification of specified properties such as density, moisture content, permeability, or strength of compacted clay seals can be determined by direct measurement during construction. However, indirect methods are preferred because certain measurements, such as permeability, are likely to be time consuming and invasive. Methods used to verify the quality of emplaced seals will include quality of block production and field measurements of density.

5.2.3 Asphalt

Asphalt is used to prevent water migration down the shaft in two ways: as an asphalt column near the Rustler/Salado contact and as a “waterstop” sandwiched between concrete plugs at three locations within the Salado Formation. Asphalt components of the WIPP seal design add assurance that minimal transport of brine down the sealed shaft will occur.
Asphalt is a widely used construction material because of its many desirable engineering properties. Asphalt is a strong cement, readily adhesive, highly waterproof, and durable. Furthermore, it is a plastic substance that is readily mixed with mineral aggregates. A range of viscosity is achievable for asphalt mixtures. It is highly resistant to most acids, salts, and alkalis. These properties are well suited to the requirements of the WIPP shaft seal system.

Construction of the seal components containing asphalt can be accomplished using a slickline process where low-viscosity heated material is effectively pumped into the shaft. The technology to apply the asphalt in this manner is available as described in the construction procedures in Appendix G2-B.

The asphalt components are required to endure for about 100 years and limit brine flow down the shaft to the compacted salt component. Since asphalt will not be subjected to ultraviolet light or an oxidizing environment, it is expected to provide an effective seal for centuries. Air voids less than 2% ensure low permeability. The permeability of the massive asphalt column is expected to have an upper limit $1 \times 10^{-18} \text{ m}^2$.

Sufficient construction practice and laboratory testing information is available to assure performance of the asphalt component. Laboratory validation tests to optimize viscosity may be desirable before final installation specifications are prepared. In general, verification tests would add quantitative documentation to expected performance values and have direct application to WIPP.

### 5.2.4 Compacted Salt Column

A reconsolidated column of natural WIPP salt will seal the shafts permanently. If salt reconsolidation is unimpeded by fluid pore pressures, the material will eventually achieve extremely low permeabilities approaching those of the native Salado Formation. Recent developments in support of the WIPP shaft seal system have produced confirming experimental results, constitutive material models, and construction methods that substantiate use of a salt column to create a low permeability seal component. Reuse of salt excavated in the process of creating the underground openings has been advocated since its initial proposal in the 1950s. Replacing the natural material in its original setting ensures physical, chemical, and mechanical compatibility with the host formation.

The function of the compacted and reconsolidated salt column is to limit transmission of fluids into or out of the repository for the statutory period of 10,000 years. The functional period starts within a hundred years and lasts essentially forever. After a period of consolidation, the salt column will almost completely retard gas or brine migration within the former shaft opening. A completely consolidated salt column will achieve flow properties indistinguishable from natural Salado salt.

The salt component is composed of crushed Salado salt with additional small amounts of water. The total water content of the crushed salt will be adjusted to 1.5 wt% before it is tamped into place. Field and laboratory tests have verified that natural salt can be compacted to significant fractional density ($\rho \geq 0.9$) with addition of these moderate amounts of water.

Dynamic compaction is the specified construction procedure to tamp crushed salt in the shaft. Deep dynamic compaction provides great energy to the crushed salt, is easy to apply, and has an effective depth of compactive influence greater than lift thickness. Dynamic compaction is
relatively straightforward and requires a minimal work force in the shaft. Compaction itself will follow procedures developed in a large-scale compaction demonstration, as outlined in Appendix G2-B.

Numerical models of the shaft provide density of the compacted salt column as a function of depth and time. Many calculations comparing models for consolidation of crushed salt were performed to quantify performance of the salt column, as discussed in Appendix D of the Compliance Submittal Design Report (Sandia, 1996) and the references (Callahan et al., 1996; Brodsky et al., 1996). From the density-permeability relationship of reconsolidating crushed salt, permeability of the compacted salt seal component is calculated. In general, results show that the bottom of the salt column consolidates rapidly, achieving permeability of $1 \times 10^{-19} \text{ m}^2$ in about 50 years. By 100 years, the middle of the salt column reaches similar permeability.

Results of the large-scale dynamic compaction demonstration suggest that deep dynamic compaction will produce a sufficiently dense starting material. As with other seal components, testing of the material in situ will be difficult and probably not optimal to ensure quality of the seal element. This is particularly apparent for the compacted salt component because the compactive effort produces a finely powdered layer on the top of each lift. It was demonstrated (Hansen and Ahrens, 1996) that the fine powder is very densely compacted upon tamping the superincumbent lifts. The best means to ensure that the crushed salt element is placed properly is to establish performance through verification of quality assurance/quality control procedures. If crushed salt is placed with a reasonable uniformity of water and compacted with sufficient energy, long-term performance can be assured.

5.2.5 Cementitious Grout

Cementitious grouting is specified for all concrete members. Grouting is also used in advance of liner removal to stabilize the ground and to limit water inflow during shaft seal construction. Cementitious grout is specified because of its proven performance, nontoxicity, and previous use at the WIPP.

The function of grout is to stabilize the surrounding rock before existing concrete liners are removed. Grout will fill fractures within adjacent lithologies, thereby adding strength and reducing permeability and, hence, water inflow during shaft seal construction. Grout around concrete members of the concrete asphalt waterstop will be employed in an attempt to tighten the interface and fill microcracks in the DRZ. Efficacy of grouting will be determined during construction.

An ultrafine cementitious grout has been specifically developed for use at the WIPP (Ahrens and Onofrei, 1996). This grout consists of Type 5 portland cement, pumice as a pozzolanic material, and superplasticizer. The average particle size is approximately 2 microns. The ultrafine grout is mixed in a colloidal grout mixer, with a water to components ratio ($W:C$) of 0.6:1.

Drilling and grouting sequences provided in Appendix G2-B follow standard procedures. Grout will be mixed on the surface and transported by slickline to the middle deck on the multi-deck stage (galloway). Grout pressures are specified below lithostatic to prevent hydrofracturing.
Performance of grout is not a consideration for compliance issues. Grouting of concrete elements is an added assurance to tighten interfaces. Grouting is used to facilitate construction by stabilizing any loose rock behind the concrete liner.

No verification of the effectiveness of grouting is currently specified. If injection around concrete plugs is possible, an evaluation of quantities and significance of grouting will be made during construction. Procedural specifications will include measurements of fineness and determination of rheology in keeping with processes established during the WIPP demonstration grouting (Ahrens et al., 1996).

5.2.6 Earthen Fill

A brief description of the earthen fill is provided in Appendix G2-A, and construction is summarized in Appendix G2-B. Compacted fill can be obtained from local borrow pits, or material excavated during shaft construction can be returned to the shaft. There are minimal design requirements for earthen fill and none that are related to WIPP regulatory performance.

5.3 Concluding Remarks

Materials specifications in Appendix G2-A provide descriptions of seal materials along with reasoning on their expected reliability in the WIPP setting. The specification follows a framework that states the function of the seal component, a description of the material, and a summary of construction techniques. The performance requirements for each material are detailed. Materials chosen for use in the shaft seal system have several common desirable attributes: low permeability, high density, compatibility, longevity, low cost, constructability, availability, and supporting documentation.
6. Construction Techniques

Construction of the shaft sealing system is feasible. The described procedures utilize currently available technology, equipment, and materials to satisfy shaft sealing system design guidance. Although alternative methods are possible, those described satisfy the design guidance requirements listed in Table G2-7 and detailed in the appendices. Construction feasibility is established by reference to comparable equipment and activities in the mining, petroleum, and food industries and test results obtained at the WIPP. Equipment and procedures for emplacement of sealing materials are described below.

6.1 Multi-Deck Stage

A multi-deck stage (Figures G2-6 and G2-7) consisting of three vertically connected decks will be the conveyance utilized during the shaft sealing operation. Detailed sketches of the multi-deck stage appear in Appendix G2-E. The stage facilitates installation and removal of utilities and provides a working platform for the various sealing operations. A polar crane attached to the lower deck provides the mechanism required for dynamic compaction and excavation of the shaft walls. Additionally, the header at the bottom of the slickline is supported by a reinforced steel shelf, which is securely bolted to the shaft wall during emplacement of sealing materials. The multi-deck stage can be securely locked in place in the shaft whenever desired (e.g., during dynamic compaction, excavation of the salt walls of the shaft, grouting, liner removal, etc.). The multi-deck stage is equipped with floodlights, remotely aimed closed-circuit television, fold-out floor extensions, a jib crane, and range-finding devices. Similar stages are commonly employed in shaft sinking operations.

The polar crane can be configured for dynamic compaction (Figure G2-6) or for excavation of salt (Figure G2-7); a man cage or bucket can be lowered through the stage to the working surface below. Controlled manually or by computer, the crane and its trolley utilize a geared track drive. The crane can swiftly position the tamper (required for dynamic compaction) in the drop positions required (Figure G2-8) or accommodate the undercutter required for excavation of the shaft walls. The crane incorporates a hoist on the trolley and an electromagnet, enabling it to position, hoist, and drop the tamper. A production rate of one drop every two minutes during dynamic compaction is possible.

6.2 Salado Mass Concrete (Shaft Station Monolith and Shaft Plugs)

Salado Mass Concrete, described in Appendix G2-A, will be mixed on surface at 20ºC and transferred to emplacement depth through a slickline (i.e., a steel pipe fastened to the shaft wall and used for the transfer of sealing materials from surface to the fill horizon) minimizing air entrainment and ensuring negligible segregation. Existing sumps will be filled to the elevation of the floor of the repository horizon, and emplacement of the shaft station monolith is designed to eliminate voids at the top (back) of the workings.

When excavating salt for waterstops or plugs in the Salado Formation, an undercutter attached to the trolley of the polar crane will be forced into the shaft wall by a combination of geared trolley and undercutter drives. Full circumferential cuts will be accomplished utilizing the torque developed by the geared polar crane drive.
The undercutter proposed is a modified version of those currently in use in salt and coal mines, where their performance is proven. Such modifications and applications have been judged feasible by the manufacturer.

The concrete-salt interface and DRZ around concrete plugs in the Salado Formation (and the one at the base of the Rustler Formation) will be grouted with ultrafine grout. Injection holes will be collared in the top of the plug and drilled downward at 45° below horizontal. The holes will be drilled in a “spin” pattern describing a downward opening cone designed to intercept both vertical and horizontal fractures (Figure G2-9). The holes will be stage grouted (i.e., primary holes will be drilled and grouted, one at a time). Secondary holes will then be drilled and grouted, one at a time, on either side of primaries that accepted grout.

6.3 Compacted Clay Columns (Salado and Rustler Formations)

Cubic blocks of sodium bentonite, 20.8 cm on the edge and weighing approximately 18 kg, will be precompacted on surface to a density between 1.8 and 2.0 gm/cm³ and emplaced manually. The blocks will be transferred from surface on the man cage. Block surfaces will be moistened with a fine spray of potable water, and the blocks will be manually placed so that all surfaces are in contact. Peripheral blocks will be trimmed to fit irregularities in the shaft wall, and remaining voids will be filled with a thick mortar of sodium bentonite and potable water. Such blocks have been produced at the WIPP and used in the construction of 0.9-m-diameter seals, where they performed effectively (Knowles and Howard, 1996). Alternatives, which may be considered in future design evaluations, are discussed in Appendix G2-B.

6.4 Asphalt Waterstops and Asphallic Mix Columns

Neat asphalt is selected for the asphalt waterstops, and an asphallic mastic mix (AMM) consisting of neat asphalt, fine silica sand, and hydrated lime will be the sealing material for the columns. Both will be fluid at emplacement temperature and remotely emplaced. Neat asphalt (or AMM, prepared in a pug mill near the shaft collar) will be heated to 180°C and transferred to emplacement depth via an impedance-heated, insulated tremie line (steel pipe) suspended from slips (pipe holding device) at the collar of the shaft.

This method of line heating is common practice in the mining and petroleum industries. This method lowers the viscosity of the asphalt so that it can be pumped easily. Remote emplacement by tremie line eliminates safety hazards associated with the high temperature and gas produced by the hot asphalt. Fluidity ensures that the material will flow readily and completely fill the excavations and shaft. Slight vertical shrinkage will result from cooling (calculations in Appendix D of the Compliance Submittal Design Report (Sandia, 1996)), but the material will maintain contact with the shaft walls and the excavation for the waterstop. Vertical shrinkage will be counteracted by the emplacement of additional material.

6.5 Compacted WIPP Salt

Dynamic compaction of mine-run WIPP salt has been demonstrated (Ahrens and Hansen, 1995). The surface demonstration produced salt compacted to 90% of in-place rock salt density, with a statistically averaged permeability of 1.65×10⁻¹⁵ m². Additional laboratory consolidation of this material at 5 MPa confining pressure (simulating creep closure of the salt) resulted in increased compaction and lower permeability (Brodsky, 1994). Dynamic compaction was
selected because it is simple, robust, proven, has excellent depth of compaction, and is applicable to the vertical WIPP shafts.

The compactive effect expanded laterally and downward in the demonstration, and observation during excavation of the compacted salt revealed that the lateral compactive effect will fill irregularities in the shaft walls. Additionally, the depth of compaction, which was greater than that of the three lifts of salt compacted, resulted in the bottom lift being additionally compacted during compaction of the two overlying lifts. This cumulative effect will occur in the shafts.

Construction of the salt column will proceed in the following manner:

- Crushed and screened salt will be transferred to the fill elevation via slickline. Use of slicklines is common in the mining industry, where they are used to transfer backfill materials or concrete to depths far greater than those required at the WIPP. Potable water will be added via a fine spray during emplacement at the fill surface to adjust the moisture content to 1.5 ±0.3 wt%, accomplished by electronically coordinating the weight of the water with that of the salt exiting the hose.

- Dynamic compaction will then be used to compact the salt by dropping the tamper in specific, pre-selected positions such as those shown in Figure G2-8.

### 6.6 Grouting of Shaft Walls and Removal of Liners

The procedure listed below is a common mining practice which will be followed at each elevation where liner removal is specified. If a steel liner is present, it will be cut into manageable pieces and hoisted to the surface for disposal, prior to initiation of grouting.

Upward opening cones of diamond drill holes will be drilled into the shaft walls in a spin pattern (Figure G2-10) to a depth ensuring complete penetration of the Disturbed Rock Zone (DRZ) surrounding the shaft. For safety reasons, no major work will be done from the top deck; all sealing activities will be conducted from the bottom deck. The ends of the holes will be 3 m apart, and the fans will be 3 m apart vertically, covering the interval from 3 m below to 3 m above the interval of liner removal. Tests at the WIPP demonstrated that the ultrafine cementitious grout penetrated more than 2 m from the injection holes (Ahrens et al., 1996).

Injection holes will be drilled and grouted one at a time, as is the practice in stage grouting. Primary holes are grouted first, followed by the grouting of secondary holes on either side of primaries that accepted grout. Ultrafine grout will be injected below lithostatic pressure to avoid hydrofracturing the rock, proceeding from the bottom fan upward. Grout will be mixed on surface and transferred to depth via the slickline.

Radial, horizontal holes will then be drilled on a 0.3-m grid, covering the interval to be removed. These will be drilled to a depth sufficient to just penetrate the concrete liner. A chipping hammer will be used to break a hole through the liner at the bottom of the interval. This hole, approximately 0.3 m in diameter, will serve as “free face,” to which the liner can be broken. Hydraulically-actuated steel wedges will then be used in the pre-drilled holes to break out the liner in manageable pieces, beginning adjacent to the hole and proceeding upward. Broken concrete will be allowed to fall to the fill surface, where it will be gathered and hoisted to the surface for disposal. Chemical seal rings will be removed as encountered.
6.7 Earthen Fill

Local soil, screened to produce a maximum particle dimension of approximately 15 mm, will be the seal material. This material will be transferred to the fill surface via the slickline and emplaced in the same manner as the salt. After adjusting the moisture content of the earthen fill below the concrete plug in the Dewey Lake Redbeds to achieve maximum compaction, the fill will be dynamically compacted, achieving a permeability as low as that of the enclosing formation.

The portion of the earthen fill above the plug will be compacted with a vibratory-impact sheepsfoot roller, a vibratory sheepsfoot roller, or a walk-behind vibratory plate compactor, because of insufficient height for dynamic compaction.

6.8 Schedule

For discussion purposes, it has been assumed that the shafts will be sealed two at a time. This results in the four shafts being sealed in approximately six and a half years. The schedules presented in Appendix G2-B are based on this logic. Sealing the shafts sequentially would require approximately eleven and a half years.
7. Structural Analyses of Shaft Seals

7.1 Introduction

The shaft seal system was designed in accordance with design guidance described in Section 3.2. To be successful, seal system components must exhibit desired structural behavior. The desired structural behavior can be as simple as providing sufficient strength to resist imposed loads. In other cases, structural behavior is critical to achieving desired hydrological properties. For example, permeability of compacted salt depends on the consolidation induced by shaft closure resulting from salt creep. In this example, results from structural analyses feed directly into fluid-flow calculations, which are described in Section 8, because structural behavior affects both time-dependent permeabilities of the compacted salt and pore pressures within the compacted salt. In other structural considerations, thermal effects are analyzed as they affect the constructability and schedule for the seal system. Thus a series of analyses, loosely termed structural analyses, were performed to accomplish three purposes:

1. to determine loads imposed on components and to assess both structural stability based on the strength of the component and mechanical interaction between components;

2. to estimate the influence of structural behavior of seal materials and surrounding rock on hydrological properties; and

3. to provide structural and thermal related information on construction issues.

For the most part, structural analyses rely on information and design details presented in the Design Description (Section 4), the Design Drawings (Appendix G2-E), and Material Specification (Section 5 and Appendix G2-A). Some analyses are generic, and calculation input and subsequent results are general in nature.

7.2 Analysis Methods

Finite-element modeling was the primary numerical modeling technique used to evaluate structural performance of the shaft seals and surrounding rock mass. Well documented finite-element computer programs, SPECTROM-32 and SPECTROM-41, were used in structural and thermal modeling, respectively. The computer program SALT_SUBSID was used in the subsidence modeling over the backfilled shaft-pillar area. Specific details of these computer programs as they relate to structural calculations are listed in Appendix D of the Compliance Submittal Design Report (Sandia, 1996), Section D2.

7.3 Models of Shaft Seals Features

Structural calculations require material models to characterize the behavior of (1) each seal material (concrete, crushed salt, compacted clay, and asphalt); (2) the intact rock lithologies in the near-surface, Rustler, and Salado formations; and (3) any DRZ within the surrounding rock. A general description of the material models used in characterizing each of these materials and features is given below. Details of the models and specific values of model parameters are given in Appendix D in the Compliance Submittal Design Report (Sandia, 1996), Section D3.
7.3.1 Seal Material Models

The SMC thermal properties required for the structural analyses (thermal conductivity, density, specific heat, and volumetric heat generation rate) were obtained from SMC test data. Concrete was assumed to behave as a viscoelastic material, based on experimental data, and the elastic modulus of SMC was modeled as age-dependent. Strength properties of SMC were specified in the design (see Appendix G2-A).

For crushed salt, the deformational model included a nonlinear elastic component and a creep consolidation component. The nonlinear elastic modulus was assumed to be density-dependent, based on laboratory test data performed on WIPP crushed salt. Creep consolidation behavior of crushed salt was based on three candidate models whose parameters were obtained from model fitting to hydrostatic and shear consolidation test data performed on WIPP crushed salt. Creep consolidation models include functional dependencies on density, mean stress, stress difference, temperature, grain size, and moisture content.

Compacted clay was assumed to behave according to a nonlinear elastic model in which shear stiffness is negligible, and asphalt was assumed to behave as a weak elastic material. Thermal properties of asphalt were taken from literature.

7.3.2 Intact Rock Lithologies

Salado salt was assumed to be argillaceous salt that is governed by the Multimechanism Deformation Coupled Fracture (MDCF) model, which is an extension of the Munson-Dawson (M-D) creep model. A temperature-dependent thermal conductivity was necessary.

Salado interbeds were assumed to behave elastically. Their material strength was assumed to be described by a Drucker-Prager yield function, consistent with values used in previous WIPP analyses.

Deformational behavior of the near-surface and Rustler Formation rock types was assumed to be time-invariant, and their strength was assumed to be described by a Coulomb criterion, consistent with literature values.

7.3.3 Disturbed Rock Zone Models

Two different models were used to evaluate the development and extent of the DRZ within intact salt. The first approach used ratios of time-dependent stress invariants to quantify the potential for damage or healing to occur. The second approach used the damage stress criterion according to the MDCF model for WIPP salt.

7.4 Structural Analyses of Shaft Seal Components

7.4.1 Salado Mass Concrete Seals

Five analyses related to structural performance of SMC seals were performed, including (1) a thermal analysis, (2) a structural analysis, (3) a thermal stress analysis, (4) a dynamic compaction analysis, and (5) an analysis of the effects of clay swelling pressure. This section presents these analyses and evaluates the results in terms of the performance of the SMC seal.
Details of these calculations are given in Appendix D in the Compliance Submittal Design Report (Sandia, 1996), Section D4.

7.4.1.1 Thermal Analysis of Concrete Seals

The objective of this calculation was to determine expected temperatures within (and surrounding) an SMC emplacement resulting from its heat of hydration. Results indicate that the concrete component temperature increases from ambient (27°C) to a maximum of 53°C at 0.02 year after emplacement. The maximum temperature in the surrounding salt is 38°C at approximately the same time. The thermal gradient within the concrete is approximately 1.5°C/m. Most of the higher temperatures are contained within the concrete. At a radial distance of 2 m into the surrounding salt, the temperature rise is less than 1°C. These conditions are favorable for proper performance of the SMC components. A 26°C temperature rise and a 1.5°C/m temperature gradient are not large enough to cause thermal cracking as the concrete cools (Andersen et al., 1992).

7.4.1.2 Structural Analysis of Concrete Seals

The objectives of this calculation were to determine (1) expected stresses within the concrete components caused by restrained creep of the surrounding salt and (2) expected stresses in the concrete component from weight of overlying seal material.

In the upper concrete-asphalt waterstop, radial stresses increase (compression is positive) from zero at time of emplacement (t = 0) to 2.5 MPa at t = 50 years. Similarly, radial stresses in the middle concrete component range from 3.5 to 4.5 MPa at 50 years after emplacement. In the lower concrete-asphalt waterstop, radial stresses range from 4.5 to 5.5 MPa at t = 50 years. All the calculated stresses are well below the unconfined compressive strength of the concrete (30 MPa).

The upper, middle, and lower concrete-asphalt waterstops are located at depths of 300, 420, and 610 m, respectively. When performing these calculations, it was assumed that each concrete component must support the weight of the overlying materials between it and the next concrete component above it. Using an average overburden density of 0.02 MPa/m, stresses induced by the overlying material are significantly less than the strength of the concrete. The structural integrity of concrete components will not be compromised by either induced radial stress or imposed vertical stress.

7.4.1.3 Thermal Stress Analysis of Concrete Seals

The objectives of this calculation were (1) to determine thermal stresses in concrete components from the heat of hydration and (2) to determine thermal impact on the creep of the surrounding salt.

Thermoelastic stresses in the concrete were calculated based on a maximum temperature increase of 26°C and assuming a fully confined condition. Results of this calculation indicate that short-term compressive thermal stresses in the concrete will be less than 9.2 MPa. The temperature rise in the surrounding salt is insignificant in terms of producing either detrimental or beneficial effects. Based on these results, the structural integrity of concrete components will not be compromised by thermoelastic stresses caused by heat of hydration.
7.4.1.4 Effect of Dynamic Compaction on Concrete Seals

The objective of this calculation was to determine a required thickness of seal layers above concrete components to reduce the impact of dynamic compaction. Compaction depths for crushed salt and clay layers are 2.8 m and 2.2 m, respectively. Layers 3.7-m thick for crushed salt and 3-m thick for clay are to be emplaced before compaction begins, thus providing a layer about 30% thicker than the calculated compaction depths.

7.4.1.5 Effect of Clay Swelling Pressures on Concrete Seals

The objective of this calculation was to determine the increased stresses within concrete components as a result of clay swelling pressures. Test measurements on confined bentonite at an emplaced density of 1.8 g/cm³ indicate that anticipated swelling pressures are on the order of 3.5 MPa. In order to fracture the salt surrounding the clay, the swelling pressures must exceed the lithostatic rock stress in the salt, which ranges from nominally 8.3 MPa at the upper clay seal to 14.4 MPa at the lower clay seal. The design strength of the concrete (31.0 MPa) is significantly greater than the swelling pressure of 3.5 MPa. Even in the unlikely event that the clay swelled to lithostatic pressures, the resulting state of stress in the concrete seal would lie well below any failure surface. Furthermore, the compressive tangential stress in the salt along the shaft wall, even after stress relaxation from creep, is always larger than lithostatic. Hence, radial fracturing from clay swelling pressure is not expected.

7.4.2 Crushed Salt Seals

Two analyses related to structural performance of crushed salt seals were performed, including (1) a structural analysis and (2) an analysis to determine effects of pore pressure on consolidation of crushed salt seals. This section presents the results of these analyses and evaluates the results in terms of performance of crushed salt seals. Details of these analyses are given in Appendix D in the Compliance Submittal Design Report (Sandia, 1996), Section D4.

7.4.2.1 Structural Analysis of Compacted Salt Seal

The objectives of this calculation were (1) to determine the fractional density of the crushed salt seal as a function of time and depth and, using these results, (2) to determine permeability of the crushed salt as a function of time and depth.

Results indicate that compacted salt will increase from its emplaced fractional density of 90% to a density of 95% approximately 40, 80, and 120 years after emplacement at the bottom, middle, and top of the shaft seal, respectively. Using the modified Sjaardema-Krieg creep consolidation model, the times required to fully reconsolidate the crushed salt to 100% fractional density are 70 years, 140 years, and 325 years at the bottom, middle, and top of the salt column, respectively. Based on these results, the desired fractional densities (hence, permeability) can be achieved over a substantial length of the compacted salt seal in the range of 50 to 100 years.

7.4.2.2 Pore Pressure Effects on Reconsolidation of Crushed Salt Seals

The objective of this calculation was to determine the effect of pore pressure on the reconsolidation of the crushed salt seal. Fractional densities of the crushed salt seal were calculated using the modified Sjaardema-Krieg consolidation model for a range of pore
pressures (0, 2, and 4 MPa). Results indicate that times required to consolidate the crushed salt increase as the pore pressure increases, as expected. For example, for a pore pressure of 2 MPa, the times required to achieve a fractional density of 96% are about 90 years, 205 years, and 560 years at the bottom, middle, and top of the crushed salt column, respectively. A pore pressure of 4 MPa would effectively prevent reconsolidation of the crushed salt within a reasonable period (<1,000 years). The results of this calculation were used in the fluid flow calculations, and the impact of these pore pressures on the permeability of the crushed salt seal is described in Section 8 and Appendix C of the Compliance Submittal Design Report (Sandia, 1996).

7.4.3 Compacted Clay Seals

One analysis was performed to determine the structural response of compacted clay seals. The objective of this calculation was to determine stresses in the upper Salado compacted clay component and the lower Salado compacted clay component as a result of creep of the surrounding salt. Details of this calculation are given in Appendix D in the Compliance Submittal Design Report (Sandia, 1996), Section D4. Results of this calculation indicate that after 50 years the compressive stresses in the upper Salado compacted clay component are about 0.7 MPa, not including the effects of swelling pressures. Similarly, after 50 years the stresses in the lower Salado compacted clay component are approximately 2.6 MPa. Based on these results, the compacted clay component will provide some restraint to the creep of salt and induce a back (radial) stress in the clay seal, which will promote healing of the DRZ in the surrounding intact salt (see discussion about DRZ in Section 7.5.1).

7.4.4 Asphalt Seals

Three analyses were performed related to structural performance of the asphalt seals, including (1) a thermal analysis, (2) a structural analysis, and (3) a shrinkage analysis. This section presents the results of these analyses and evaluates the results in terms of the performance of the asphalt seal. Details of these analyses are given in Appendix D of the Compliance Submittal Design Report (Sandia, 1996), Section D4.

7.4.4.1 Thermal Analysis

The objectives of this calculation were (1) to determine temperature histories within the asphalt seal and the surrounding salt and (2) to determine effects of the length of the waterstop.

Results indicate that the center of the asphalt column will cool from its emplaced temperature of 180°C to 83°C, 49°C, 31°C, and 26°C at times 0.1 year, 0.2 year, 0.5 year, and 1.0 year, respectively. Similarly, the asphalt/salt interface temperatures at corresponding times are 47°C, 38°C, 29°C, and 26°C. The time required for a waterstop to cool is significantly less than that required to cool the asphalt column. Based on these results, about 40 days are required for asphalt to cool to an acceptable working environment temperature. The thermal impact on enhanced creep rate of the surrounding salt is considered to be negligible.

7.4.4.2 Structural Analysis

The objective of this analysis was to calculate pressures in asphalt that result from restrained creep of the surrounding salt and to evaluate stresses induced on the concrete seal component by such pressurization.
Results indicate that pressures in the waterstops after 100 years are 1.8 MPa, 2.5 MPa, and 3.2 MPa for the upper, middle, and lower waterstops, respectively. Based on these results, the structural integrity of concrete components will not be compromised by imposed pressures, and the rock surrounding the asphalt will not be fractured by the pressure. The pressure from asphalt is enough to initiate healing of the DRZ surrounding the waterstop.

7.4.4.3 Shrinkage Analysis

The objective of this analysis was to calculate shrinkage of the asphalt column as it cools from its emplaced temperature to an acceptable working environment temperature. Results of this analysis indicate that the 42-m asphalt column will shrink 0.9 m in height as the asphalt cools from its emplaced temperature of 180°C to 38°C.

7.5 Disturbed Rock Zone Considerations

7.5.1 General Discussion of DRZ

Microfracturing leading to a DRZ occurs within salt whenever excavations are made. Laboratory and field measurements show that a DRZ has enhanced permeability. The body of evidence strongly suggests that induced fracturing is reversible and healed when deviatoric stress states created by the opening are reduced. Rigid seal components in the shaft provide a restraint to salt creep closure, thereby inducing healing stress states in the salt. A more detailed discussion of the DRZ is included in Appendix D in the Compliance Submittal Design Report (Sandia, 1996).

7.5.2 Structural Analyses

Three analyses were performed to determine the behavior of the DRZ in the rock mass surrounding the shaft. The first analysis considered time-dependent DRZ development and subsequent healing of intact Salado salt surrounding each of the four seal materials. The second analysis considered time-dependent development of the DRZ within anhydrite and polyhalite interbeds within the Salado Formation. The last analysis considered time-independent DRZ development within the near-surface and Rustler formations. These analyses are discussed below and given in more detail in Appendix D of the Compliance Submittal Design Report (Sandia, 1996), Section D5. Results from these analyses were used as input conditions for the fluid flow analysis presented in Section 8 and Appendix C of the Compliance Submittal Design Report (Sandia, 1996).

7.5.2.1 Salado Salt

The objective of this calculation was to determine time-dependent extent of the DRZ in salt, assuming no pore pressure effects, for each of the four shaft seal materials (i.e., concrete, crushed salt, compacted clay, and asphalt. The seal materials below a depth of about 300 m provide sufficient rigidity to heal the DRZ within 100 years. Asphalt, modeled as a weak elastic material, will not create a stress state capable of healing the DRZ because it is located high in the Salado.
7.5.2.2 Salado Anhydrite Beds

The objective of this calculation was to determine the extent of the DRZ within the Salado anhydrite and polyhalite interbeds as a result of creep of surrounding salt.

For all interbeds, the factor of safety against failure (shear or tensile fracturing) increases with depth into the rock surrounding the shaft wall. These results indicate that, with the exception of Marker Bed 117 (MB117), the factor of safety is greater than 1 (no DRZ will develop) for all interbeds. For MB117, the potential for fracturing is localized to within 1 m of the shaft wall.

7.5.2.3 Near-Surface and Rustler Formations

The objective of this calculation was to determine the extent of the DRZ surrounding the shafts in the near-surface and Rustler formations.

Rock types in near-surface and Rustler formations are anhydrite, dolomite, and mudstone. These rock types exhibit time-independent behavior. Results indicate that no DRZ will develop in anhydrite and dolomite (depths between 165 and 213 m). For mudstone layers, the radial extent of the DRZ increases with depth, reaching a maximum of 2.6 shaft radii at a depth of 223 m.

7.6 Other Analyses

This section discusses two structural analyses performed in support of design concerns, namely (1) the asphalt waterstops constructability and (2) benefits from shaft station backfilling. Analyses performed in support of these efforts are discussed below and given in more detail in Appendix D of the Compliance Submittal Design Report (Sandia, 1996), Section D6.

7.6.1 Asphalt Waterstops

The DRZ is a major contributor to fluid flows through a low permeability shaft seal system, regardless of the materials emplaced within the shaft. Therefore, to increase the confidence in the overall shaft seal, low permeability layers (termed radial waterstops) were included to intersect the DRZ surrounding the shaft. These waterstops are emplaced to alter the flow direction either inward toward the shaft seal or outward toward intact salt. Asphalt-filled waterstops will be effective soon after emplacement. The objectives of these structural calculations were to evaluate performance of the waterstops in terms of (1) intersecting the DRZ around the shaft, (2) inducing a new DRZ because of special excavation, and (3) promoting healing of the DRZ.

Results indicate that the DRZ from the shaft extends to a radial distance of less than one shaft radius (3.04 m). Waterstop excavation extends the DRZ radially to about 1.4 shaft radii (4.3 m). However, this extension is localized within the span of the concrete component and extends minimally past the waterstop edge. The DRZ extent reduced rapidly after the concrete and asphalt restrained creep of the surrounding salt. After 20 years, the spatial extent of the DRZ is localized near the asphalt-concrete interface, extending spatially into the salt at a distance of less than 2 m. Based on these results, construction of waterstops is possible without substantially increasing the DRZ. Furthermore, the waterstop extends well beyond the maximum extent of the DRZ surrounding the shaft and effectively blocks this flow path (within 2 years after emplacement), albeit over only a short length of the flow path.
7.6.2 Shaft Pillar Backfilling

The objective of this calculation was to assess potential benefits from backfilling a portion of the shaft pillar to reduce subsurface subsidence and thereby decrease the potential for inducing fractures along the shaft wall. The calculated subsidence without backfilling is less than one foot, due to the relatively low extraction ratio at the WIPP. Based on the results of this analysis, backfilling portions of the shaft pillar would result in only 10% to 20% reduction in surface subsidence. This reduction in subsidence from backfilling is not considered enough to warrant backfilling the shaft pillar area. The shaft seals within the Salado are outside the angle-of-draw for any horizontal displacements caused by the subsidence over the waste panels. Moreover, horizontal strains caused by subsidence induced by closures within the shaft pillar are compressive in nature and insignificant in magnitude to induce fracturing along the shaft wall.
8. Hydrologic Evaluation of the Shaft Seal System

8.1 Introduction

The design guidance in Section 3 presented the rationale for sealing the shaft seal system with low permeability materials, but it did not provide specific performance measures for the seal system. This section compares the hydrologic behavior of the system to several performance measures that are directly related to the ability of the seal system to limit liquid and gas flows through the seal system. The hydrologic evaluation is focused on the processes that could result in fluid flow through the shaft seal system and the ability of the seal system to limit any such flow. Transport of radiological or hazardous constituents will be limited if the carrier fluids are similarly limited.

The hydrologic performance models are fully described in Appendix C of the Compliance Submittal Design Report (Sandia, 1996). The analyses presented are deterministic. Quantitative values for those parameters that are considered uncertain and that may significantly impact the primary performance measures have been varied, and the results are presented in Appendix C of the Compliance Submittal Design Report (Sandia, 1996). This section summarizes the seal system performance analyses and discusses results within the context of the design guidance of Section 3. The results demonstrate that (1) fluid flows will be limited within the shaft seal system and (2) uncertainty in the conceptual models and parameters for the seal system are mitigated by redundancy in component function and materials.

8.2 Performance Models

The physical processes that could impact seal system performance are presented in detail in Appendix C of the Compliance Submittal Design Report (Sandia, 1996). These processes have been incorporated into four performance models. These models evaluate (1) downward migration of groundwater from the Rustler Formation, (2) gas migration and consolidation of the crushed salt seal component, (3) upward migration of brines from the repository, and (4) flow between water-bearing zones in the Rustler Formation. The first three are analyzed using numerical models of the Air Intake Shaft (AIS) seal system and the finite-difference codes SWIFT II and TOUGH28W. These codes are extensively used and well documented within the scientific community. A complete description of the models is provided in Appendix C of the Compliance Submittal Design Report (Sandia, 1996). The fourth performance model uses a simple, analytical solution for fluid flow. Results from the analyses are summarized in the following sections and evaluated in terms of the design guidance presented in Section 3.

Material properties and conceptual models that may significantly impact seal system performance have been identified, and uncertainty in properties and models have been addressed through variation of model parameters. These parameters include (1) the effective permeability of the DRZ, (2) those describing salt column consolidation and the relationship between compacted salt density and permeability, and (3) repository gas pressure applied at the base of the shaft seal system.

8.3 Downward Migration of Rustler Groundwater

The shaft seal system is designed to limit groundwater flowing into and through the shaft sealing system (see Section 3). The principal source of groundwater to the seal system is the Culebra Member of the Rustler Formation. The Magenta Member of this formation is also considered a
groundwater source, albeit a less significant source than the Culebra. No significant sources of groundwater exist within the Salado Formation; however, brine seepage has been noted at a number of the marker beds. The modeling includes the marker beds, as discussed in Appendix C of the Compliance Submittal Design Report (Sandia, 1996). Downward migration of Rustler groundwater must be limited so that liquid saturation of the compacted salt column salt column does not impact the consolidation process and to ensure that significant quantities of brine do not reach the repository horizon. Because it is clear that limitation of liquid flow into the salt column necessarily limits liquid flow to the repository, the volumetric flux of liquid into and through the salt column were selected as performance measures for this model.

Consolidation of the compacted salt column salt column will be most rapid immediately following seal construction. Simulations were conducted for the 200-year period following closure to demonstrate that, during this initial period, downward migration of Rustler groundwater will be insufficient to impact the consolidation process. Lateral migration of brine through the marker beds is also quantified in the analysis and shown to be nondetrimental to the function of the salt column.

8.3.1 Analysis Method

Seal materials will not, in general, be fully saturated with liquid at the time of construction. The host rock surrounding the shafts will also be partially desaturated at the time of seal construction. The analysis presented in this section assumes a fully saturated system. The effects of partial saturation of the shaft seal system are favorable in terms of system performance, as will be discussed in Section 8.3.2.

Seal material and host rock properties used in the analyses are discussed in Appendix C of the Compliance Submittal Design Report (Sandia, 1996), Section C3. Appendix G2-A contains a detailed discussion of seal material properties. A simple perspective on the effects of material and host rock properties may be obtained from Darcy’s Law. At steady-state, the flow rate in a fully saturated system depends directly on the system permeability. The seal system consists of the component material and host rock DRZ. Low permeability is specified for the engineered materials; thus the system component most likely to impact performance is the DRZ. Rock mechanics calculations presented in Appendix D of the Compliance Submittal Design Report (Sandia, 1996) predict that the DRZ in the Salado Formation will not be vertically continuous because of the intermittent layers of stiff anhydrites (marker beds). Asphalt waterstops are included in the design to minimize DRZ impacts. The effects of the marker beds and the asphalt waterstops on limiting downward migration are explicitly simulated through variation of the permeability of the layers of Salado DRZ.

Initial, upper, and lateral boundary conditions for the performance model are consistent with field measurements for the physical system. At the base of the shaft a constant atmospheric pressure is assumed.

8.3.2 Summary of Results

The initial pore volumes in the filled repository and the AIS salt column are approximately 460,000 m$^3$ and 250 m$^3$, respectively. The performance model predicts a maximum cumulative flow of less than 5 m$^3$ through the sealed shafts for the 200 years following closure. If the marker beds have a disturbed zone immediately surrounding the shaft, the maximum flow is less than 10 m$^3$ during the same period. Assuming the asphalt waterstops are not effective in
interrupting the vertical DRZ, the volumetric flow increases but is still less than 30 m$^3$ for the 200
years following closure. These volumes are less than 1/100 of 1% of the pore volume in the
repository and less than 20% of the initial pore volume of the salt column.

Two additional features of the model predictions should also be considered. The first of these is
that flow rates fall from less than 1 m$^3$/year in the first five years to negligible values within 10
years of seal construction. Therefore most of the cumulative flow occurs within a few years
following closure. The second feature is the model prediction that the system returns to nearly
ambient undisturbed pressures within two years. The repressurization occurs quickly within the
model due to the assumption of a fully saturated flow regime because of brine incompressibility.
As will be discussed in Section 8.4, the pore pressure in the compacted salt column is a critical
variable in the analysis. The pressure profiles predicted by the model are an artifact of the
assumption of full liquid saturation and do not apply to the pore pressure analysis of the salt
column.

The magnitude of brine flow that can reach the repository through a sealed shaft is minimal and
will not impact repository performance. The flow that reaches the salt column must be assessed
with regard to the probable impacts on the consolidation process. Although the volume of flow to
the salt column is a small percentage of the available pore volume, the saturation state and fluid
pore pressure of this component are the variables of significance. These issues cannot be
addressed by a fully saturated model. Instead it is necessary to include these findings in a multi-
phase model that includes the salt column. This is the topic of Section 8.4.

The results of the fully saturated model will over-predict the flow rates through the sealed shaft.
This analysis does not take credit for the time required for the system to resaturate, nor does it
take credit for the sorptive capabilities of the clay components. The principal source of
groundwater to the system is the Rustler Formation. The upper clay component is located below
the Rustler and above the salt column and will be emplaced at a liquid saturation state of
approximately 80%. Bentonite clays exhibit strong hydrophilic characteristics, and it is expected
that the upper clay component will have these same characteristics. As a result, it is possible
that a significant amount of the minimal Rustler groundwater that reaches the clay column will
be absorbed and retained by this seal component. Although this effect is not directly included in
the present analysis, the installation of a partially saturated clay component provides assurance
that the flow rates predicted by the model are maximum values.

8.4 Gas Migration and Consolidation of Compacted Salt Column

The seal system is designed to limit the flow of gas from the disposal system through the sealed
shafts. Migration of gas could impact performance if this migration substantially increases the
fluid pore pressure of the compacted salt column. The initial pore pressure of the salt column
will be approximately atmospheric. The sealed system will interact with the adjacent desaturated
host rock as well as the far-field formation. Natural pressurization will occur as the system
returns to an equilibrium state. This pressurization, coupled with seepage of brine through the
marker beds, will also result in increasing fluid pore pressure within the compacted salt column.
The analysis presented in this section addresses the issue of fluid pore pressure in the
compacted salt column resulting from the effects of gas generation at the repository horizon and
natural repressurization from the surrounding formation. A brief discussion on the impedance to
gas flow afforded by the lower compacted clay column is also presented.
8.4.1 Analysis Method

A multi-phase flow model of the lower seal system was developed to evaluate the performance of components extending from the middle SMC component to the repository horizon. Rock mechanics calculations presented in Section 7 and Appendix D of the Compliance Submittal Design Report (Sandia, 1996) predict that the compacted salt column will consolidate for a period of approximately 400 years if the fluid-filled pores of the column do not produce a backstress. Within the physical setting of the compacted salt column, three processes have been identified which may result in a significant increase in pore pressure: groundwater flow from the Rustler Formation, gas migration from the repository, and natural fluid flow and repressurization from the Salado Formation. The first two processes were incorporated into the model as initial and boundary conditions, respectively. The third process was captured in all simulations through modeling of the lithologies surrounding the shaft. Simulations were conducted for 200 years following closure to evaluate any effects these processes might have on the salt column during this initial period.

As discussed in Section 8.3.1, the host rock DRZ is an important consideration in seal system performance. A vertically continuous DRZ could exist in both the Rustler and Salado Formations. Concrete-asphalt waterstops are included in the design to add assurance that a DRZ will not adversely impact seal performance. The significance of a continuous DRZ and waterstops will be evaluated based on results of the performance model.

A detailed description of the model grid, assumptions, and parameters is presented in Appendix C of the Compliance Submittal Design Report (Sandia, 1996).

8.4.2 Summary of Results

The consolidation process is a function of both time and depth. The resultant permeability of the compacted salt column will similarly vary. To simplify the evaluation, an effective permeability of the salt component was calculated. This permeability is calculated by analogy to electrical circuit theory. The permeability of each model layer is equated to a resistor in a series of resistors. The equivalent resistance (i.e., permeability) of a homogeneous column of identical length is derived in this manner. Figure G2-11 illustrates this process.

Results of the performance model simulations are summarized in Table G2-12. The effective permeabilities were calculated by the model assuming that, as the salt consolidated, permeability was reduced pursuant to the best-fit line through the experimental data (Appendix G2-A, Figure G2A-7). From Table G2-12 it is clear that, for all simulated conditions, the salt column consolidates to very low values in 200 years. Differences in the effective permeability because of increased repository gas pressure and a vertically continuous DRZ were negligible. The DRZ around concrete components is predicted to heal (Appendix D of the Compliance Submittal Design Report (Sandia, 1996)) within 25 years. If the asphalt waterstops do not function as intended, the DRZ in this region will still heal in 25 years, as compared to 2 years for effective waterstops. The effective permeability of the compacted salt column increases by about a factor of two for this condition. However, the resultant permeability is sufficiently low that the compacted salt columns will comprise permanent effective seals within the WIPP shafts.
Table G2-12
Summary of Results from Performance Model

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<thead>
<tr>
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<th>Continuous DRZ (Yes/No)</th>
<th>Concrete-Asphalt Waterstop Healing Time (Years)</th>
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The relationship between the fractional density (i.e., consolidation state) of the compacted salt column and permeability is uncertain, as discussed in Appendix G2-A. Lines drawn through the experimental data (Figure A-7) provide a means to quantify this uncertainty but do not capture the actual physical process of consolidation. As observed through microscopy, consolidation is dominated by pressure solution and redeposition, a mechanism of mass movement facilitated by the presence of moisture on grain boundaries (Hansen and Ahrens, 1996). As this process continues, the connected porosity and hence permeability of the composite mass will reduce at a rate that has not been characterized by the data collected in WIPP experiments. The results of the multi-phase performance model presented in Table G2-12 used a best-fit line through the data. Additional simulations were conducted using a line that represents a 95% certainty that the permeability is less than or equal to values taken from this line. Model simulations that used the 95% line are not considered representative of the consolidation process. However, these results provide an estimation of the significance that this uncertainty may have on the seal system performance.

Figure G2-12 depicts the effective permeability of the salt column as a function of time using the 95% line. The consolidation process, and hence permeability reduction, essentially stopped at 75 years for this simulation. Although the model predicts that the fractional density at the base of the salt column will reach approximately 97% of the density of intact halite, the permeability remains several orders of magnitude higher than that of the surrounding host rock. As a result, repressurization occurs rapidly throughout the vertical extent of the compacted salt column, and consolidation ceases. Laboratory experiments have shown that permeability to brine should decrease to levels of 10⁻¹⁸ to 10⁻²⁰ m² at the fractional densities predicted by the performance model. The transport of brine within the consolidating salt will reduce the permeability even further (Brodsky et al., 1995). The predicted permeability of 10⁻¹⁶ m² is still sufficiently low that brine migration would be limited (DOE, 1995). However, the results of this analysis are more valuable in terms of demonstrating the coupled nature of the mechanical and hydrological behavior of consolidating crushed salt.

A final consideration within this performance model relates to the lower compacted clay column. This clay column is included in the design to provide a barrier to both gas and brine migration from the repository horizon. The ability of the clay to prevent gas migration will depend upon its liquid saturation state (Section 5 and Appendix G2-A). The lower clay component has an initial liquid saturation of about 80%, and portions of the column achieve brine saturations of nearly 100% during the 200 year simulation period. If the clay component performs as designed, gas migration through this component should be minimal. An examination of the model gas saturations indicates that, for all runs, gas flow occurs primarily through the DRZ prior to...
healing. These model predictions are consistent with field demonstrations that brine-saturated bentonite seals will prevent gas flow at differential pressures of up to 4 MPa (Knowles and Howard, 1996).

8.5 Upward Migration of Brine

The performance model discussed in Section 8.3 was modified to simulate undisturbed equilibrium pressures. As discussed in Appendix C of the Compliance Submittal Design Report (Sandia, 1996), the Salado Formation is overpressurized with respect to the measured heads in the Rustler, and upward migration of contaminated brines could occur through an inadequately sealed shaft. Sections 8.3 and 8.4 demonstrated that the compacted salt column will consolidate to a low permeability following repository closure. Appendix D of the Compliance Submittal Design Report (Sandia, 1996) and Section 7 show that the DRZ surrounding the long-term clay and crushed salt seal components will completely heal within the first several decades. As a result, upward migration at the base of the Salado salt is predicted to be approximately 1 m³ over the regulatory period. At the Rustler/Salado contact, a total of approximately 20 m³ migrates through the sealed AIS over the regulatory period. The only brine sources between these two depths are the marker beds. It can therefore be concluded that most of the brine flow reaching the Rustler/Salado contact originates in marker beds above the repository horizon. The seal system effectively limits the flow of brine and gas from the repository through the sealed shafts throughout the regulatory period.

8.6 Intra-Rustler Flow

The potential exists for vertical flow within water-bearing strata of the Rustler Formation. Flow rates were estimated using a closed form solution of the steady-state saturated flow equation (Darcy’s Law). The significance of the calculated flow rates can be assessed in terms of the width of the hydraulic disturbance (i.e., plume half-width) generated in the recipient flow field. The plume half-width was calculated to be minimal for all expected conditions (Compliance Submittal Design Report (Sandia, 1996), Section C7). Intra-Rustler flow is therefore concluded to be of such a limited quantity that (1) it will not affect either the hydraulic or chemical regime in the Rustler and (2) it will not be detrimental to the seal system.
9. Conclusions

The principal conclusion drawn from discussions in the previous sections and details provided in the appendices is that an effective, implementable design has been documented for the WIPP shaft sealing system. Specifically, the six elements of the Design Guidance, Table G2-12, are implemented in the design in the following manner:

1. The shaft sealing system shall limit the migration of radiological or other hazardous constituents from the repository horizon to the regulatory boundary during the 10,000-year regulatory period following closure.

   Based on the analysis presented in Section 8.5, it was determined that this shaft sealing system effectively limits the migration of radiological or other hazardous constituents from the repository horizon to the regulatory boundary during the 10,000-year regulatory period following closure.

2. The shaft sealing system shall limit groundwater flowing into and through the shaft sealing system.

   The combination of the seal components in the Salado Formation, the Rustler Formation, and above the Rustler combine to produce a robust system. Based on analysis presented in Section 8.3, it was concluded that the magnitude of brine flow that can reach the repository through the sealed shaft is minimal and will not impact repository performance.

3. The shaft sealing system shall limit chemical and mechanical incompatibility of seal materials with the seal environment.

   The sealing system components are constructed of materials possessing high durability and compatibility with the host rock. Engineered materials including salt-saturated concrete, bentonite, clays, and asphalt are expected to retain their design properties over the regulatory period.

4. The shaft sealing system shall limit the possibility for structural failure of individual components of the sealing system.

   Analysis of components has determined that: (a) the structural integrity of concrete components will not be compromised by induced radial stress, imposed vertical stress, temperature gradients, dynamic compaction of overlying materials, or swelling pressure associated with bentonite (Section 7.4.1); (b) the thermal impact of asphalt on the creep rate of the salt surrounding the asphalt waterstops is negligible (Section 7.4.4); and (c) the pressure from the asphalt element of the concrete-asphalt waterstops is sufficient to initiate healing of the surrounding DRZ within two years of emplacement (Section 7.6.1). The potential for structural failure of sealing components is minimized by the favorable compressive stress state that will exist in the sealed WIPP shafts.

5. The shaft sealing system shall limit subsidence of the ground surface in the vicinity of the shafts and the possibility of accidental entry after sealing.
The use of high density sealing materials that completely fill the shafts eliminates the potential for shaft wall collapse, eliminates the possibility of accidental entry after closure, and assures that local surface depressions will not occur at shaft locations.

6. The shaft sealing system shall limit the need to develop new technologies or materials for construction of the shaft sealing system.

   The shaft sealing system utilizes existing construction technologies (identified in Section 6) and materials (identified in Section 5).

The design guidance can be summarized as focusing on two principal questions: Can you build it, and will it work? The use or adaptation of existing technologies for the placement of the seal components combined with the use of available, common materials assure that the design can be constructed. Performance of the sealing system has been demonstrated in the hydrologic analyses that show very limited flows of gas or brine, in structural analyses that assure acceptable stress and deformation conditions, and in the use of low permeability materials that will function well in the environment in which they are placed. Confidence in these conclusions is bolstered by the basic design approach of using multiple components to perform each intended sealing function and by using extensive lengths within the shafts to effect a sealing system. Additional confidence is added by the results of field and lab tests in the WIPP environment that support the data base for the seal materials.
10. References


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Figure G2-1
View of the WIPP Underground Facility
Figure G2-2
Location of the WIPP in the Delaware Basin
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Modified from Bachman, 1987

Figure G2-3
Chart Showing Major Stratigraphic Divisions, Southeastern New Mexico
Figure G2-4
Generalized Stratigraphy of the WIPP Site Showing Repository Level
Figure G2-5
Arrangement of the Air Intake Shaft Sealing System
Figure G2-6
Multi-deck Stage Illustrating Dynamic Compaction
Figure G2-7
Multi-deck Stage Illustrating Excavation for Asphalt Waterstop
Figure G2-8
Drop Pattern for 6-m-Diameter Shaft Using a 1.2-m-Diameter Tamper
Figure G2-9
Plan and Section Views of Downward Spin Pattern of Grout Holes
Figure G2-10
Plan and Section Views of Upward Spin Pattern of Grout Holes
Figure G2-11
Example of Calculation of an Effective Salt Column Permeability from the Depth-Dependent Permeability at a Point in Time
Figure G2-12
Effective Permeability of the Compacted Salt Column using the 95% Certainty Line
ATTACHMENT H
POST-CLOSURE PLAN
# ATTACHMENT H

## POST-CLOSURE PLAN

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>H-1   Post-Closure Plan</td>
<td>1</td>
</tr>
<tr>
<td>H-1a  Post-Closure Plan after Final Facility Closure</td>
<td>2</td>
</tr>
<tr>
<td>H-1a(1) Active Institutional Controls</td>
<td>2</td>
</tr>
<tr>
<td>H-1a(2) Monitoring</td>
<td>5</td>
</tr>
<tr>
<td>H-2   Notices Required for Disposal Facilities</td>
<td>5</td>
</tr>
<tr>
<td>H-2a  Post-Closure Certification</td>
<td>5</td>
</tr>
<tr>
<td>H-2b  Post-Closure Notices</td>
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</table>
ATTACHMENT H

POST-CLOSURE PLAN

Introduction

This Permit Attachment contains the Post-Closure Plan, which describes activities required to maintain the Waste Isolation Pilot Plant (WIPP) after completion of facility closure. Since the current plans for operations extend over several decades, the Permittees will periodically reapply for an operating permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.10(h)).

This plan was submitted to the New Mexico Environment Department (NMED) in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.14(b)(13)) and the U.S. Environmental Protection Agency (EPA). The Post-Closure Plan includes the implementation of institutional controls to limit access and groundwater monitoring to assess disposal system performance. Until final closure is complete and has been certified in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.115), a copy of the approved Post-Closure Plan and all approved revisions will be on file at the WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI Administrator upon request.

H-1 Post-Closure Plan

The post-closure care period begins after completion of closure of the first underground hazardous waste disposal unit (HWDU) and continues for 30 years after final closure of the facility. The post-closure care period may be shortened or lengthened by the Secretary of the NMED, based on evidence that human health and the environment are being protected or are at risk. During the post-closure period, the WIPP shall be maintained in a manner that complies with the environmental performance standards applicable to the facility. During this period, the Permittees will employ active institutional controls as necessary.

This post-closure plan focuses on activities following final facility closure. However, some discussion of post-closure following panel closure is warranted since some panel closures will occur long before final facility closure. As discussed in Attachment G (Closure Plan), Section G-4e(1), panel closures have been designed to require no post-closure maintenance of the disposal unit. The Permittees have defined a post-closure care program for closed panels that has three aspects. These are routine inspection of the openings in the vicinity of the closures, the sampling of ventilation air for harmful constituents, and a Repository Volatile Organic Compound Monitoring Program. The rules of the Mine Safety Health Administration drive the implementation of the first two programs. These rules require that underground mines monitor air quality to assure good breathing air whenever personnel are underground and that mine operators provide safe ground conditions for personnel in areas that require access. Routine monitoring of the openings in the access ways to panels will be continued and these openings will be maintained for as long as access into them is needed. This includes continued reading of installed geomechanical instrumentation, sounding the areas, visual inspection and maintenance activities such as scaling, mining, or bolting as required and as described in Permit Attachment A2. In addition, all areas in the underground that are occupied by personnel are checked prior to each day’s work activities for accumulations of harmful gases, including
methane. Action levels for increasing ventilation to areas that show high levels of harmful gases are specified as described in Permit Attachment D.

These monitoring programs will be carried out during the period between the closure of the first panel and the initiation of final facility closure for the underground facility. The Permittees have prepared a Volatile Organic Compound Monitoring Plan (VOCMP) which will be implemented to confirm that the annual average concentration of volatile organic compounds (VOCs) in the air emissions from the underground HWDUs do not exceed the VOC concentrations of concern limits listed in Permit Part 4 and Permit Attachment N, Table N-3.1. The VOCMP is provided in Attachment N. The VOCMP includes monitoring design, sampling and analysis procedures and quality assurance objectives. This plan is required to demonstrate compliance with 20.4.1.500 and .900 NMAC (incorporating 40 CFR §264.602 and §270.23(a)(2)).

The Permittees will collect air samples upstream of all open and closed panels, and down stream of Panel 1 until after certification of the closure of the last underground HWDU. The VOCMP uses EPA Compendium Method TO-15. The Permittees have had success with TO-15 at the WIPP if care is taken in placing the sampler to avoid high dust and if stringent cleaning requirements are imposed for the clean canisters. This is necessary because of the extremely low concentrations that are being monitored.

The VOCMP will be implemented under a Quality Assurance Plan that conforms to the document entitled “EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations”. Quality Assurance criteria required for the target analytes are presented in Table N-4 in Permit Attachment N. Definitions of these criteria are given in Permit Attachment N along with a discussion of other requirements of the Quality Assurance Program including sample handling, calibration, analytical procedures, data reduction, validation and reporting, performance and system audits, preventive maintenance, and corrective actions.

H-1a Post-Closure Plan after Final Facility Closure

A number of regulations deal with the period of time that begins once the WIPP has undergone final facility closure and decommissioning. Under 40 CFR Part 191, the period consists of an active control period and a passive control period; only 100 years of the active control period can be used in performance assessment. The Land Withdrawal Act (LWA) of 1992 requires that the U.S. Department of Energy (DOE) prepare and submit a post-decommissioning land management plan. 20.4.1.500 NMAC (incorporating 40 CFR §264.117) requires post-closure care, including monitoring, security, and control of property use. Because of the numerous regulations, the Permittees have prepared a single strategy for post-closure management of the WIPP. This strategy consists of three elements: 1) active controls, 2) monitoring, and 3) passive controls. Only the first and second elements occur within the post-closure period covered by this permit.

H-1a(1) Active Institutional Controls

Once a facility is decommissioned, positive actions (referred to as “active institutional controls”) will be taken to assure proper maintenance and monitoring. The EPA, in 40 CFR §191.14(a) has specified that active controls will be maintained for as long as practicable and that no more than 100 years of active institutional control can be assumed in predictions of long-term
performance. This assumption assures that future protection and control does not rely on positive actions by future generations.

The Permittees’ active institutional control program has a primary objective of addressing all applicable requirements, including restoring the WIPP site as nearly as possible to its original condition, and thereby equalizing any preference over other areas for development by humans in the future. Restoration of the WIPP site includes any necessary remedial actions or cleanup of releases resulting from decommissioning. In addition, as part of the active institutional control program implemented under 40 CFR §194.14(a), the Permittees will implement monitoring systems suitable for assessing disposal system performance if such monitoring is feasible.

The Permittees will implement the active institutional control program as described in more detail below:

Identification of Active Institutional Control Measures

A detailed explanation of the active institutional controls selected by the Permittees as part of this first step is provided in Permit Attachment H1 (WIPP Active Institutional Controls). This is the Permittees’ reference design for active institutional controls. The reference design will be reviewed periodically and updated by the Permittees as appropriate during WIPP disposal operations. The ongoing review and evaluation ensure that the active institutional controls implemented are appropriate for the conditions that may exist at that time. The Permittees will review the reference design prior to implementation and all affected regulatory agencies will be consulted as part of this review. If updating the reference design proposes any changes in the Post-Closure Plan as described in this permit, the Permittees shall apply for a permit modification to include those changes, or submit the reference design and revised Post-Closure Plan as part of a routine permit renewal application, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)).

As part of the active institutional controls program, the Permittees have developed a set of active institutional controls which will be implemented. These are as follows:

- A fence line shall be established to control access to the repository’s footprint area (the waste disposal area projected to the surface). A standard wire fence shall be erected along the perimeter of the repository surface footprint. The fence shall have gates placed approximately midway along each of the four sides.

- An unpaved roadway along the perimeter of the barbed wire fence shall be constructed to provide ready vehicle access to any point around the fenced perimeter, to facilitate inspection and maintenance of the fence line, and to permit visual observation of the repository footprint to the extent permitted by the lay of the land. This roadway shall connect to the paved south access road.

- To ensure visual notification, the fence line shall be posted with signs having as a minimum, a legend reading “Danger—Unauthorized Personnel Keep Out” and a warning against entering the area without specific permission of the Permittees.

- Contractual arrangements shall be developed to ensure that periodic inspection and necessary corrective maintenance is conducted on the fence line, its associated warning signs, and the roadway. The Permittees will maintain control over all
contractual work and will maintain, in the operating record, the results of all inspections and maintenance activities.

- Through direct Permittee staffing support and/or contractual arrangements, procedures shall be established to provide routine periodic patrols and surveillances of the protected area by personnel trained in security surveillance and investigation.

- Mitigating actions will be taken to address any abnormal conditions\(^1\) identified during periodic surveillance and inspections.

- Reports of activities associated with the post-disposal active access controls shall be prepared in accordance with regulatory requirements for submittal to the appropriate regulatory and legislative authority.

Details on meeting these criteria are found in Permit Attachment H1.

Preparation of a Post-Decommissioning Land Management Plan

Section 13(b) of the LWA requires the DOE to prepare and submit a plan for managing the land withdrawal area after decommissioning the WIPP facility. This plan will include a description of both the active and passive institutional controls that will be imposed after decommissioning is complete. This plan will be prepared in consultation with the Department of Interior and the state of New Mexico. If the land management plan proposes any changes in the Post-Closure Plan as described in this permit, the Permittees shall apply for a permit modification to include those changes, or submit the land management plan and revised Post-Closure Plan as part of a routine permit renewal application, as required by 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)).

Preparation of the Active Institutional Control Plan

An active institutional control plan will be initiated prior to actual plant closure, and will contain all the information needed to implement the active and passive institutional controls for the WIPP facility. Active institutional control planning will be based on the reference design and will take into account the most current information regarding the facility and its vicinity and will make use of state-of-the-art materials and techniques. This plan will include acceptable decontamination levels, sampling and analysis plans, and QA/QC specifications. If such future plan contains provisions different from those in this Post-Closure Plan or Permit Attachment H1 (Active Institutional Controls), the Permittees shall submit a request for modification of the Post-Closure Plan and the WIPP Permit. The changes must be approved and made part of the revised Permit before the changes are implemented, in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.118(d)).

Implementation of Active Institutional Control Measures

Most of the active institutional control measures, such as long-term site monitoring and site remedial actions, will be implemented simultaneously with facility closure. However, it may be

\(^1\) “Abnormal conditions” include any natural or human-caused conditions which could affect the integrity of Active Institutional controls required by the Permit or which could affect compliance of the WIPP with applicable RCRA standards.
possible to implement some measures earlier. For example, salt disposal may begin prior to
final plant closure. Reclamation and restoration of unused disturbed surface areas has already
begun. Guarding and maintenance activities, which are already in place, could evolve into an
appropriate type of post-closure activity, subject to appropriate modifications of the Permit.

H-1a(2) Monitoring

Post-closure groundwater monitoring will involve a continuation of the monitoring plan in Permit
Attachment L as described in Permit Part 5. The sampling frequency may be changed to a
frequency of every two years after final facility closure is complete by modification of the Permit
as approved by the Secretary of the NMED in accordance with 20.4.1.901.B NMAC
(incorporating 40 CFR §270.42). In addition, the final target analyte list specified in Permit
Attachment L may be changed by permit modification based on final volume of waste.

H-2 Notices Required for Disposal Facilities

H-2a Post-Closure Certification

Within 60 days of completion of the post-closure care period after final facility closure, the
Permittees will submit to the Secretary of the NMED, via registered mail, a certification that
post-closure care was performed in accordance with the specifications of the approved post-
closure plan. The certification will be signed by the Permittees and by an independent New
Mexico registered professional engineer. Documentation supporting the independent registered
engineer’s certification and a copy of the certification will be furnished to the Secretary of the
NMED.

H-2b Post-Closure Notices

Within 60 days after certification of closure of each underground HWDU or final facility closure,
the Permittees will submit to the Secretary of the NMED, and to the Eddy County government or
other applicable local government agencies, a record of the type, location, and quantity of
hazardous wastes disposed of in each underground HWDU as required in 20.4.1.500 NMAC
(incorporating 40 CFR §264.119).
ATTACHMENT H1

ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE
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ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE

TABLE OF CONTENTS

Introduction ................................................................................................................................. 1
H1.1 Active Institutional Controls .............................................................................................4
  H1.1.1 Repository Footprint Fencing ............................................................................ 5
  H1.1.2 Surveillance Monitoring ..................................................................................... 6
  H1.1.3 Maintenance and Remedial Actions ................................................................. 6
  H1.1.4 Control and Clean-up of Releases ................................................................. 7
  H1.1.5 Groundwater Monitoring .................................................................................... 7
H1.2 Additional Post-Closure Activities .................................................................................... 7
H1.3 Quality Assurance ........................................................................................................... 7
References ................................................................................................................................. 8
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
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<tbody>
<tr>
<td>Figure H1-1</td>
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<tr>
<td>Figure H1-2</td>
<td>Standard Waste Box and Seven-Pack Configuration</td>
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<td>Figure H1-3</td>
<td>Typical Shaft Sealing System</td>
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ACTIVE INSTITUTIONAL CONTROLS DURING POST-CLOSURE

Introduction

Under the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.118(b), the following activities identified as active institutional controls during post-closure are incorporated into the Post-Closure Plan.

The post-closure requirements of this permit include 20.4.1.500 NMAC, incorporating:

- 40 CFR §264.117(a)(1), which requires that
  “Post-closure care for each hazardous waste management unit subject to the requirements of §264.117 through 264.120 must begin after completion of closure of the unit and continue for 30 years after that date...”

- 40 CFR §264.601, which requires that
  “A miscellaneous unit must be...maintained and closed in a manner that will ensure protection of human health and the environment...”

- and 40 CFR §264.603, which requires that
  “A miscellaneous unit that is a disposal unit must be maintained in a manner that complies with §264.601 during the post-closure care period.”

The containment requirements for a disposal system for transuranic (TRU) radioactive wastes are defined in Title 40 CFR §191.13 (U.S. Environmental Protection Agency [EPA] 1993). 40 CFR §191.14 is titled Assurance Requirements. With regard to the active institutional controls aspect of Assurance Requirements, 40 CFR §191.14 states the following:

“To provide the confidence needed for long-term compliance with the requirements of §191.13, disposal of spent fuel or high-level or transuranic wastes shall be conducted in accordance with the following provisions... (a) Active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contribution from active institutional controls for more than 100 years after disposal...”

40 CFR §191.12 states the following:

“Active institutional controls mean:
1) controlling access to a disposal site by any means other than passive institutional controls,
2) performing maintenance operations or remedial actions at a site,
3) controlling or cleaning up releases from a site, or
4) monitoring parameters related to disposal system performance.”
Purpose: This Permit Attachment describes the design of a system that the Permittees will implement for compliance with the requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.118(b)) and 40 CFR §191.14(a) to control access to the Waste Isolation Pilot Plant (WIPP) disposal site and implement maintenance and remedial actions pertaining to the site access controls. In addition, this Permit Attachment addresses the scheduling process for control of inspection, maintenance, and periodic reporting related to long-term monitoring. Long-term monitoring addresses the monitoring of disposal system performance, as required by 40 CFR §191.14(b), and environmental monitoring, in accordance with this Permit and the Consultation and Cooperation Agreement between the U.S. Department of Energy (DOE) and the state of New Mexico. The scheduling process will also address evaluation of testing activities related to the permanent marker system design contained within the passive institutional controls (not required by this permit).

Implementation of active institutional controls at the WIPP will commence when final facility closure is achieved, as specified in Permit Part 6 and Permit Attachment G. Implementation of active institutional controls marks the transition from the active life of the facility (which ends upon certification of closure) to the post-closure care period, as specified in 20.4.1.500 NMAC (incorporating 40 CFR §264 Subpart G). The Permittees will continue the imposition of active institutional controls under this Permit until NMED approves the post-closure certification specified in Permit Part 7 and Permit Attachment H.

Decommissioning activities include decontamination and site restoration. The decontamination effort will be completed prior to sealing of the shafts to allow disposal of all derived waste (radioactive and/or mixed waste derived from TRU/TRU-mixed waste received at the WIPP) into the repository. The implementation of active institutional controls upon certification of facility closure will prevent human intrusion into the repository. The Permittees’ restoration efforts will return the land disturbed by the WIPP activities to a stable ecological state that will assimilate with the surrounding undisturbed ecosystem. Necessary exceptions to returning the site to its full pre-WIPP condition include measurements associated with long-term monitoring.

Scope: The active institutional control requirements include a means of controlling access to the site of the repository’s surface footprint (the repository area projected to the surface) and maintenance, including corrective actions, for access control system components. Active control of access to the site will be exercised by the Permittees for the duration of the post-closure care period. Although the Permittees are only required to maintain active institutional controls until approval of the post-closure certification by NMED, the Permittees will continue active institutional controls for at least 100 years after final facility closure to satisfy other regulatory requirements. Control of access will prevent intrusion into the disposed waste by deep drilling or mining for natural resources. This Permit Attachment also specifies a process for scheduling activities related to the long-term monitoring of the repository. Some of the activities supporting the monitoring programs will be initiated during the active life of the facility to establish databases. These activities are planned to continue beyond closure through the time after removal of the site structures and return of the land disturbed by the WIPP activities to a stable ecological state that will assimilate with the surrounding undisturbed ecosystem. Long-term monitoring requirements will be necessarily integrated with efforts toward returning the land to a stable ecological state.

Background: The WIPP was sited and designed as a research and development facility to demonstrate the safe disposal of radioactive wastes. The wastes are derived from DOE defense-related activities. Specifically, the mission of the WIPP project is to conduct research,
demonstration, and siting studies relevant to the permanent disposal of TRU wastes. Most of these wastes will be contaminated with hazardous constituents, making them mixed wastes.

The LWA addresses the disposal phase of the WIPP project, the period following closure of the site, and the removal of the surface facilities. The LWA set aside 10,240 acres (4,144 hectares) located in Eddy County, 26 miles (42 kilometers) east of Carlsbad, New Mexico, as the WIPP site. A 277-acre (112-hectare) portion within the 10,240 acres (4,144 hectares) is bounded by a barbed wire fence. This fenced area contains the surface facilities and the mined salt piles for the WIPP site. Figure H1-1 is a cutaway illustrating the spatial relationship of the surface facilities and the underground repository.

Upon receipt of the necessary certifications and permits from the EPA and the New Mexico Environment Department, the Permittees will begin disposal of contact-handled (CH) and remote-handled (RH) TRU and TRU mixed waste in the WIPP. This waste emplacement and disposal phase will continue until the regulated capacity of the repository of 6,200,000 cubic feet (175,588 cubic meters) of TRU and TRU mixed waste has been reached, and as long as the Permittees comply with the requirements of the Permit. For the purposes of this Permit Attachment, this time period is assumed to be 25 years. The waste will be shipped from DOE facilities across the country in specially designed transportation containers certified by the Nuclear Regulatory Commission. The transportation routes from these facilities to the WIPP have been predetermined. The CH TRU mixed waste will be packaged in 55-gallon (208-liter), 85-gallon (322-liter), 100-gallon (379-liter) steel drums, standard waste boxes (SWBs), ten drum overpacks (TDOPs), and/or standard large box 2s (SLB2s). An SWB is a steel container having a free volume of 66.3 cubic feet (1.88 cubic meters). Figure H1-2 shows the general arrangement of a seven-pack of drums and an SWB as received in a Contact-Handled Package. RH TRU mixed waste inside a Remote-Handled Package is contained in one or more of the allowable containers described in Permit Attachment A1. Some RH TRU mixed waste may arrive in shielded containers as described in Permit Attachment A1.

Upon receipt and inspection of the waste containers in the waste handling building, the containers will be moved into the repository 2,150 feet (655 meters) below the surface. The containers will then be transported to a disposal room. (See Figure H1-1 for room and panel arrangement.) The initial seven disposal rooms are in Panel 1. Panel 1 is the first of 10 eight panels planned to be excavated. Special supports and ground control corrective actions have been implemented in Panel 1 to ensure its stability. Upon filling an entire panel, that panel will be closed to isolate it from the rest of the repository and the ventilation system. During the period of time it takes to fill a given panel, an additional panel will be excavated. Sequential excavation of Panels 2 through 10A8 will ensure that these individual panels remain stable during the entire time a panel is being filled with waste. Ground control maintenance and evaluation with appropriate corrective action will be required to ensure that Panels 9 and 10 (ventilation and access drifts in the repository) remain stable.

Decontamination of the WIPP facility will commence with a detailed radiation survey of the entire site. Contaminated areas and equipment will be evaluated and decontaminated in accordance with applicable requirements. Where decontamination efforts identify areas that meet clean closure standards for permitted container storage units and are below radiological release criteria, routine dismantling and salvaging practices will determine the disposition of the material or equipment involved. Material and equipment that do not meet these standards and criteria will be emplaced in the last open panel access entries (Panels 9 and/or 10). Upon completion of emplacement of the contaminated facility material, the entries will be closed and
the repository shafts will be sealed. Final repository closure includes sealing the shafts leading to the repository. Figure H1-3 illustrates the shaft sealing arrangement. Certification of closure will end disposal operations and initiate the post-closure care period for implementation of active institutional controls.

H1.1 Active Institutional Controls

Active institutional controls during post-closure consist of three elements:

- controlling access to a disposal site,
- performing maintenance operations or remedial actions at a site, and
- controlling or cleaning up releases from a site.

The LWA has removed the WIPP site from public use as a site for mining and other types of mineral resource extraction. Since any type of exploration activity would require authorization, the issuance of approval to intrude upon the repository is precluded by the LWA. The existence of the LWA as law permits meeting the requirements of the first element above by implementing low technology barriers. These barriers include a posted fence and active surveillance at a frequency that denies sufficient time for an individual or organization to intrude into the repository undetected using today’s drilling technology. Maintenance and remedial actions at the WIPP site will be conducted by the Permittees at the time of implementing the access controls for the site. The control or cleanup of releases from the site will be conducted as part of the operational program prior to sealing of the shafts. This is necessary to ensure that all derived waste is disposed of within the repository prior to shaft sealing.

The Permittees shall maintain the access controls. This requirement includes the maintenance and corrective actions necessary to ensure that the fence and patrol requirements (surveillance) are met. The active institutional controls to be implemented by the Permittees after final closure are the following:

1. A fence line will be established to control access to the repository footprint area on the surface. A standard four-strand (three barbed and one unbarbed, in accordance with the Bureau of Land Management specifications) wire fence will be erected along the perimeter of the repository surface footprint. To provide access to the repository footprint during construction of the berm (which may be built in multiple sections simultaneously), the fence will have gates placed approximately midway along each of the four sides. These gates will remain locked with access controlled by the Permittees. The western gate will be 20 feet (6 meters) wide. The remaining three gates will each be 16 feet (4.9 meters) wide. Additional fencing will be constructed where appropriate for remote locations that are used for disposal system monitoring. Such fences will meet the same construction specifications as the repository footprint perimeter fence.

2. Unpaved roadways 16 feet (4.9 meters) wide will be established along the perimeter of the barbed wire fence as well as along the WIPP site boundary. These roadways will be constructed so as to provide ready vehicle access to any point around the fenced perimeter and the site boundary. These roadways will facilitate inspection and maintenance of the fenceline and will allow visual observation of the repository footprint and the site boundary to the extent permitted by the lay of the land. These roadways will connect to the paved south access road. Roads to remote sites will also be constructed and maintained where appropriate.
3. The fence line will be posted with signs having, as a minimum, a legend reading “Danger—Unauthorized Personnel Keep Out” (20.4.1.500 NMAC (incorporating 40 CFR §264.14[c])) and warning against entering the area without specific permission of the Permittees. The legend must be written in English and Spanish. The signs must be legible from a distance of at least 25 feet (7.6 meters). The size of the visual warning and the spacing of the warning signs will be sufficiently large and close to ensure that one or more of the signs can be seen from any approach prior to an individual actually making contact with the fence line. In no case will the spacing be greater than 300 feet (91.5 meters).

4. The Permittees will ensure that periodic inspection and expedited corrective maintenance are conducted on the fence line, its associated warning signs, and roadways.

5. The Permittees will provide for routine periodic patrols and surveillance of all areas controlled by or under the authority of the Permittees by personnel trained in security surveillance and investigation.

6. The Permittees will implement the periodic monitoring requirements of the long-term monitoring system.

7. The Permittees will submit a Permit modification request for any proposed modifications to the active institutional controls appropriate for access control, as specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42).

8. The Permittees will immediately take appropriate action to address abnormal conditions identified during periodic surveillance and inspections. Abnormal conditions include any natural or human-caused conditions which would affect the integrity of the active institutional controls.

9. Reports addressing activities associated with the performance of the active access controls after final closure will be prepared periodically according to applicable requirements by the Permittees for submittal to the appropriate regulatory and legislative authorities.

H1.1.1 Repository Footprint Fencing

Access to an area approximately 2,870 feet by 2,360 feet (875 meters by 720 meters) will be controlled by a four-strand barbed wire fence. A single gate will be included along each side of the fence for access. These gates will remain locked with access controlled by the Permittees. Around the perimeter of the fence, an unpaved roadway 16 feet (4.9 meters) wide will be cut to allow for patrolling of the perimeter. Figure H1-4 is an illustration of the fence line in relation to the repository footprint. Patrolling of the perimeter is based upon the need to ensure that no mining or well drilling activity is initiated that could threaten the integrity of the repository.

Fencing off an area larger than the disposal area footprint would not significantly reduce the risk of intrusion but would interfere with cattle grazing established prior to the LWA. The LWA states that the Secretary of Energy can allow grazing to continue where it was established prior to enactment of the LWA. Based upon current drilling technologies, discussions with local well
drilling organizations, and observation of well drilling activities in the WIPP vicinity, it typically requires at least two to three days for a driller to set up a deep drilling rig and commence actual drilling operations. Attaining the 2,150-foot (655-meter) depth that would approach the repository horizon takes at least another week to 10 days. Based upon current drilling practices, patrolling the fenced area two to three times weekly would identify any potential drilling activity well before any breach of the repository could occur. Therefore, the perimeter fence will be patrolled three times weekly after final closure.

Construction of access control systems using higher technology than described is not required. Likewise, continuous surveillance whether human or electronic is not required.

H1.1.2 Surveillance Monitoring

The Permittees will conduct periodic surveillance of the site and the repository footprint during the post-closure period. Unpaved roadways around the WIPP site boundary and around the repository footprint will facilitate such surveillance. Contractual arrangements with a local organization such as the Eddy County Sheriff’s Department may be established which would provide some distinct advantages. Among the advantages are the following:

- deputies are trained in patrol and surveillance activities,
- deputies are authorized to arrest members of the general public who are found to be violating trespassing laws,
- the liability associated with apprehension, attempted apprehension, or circumstances arising from attempts would remain with the Sheriff’s Department, and
- the general area to be patrolled is already a part of the Sheriff’s area of responsibility.

Surveillance will consist of drive-by patrolling around the fenced perimeter a minimum of three times per week. In the course of the patrol, particular note will be taken of the fence integrity. In addition, the locked condition of each gate will be checked to ensure that gate integrity is maintained and there is no evidence of tampering. Surveillance will also include visual observation of the entire enclosed area for any signs of human activity. Additionally, surveillance patrols will be conducted around the site boundary’s perimeter for signs of unauthorized human activities. A routine summary of each month’s surveillance activity will be prepared documenting the date and time of each patrol and any unusual circumstances that may have been observed. This surveillance routine will continue throughout the post-closure care period.

H1.1.3 Maintenance and Remedial Actions

Anticipated maintenance and remedial action issues during the post-closure care period are minimal and should encompass such issues as

- fence and road maintenance,
- repair of any damage that occurs,
- response to evidence of potential erection of drilling equipment, and
- response to unauthorized entry into prohibited areas.
The Permittees will provide maintenance services within a reasonable time after the need is identified during routine patrolling activity. Any observed vandalism or unauthorized entry will be investigated and action will be taken as the circumstances warrant.

H1.1.4 Control and Clean-up of Releases

The decontamination process and disposal of the derived waste will be completed prior to sealing the shafts and final facility closure. With the location of the WIPP repository at 2,150 feet (655 meters) below the surface and with panels closed and shafts sealed, the potential for releases of radioactive material or hazardous constituents following the sealing of the shafts is precluded. There will be no credible pathway for releases from the repository other than human intrusion. Routine patrols in accordance with access control requirements will preclude human intrusion into the repository during the post-closure period.

H1.1.5 Groundwater Monitoring

Groundwater monitoring is the only monitoring program required by the Permit that will be conducted throughout the post-closure care period. The post-closure groundwater monitoring requirements are specified in Permit Part 7 and Permit Attachment L.

H1.2 Additional Post-Closure Activities

With the certification of closure of WIPP and return of the land disturbed by the WIPP activities to a stable ecological state that will assimilate with the surrounding undisturbed ecosystem, continuous occupancy of the site for operational and security purposes will cease. Any additional activities will be imposed through the Post-Closure Care Permit issued by NMED after certification of closure.

H1.3 Quality Assurance

The quality assurance and quality control plan will be applied to the procurement of materials for and the erection of the fencelines enclosing the repository footprint. In particular, quality control inspection of the placement and tensioning of the barbed wire and chain link fabric will be applied and utilized to provide reasonable assurance that the fencing structures will function during the post-closure care period with normal maintenance.

Quality assurance and quality control will also be applied to the sampling and analyses supporting the environmental monitoring program. Contractors collecting samples and laboratories conducting analyses for the Permittees shall be qualified in accordance with guidelines prescribed in the most current edition of the Permittees’ quality assurance program document at the time that the contracts are awarded.
References


FIGURES
Figure H1-1
Spatial View of WIPP Surface and Underground Facilities
Figure H1-1
Spatial View of WIPP Surface and Underground Facilities
Figure H1-2
Standard Waste Box and Seven-Pack Configuration
Figure H1-3
Typical Shaft Sealing System
Figure H1-4
Perimeter Fenceline and Roadway
Figure H1-4
Perimeter Fenceline and Roadway
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# ATTACHMENT J

## HAZARDOUS WASTE MANAGEMENT UNIT TABLES

### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table J-1</td>
<td>Waste Handling Building (WHB) Container Storage Unit</td>
</tr>
<tr>
<td>Table J-2</td>
<td>Parking Area Container Storage Unit</td>
</tr>
<tr>
<td>Table J-3</td>
<td>Underground Hazardous Waste Disposal Units</td>
</tr>
<tr>
<td>Description</td>
<td>Area</td>
</tr>
<tr>
<td>-----------------------------------</td>
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</tr>
<tr>
<td>CH Bay Storage Area</td>
<td>32,307 ft²</td>
</tr>
<tr>
<td></td>
<td>(3,001 m²)</td>
</tr>
<tr>
<td>CH Bay Surge Storage Area</td>
<td>included in CH Bay Storage Area</td>
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<tr>
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</tr>
<tr>
<td>Derived Waste Storage Area</td>
<td>included in CH Bay Storage Area</td>
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<td></td>
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<tr>
<td><strong>Total for CH Waste</strong></td>
<td>32,307 ft²</td>
</tr>
<tr>
<td></td>
<td>(3,001 m²)</td>
</tr>
<tr>
<td>RH Bay</td>
<td>12,552 ft²</td>
</tr>
<tr>
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<td>(1,166 m²)</td>
</tr>
<tr>
<td>Cask Unloading Room</td>
<td>382 ft²</td>
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<td>(36 m²)</td>
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<td>Hot Cell</td>
<td>1,841 ft²</td>
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<td>(171 m²)</td>
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<td>Transfer Cell</td>
<td>1,003 ft²</td>
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<td>(93 m²)</td>
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<td>Facility Cask Loading Room</td>
<td>1,625 ft²</td>
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<td>(151 m²)</td>
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<td><strong>Total for RH Waste</strong></td>
<td>17,403 ft²</td>
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<tr>
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<td>(1,617 m²)</td>
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<tr>
<td><strong>WHB Unit Total</strong></td>
<td>49,710 ft²</td>
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<tr>
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<td>(4,618 m²)</td>
</tr>
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### Table J-2
Parking Area Container Storage Unit

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<th>Description</th>
<th>Area</th>
<th>Maximum Capacity</th>
<th>Container Equivalent</th>
</tr>
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<tbody>
<tr>
<td>Parking Area</td>
<td>137,050 ft²</td>
<td>6,734 ft³</td>
<td>40 Contact-Handled Packages containing waste and 8 Remote-Handled Packages containing waste.  The total number of Contact-Handled Packages containing waste in the Parking Area Unit cannot exceed 50.</td>
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<tr>
<td></td>
<td>(12,730 m²)</td>
<td>(191 m³)</td>
<td></td>
</tr>
<tr>
<td>Parking Area Surge Storage</td>
<td>Included in Parking Area</td>
<td>2,129 ft³ (60 m³)</td>
<td>12 Contact-Handled Packages and 4 Remote-Handled Packages. The total number of Contact-Handled Packages containing waste in the Parking Area Unit cannot exceed 50.</td>
</tr>
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### Table J-3
Underground Hazardous Waste Disposal Units

<table>
<thead>
<tr>
<th>Description</th>
<th>Waste Type</th>
<th>Maximum Disposal Unit Capacity</th>
<th>Final Waste Volume Disposed</th>
<th>Container Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel 1</td>
<td>CH TRU</td>
<td>636,000 ft³ (18,000 m³)</td>
<td>370,800 ft³ (10,500 m³)</td>
<td>86,500 55-Gallon Drums</td>
</tr>
<tr>
<td>Panel 2</td>
<td>CH TRU</td>
<td>636,000 ft³ (18,000 m³)</td>
<td>635,600 ft³ (17,998 m³)</td>
<td>86,500 55-Gallon Drums</td>
</tr>
<tr>
<td>Panel 3</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td>603,600 ft³ (17,092 m³)</td>
<td>90,150 55-Gallon Drums</td>
</tr>
<tr>
<td>Panel 4</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td>503,500 ft³ (14,258 m³)</td>
<td>90,150 55-Gallon Drums</td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>12,570 ft³ (356 m³)</td>
<td>6,200 ft³ (176 m³)</td>
<td>400 RH TRU Canisters</td>
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<tr>
<td>Panel 5</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td>562,500 ft³ (15,927 m³)</td>
<td>90,150 55-Gallon Drums</td>
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<td></td>
<td>RH TRU</td>
<td>15,720 ft³ (445 m³)</td>
<td>8,300 ft³ (235 m³)</td>
<td>500 RH TRU Canisters</td>
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<tr>
<td>Panel 6</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td>510,900 ft³ (14,468 m³)</td>
<td>90,150 55-Gallon Drums</td>
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<td>RH TRU</td>
<td>18,860 ft³ (534 m³)</td>
<td>7,500 ft³ (214 m³)</td>
<td>600 RH TRU Canisters</td>
</tr>
<tr>
<td>Panel 7</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td>90,150 55-Gallon Drums</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft³ (650 m³)</td>
<td>730 RH TRU Canisters</td>
<td></td>
</tr>
<tr>
<td>Panel 8</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td>90,150 55-Gallon Drums</td>
<td></td>
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<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft³ (650 m³)</td>
<td>730 RH TRU Canisters</td>
<td></td>
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<tr>
<td>Panel 9A</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft³ (650 m³)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Waste Type</td>
<td>Maximum Disposal Unit Capacity</td>
<td>Final Waste Volume Disposed</td>
<td>Container Equivalent</td>
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<tr>
<td>-------------</td>
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<td>--------------------------------</td>
<td>----------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Panel 10A</td>
<td>CH TRU</td>
<td>662,150 ft³ (18,750 m³)</td>
<td></td>
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<tr>
<td></td>
<td>RH TRU</td>
<td>22,950 ft³ (650 m³)</td>
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<tr>
<td>Total Disposed in Filled Panels</td>
<td>CH TRU</td>
<td>5,244,900 ft³ (148,500 m³)*</td>
<td>2,676,000 ft³ (75,775 m³)</td>
<td>713,900 55-Gallon Drums</td>
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<tr>
<td></td>
<td>RH TRU</td>
<td>93,050 ft³ (2,635 m³)*</td>
<td>14,500 ft³ (411 m³)</td>
<td>2960 RH TRU Canisters</td>
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<tr>
<td>Summation of Disposal Unit Capacity</td>
<td>CH TRU</td>
<td>6,569,200 ft³ (186,000 m³)</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RH TRU</td>
<td>138,950 ft³ (3,935 m³)</td>
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</tbody>
</table>

1 The area of each panel is approximately 124,150 ft² (11,533 m²).
2 "Maximum Disposal Unit Capacity" is the maximum volume of TRU mixed waste that may be emplaced in each panel.
3 The total final waste volume disposed cannot exceed the maximum repository capacity (final waste volume disposed) of “6.2 million cubic feet of transuranic waste” is specified in the WIPP Land Withdrawal Act (Pub. L. 102-579, as amended).
4 This total is a summation of the listed disposal unit capacity and is for information purposes only and is not a limit or condition.

* Total only applies to the Final Waste Volume Disposed column. The maximum repository capacity of “6.2 million cubic feet of transuranic waste” is specified in the WIPP Land Withdrawal Act (Pub. L. 102-579, as amended).
** Total only applies to the Maximum Disposal Unit Capacity column.
ATTACHMENT N

VOLATILE ORGANIC COMPOUND MONITORING PLAN
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# ATTACHMENT N
## VOLATILE ORGANIC COMPOUND MONITORING PLAN

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-1</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>N-1a</td>
<td>Background</td>
<td>1</td>
</tr>
<tr>
<td>N-1b</td>
<td>Objectives of the VOC Monitoring Plan</td>
<td>2</td>
</tr>
<tr>
<td>N-2</td>
<td>Target VOCs</td>
<td>2</td>
</tr>
<tr>
<td>N-3</td>
<td>Monitoring Design</td>
<td>3</td>
</tr>
<tr>
<td>N-3a</td>
<td>Sampling Locations</td>
<td>3</td>
</tr>
<tr>
<td>N-3a(1)</td>
<td>Sampling Locations for Repository VOC Monitoring</td>
<td>3</td>
</tr>
<tr>
<td>N-3a(2)</td>
<td>Sampling Locations for Disposal Room VOC Monitoring</td>
<td>43</td>
</tr>
<tr>
<td>N-3a(3)</td>
<td>Sampling Locations for Ongoing Disposal Room VOC Monitoring</td>
<td>4</td>
</tr>
<tr>
<td>N-3b</td>
<td>Analytes to Be Monitored</td>
<td>54</td>
</tr>
<tr>
<td>N-3c</td>
<td>Sampling and Analysis Methods</td>
<td>65</td>
</tr>
<tr>
<td>N-3d</td>
<td>Sampling Schedule</td>
<td>76</td>
</tr>
<tr>
<td>N-3d(1)</td>
<td>Sampling Schedule for Repository VOC Monitoring</td>
<td>76</td>
</tr>
<tr>
<td>N-3d(2)</td>
<td>Sampling Schedule for Disposal Room VOC Monitoring</td>
<td>76</td>
</tr>
<tr>
<td>N-3e</td>
<td>Data Evaluation and Reporting</td>
<td>86</td>
</tr>
<tr>
<td>N-3e(1)</td>
<td>Data Evaluation and Reporting for Repository VOC Monitoring</td>
<td>86</td>
</tr>
<tr>
<td>N-3e(2)</td>
<td>Data Evaluation and Reporting for Disposal Room VOC Monitoring</td>
<td>119</td>
</tr>
<tr>
<td>N-3e(3)</td>
<td>Calculation of Disposal Room Monitoring Limits</td>
<td>129</td>
</tr>
<tr>
<td>N-4</td>
<td>Sampling and Analysis Procedures</td>
<td>129</td>
</tr>
<tr>
<td>N-4a</td>
<td>Sampling Equipment</td>
<td>1210</td>
</tr>
<tr>
<td>N-4a(1)</td>
<td>Sample Canisters</td>
<td>1210</td>
</tr>
<tr>
<td>N-4a(2)</td>
<td>Sample Collection Units</td>
<td>1330</td>
</tr>
<tr>
<td>N-4a(3)</td>
<td>Sample Tubing</td>
<td>1330</td>
</tr>
<tr>
<td>N-4b</td>
<td>Sample Collection</td>
<td>1340</td>
</tr>
<tr>
<td>N-4c</td>
<td>Sample Management</td>
<td>1411</td>
</tr>
<tr>
<td>N-4d</td>
<td>Maintenance of Sample Collection Units</td>
<td>1512</td>
</tr>
<tr>
<td>N-4e</td>
<td>Analytical Procedures</td>
<td>1542</td>
</tr>
<tr>
<td>N-5</td>
<td>Quality Assurance</td>
<td>1642</td>
</tr>
<tr>
<td>N-5a</td>
<td>Quality Assurance Objectives for the Measurement of Precision, Accuracy, Sensitivity, and Completeness</td>
<td>1643</td>
</tr>
<tr>
<td>N-5a(1)</td>
<td>Evaluation of Laboratory Precision</td>
<td>1743</td>
</tr>
<tr>
<td>N-5a(2)</td>
<td>Evaluation of Field Precision</td>
<td>1744</td>
</tr>
<tr>
<td>N-5a(3)</td>
<td>Evaluation of Laboratory Accuracy</td>
<td>1744</td>
</tr>
<tr>
<td>N-5a(4)</td>
<td>Evaluation of Sensitivity</td>
<td>1814</td>
</tr>
<tr>
<td>N-5a(5)</td>
<td>Completeness</td>
<td>1815</td>
</tr>
<tr>
<td>N-5b</td>
<td>Sample Handling and Custody Procedures</td>
<td>1645</td>
</tr>
<tr>
<td>N-5c</td>
<td>Calibration Procedures and Frequency</td>
<td>1645</td>
</tr>
<tr>
<td>N-5d</td>
<td>Data Reduction, Validation, and Reporting</td>
<td>1915</td>
</tr>
<tr>
<td>N-5e</td>
<td>Performance and System Audits</td>
<td>1916</td>
</tr>
</tbody>
</table>

---

PERMIT ATTACHMENT N
Page N-i
N-5f  Preventive Maintenance  .......................................................................................................................... 2046
N-5g  Corrective Actions  ................................................................................................................................. 2046
N-5h  Records Management  ............................................................................................................................. 2046
N-6  References  .................................................................................................................................................. 2218

N-1  Introduction  .................................................................................................................................................. 1
   N-1a  Background  ............................................................................................................................................. 1
   N-1b  Objectives of the VOC Volatile Organic Compound Monitoring Plan  ............................................... 2
N-2  Target Volatile Organic Compounds  ........................................................................................................... 2
N-3  Monitoring Design  ......................................................................................................................................... 2
   N-3a  Sampling Locations  .................................................................................................................................. 2
   N-3a(1)  Sampling Locations for Repository VOC Monitoring  .................................................................... 2
   N-3a(2)  Sampling Locations for Disposal Room VOC Monitoring  ............................................................... 3
   N-3a(3)  Sampling Locations for Ongoing Disposal Room VOC Monitoring in Panels 3 through 8 ........ 4
   N-3b  Analytes to Be Monitored  ..................................................................................................................... 4
   N-3c  Sampling and Analysis Methods  ......................................................................................................... 4
   N-3d  Sampling Schedule  .................................................................................................................................. 5
   N-3d(1)  Sampling Schedule for Repository VOC Monitoring  .................................................................... 5
   N-3d(2)  Sampling Schedule for Disposal Room VOC Monitoring  ............................................................... 5
   N-3e  Data Evaluation and Reporting  ............................................................................................................. 6
   N-3e(1)  Data Evaluation and Reporting for Repository VOC Monitoring ................................................. 6
   N-3e(2)  Data Evaluation and Reporting for Disposal Room VOC Monitoring ........................................... 7
   N-3e(3)  Data Evaluation and Reporting for Disposal Room VOC Monitoring in Panels 3 through 8 ........ 7
N-4  Sampling and Analysis Procedures  ............................................................................................................. 8
   N-4a  Sampling Equipment  ............................................................................................................................ 8
   N-4a(1)  Sample SUMMA™ Canisters  ......................................................................................................... 8
   N-4a(2)  Sample Collection Units Volatile Organic Compound Canister Samplers  .................................... 8
   N-4a(3)  Sample Tubing  .................................................................................................................................. 8
   N-4b  Sample Collection  .................................................................................................................................. 9
   N-4c  Sample Management  ............................................................................................................................. 9
   N-4d  Sampler Maintenance of Sample Collection Units  ............................................................................. 10
   N-4e  Analytical Procedures  ........................................................................................................................... 10
N-5  Quality Assurance  ......................................................................................................................................... 11
   N-5a  Quality Assurance Objectives for the Measurement of Precision, Accuracy, Sensitivity, and Completeness 11
   N-5a(1)  Evaluation of Laboratory Precision  ............................................................................................... 12
   N-5a(2)  Evaluation of Field Precision  ........................................................................................................ 12
   N-5a(3)  Evaluation of Laboratory Accuracy  ............................................................................................... 12
   N-5a(4)  Evaluation of Sensitivity  ................................................................................................................. 13
   N-5a(5)  Completeness  ................................................................................................................................... 13
   N-5b  Sample Handling and Custody Procedures  .......................................................................................... 13
   N-5c  Calibration Procedures and Frequency  ............................................................................................... 13
   N-5d  Data Reduction, Validation, and Reporting  ......................................................................................... 13
   N-5e  Performance and System Audits  .......................................................................................................... 14
   N-5f  Preventive Maintenance  ......................................................................................................................... 14
   N-5g  Corrective Actions  ................................................................................................................................... 14

PERMIT ATTACHMENT N
Page N-ii
N-6h Records Management ........................................................................................................ 15
N-6 Sampling and Analysis Procedures for Disposal Room VOC Monitoring in Filled Panels ......................................................................................................................... 15
N-7 References ............................................................................................................................ 16
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table N-1</td>
<td>Target Analytes and Methods for Repository VOC (Station VOC-A and VOC-B) Monitoring (Station VOC-A and Disposal Room VOC Monitoring)</td>
</tr>
<tr>
<td>Table N-2</td>
<td>Quality Assurance Objectives for Accuracy, Precision, Sensitivity, and Completeness</td>
</tr>
</tbody>
</table>

LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure N-1</td>
<td>Panel Area Flow Location of Station VOC-A</td>
</tr>
<tr>
<td>Figure N-2</td>
<td>VOC Monitoring System Design</td>
</tr>
<tr>
<td>Figure N-3</td>
<td>Typical Disposal Room VOC Monitoring Locations and Path of Ventilation Air Flow</td>
</tr>
<tr>
<td>Figure N-4</td>
<td>Disposal Room VOC-Sample Head Arrangement</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
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<tr>
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<td>additional requested analyte</td>
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<tr>
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<td>blank spike/blank spike duplicate</td>
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<tr>
<td>COC</td>
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<tr>
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<td>contract-required quantitation limit</td>
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<tr>
<td>EDD</td>
<td>electronic data deliverable</td>
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<tr>
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<td>gas chromatography/mass spectrometry</td>
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<td>HWDU</td>
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<tr>
<td>IDLH</td>
<td>Immediately Dangerous to Life and Health</td>
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<td>IRIS</td>
<td>Integrated Risk Information System</td>
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<td>IUR</td>
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<td>LCS</td>
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</tr>
<tr>
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<td>method reporting limit</td>
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</tr>
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<td>PASK</td>
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</tr>
<tr>
<td>ppbv</td>
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</tr>
</tbody>
</table>
ATTACHMENT N

VOLATILE ORGANIC COMPOUND MONITORING PLAN

N-1 Introduction

This Permit Attachment describes the plan for disposal phase monitoring of volatile organic compounds (VOCs) at emissions from mixed waste that may be entrained in the exhaust air from the U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) Underground Hazardous Waste Disposal Units (HWDUs) during the disposal phase at the facility. The purpose of VOC monitoring is to ensure compliance with the VOC limits specified in Permit Part 4. This VOC monitoring plan consists of two programs as follows; (1) Repository VOC Monitoring Program, which assesses compliance with the environmental performance standards in Permit Part 4, Section 4.6.2.3; and (2) Disposal Room VOC Monitoring Program (includes ongoing disposal room VOC monitoring), which assesses compliance with the disposal room performance standards in Permit Part 4, Table 4.6.3.2. This plan includes the monitoring design, a description of sampling and analysis procedures, quality assurance (QA) objectives, and reporting activities.

N-1a Background

The WIPP facility includes a mined geologic repository located approximately 2,150 feet (ft) (655 meters [m]) below ground surface within a bedded salt formation. The repository’s underground structures for disposal of transuranic (TRU) mixed waste that may contain VOCs include the Underground Hazardous Waste Disposal Units (Underground HWDUs). The Underground HWDUs are located 2,150 feet (ft) (655 meters [m]) below ground surface, in the WIPP underground. As defined for this Permit, an Underground HWDU is a single excavated panel consisting of seven rooms and two access drifts designated for disposal of contact-handled (CH) and remote-handled (RH) TRU mixed waste. Each disposal room is approximately 300 ft (91 m) long, 33 ft (10 m) wide, and 13 ft (4 m) high. Access drifts connect the rooms and have the same cross section. The Permittees shall dispose of TRU mixed waste in Underground HWDUs designated as Panels 1 through 10A8.

This plan addresses the following elements:

1. Rationale for the design of the VOC monitoring programs, based on:

   - Possible pathways from WIPP during the active life of the facility
   - Demonstrating compliance with the disposal room performance standards by monitoring VOCs in Underground HWDUs under ground disposal rooms
   - VOC sampling operations at WIPP
   - Optimum locations for sampling of the ambient mine air monitoring stations

2. Descriptions of the specific elements of the VOC monitoring programs, including:

   - The type of monitoring conducted

N-1b Objectives of the VOC Volatile Organic Compound Monitoring Plan

The CH and RH TRU mixed waste disposed in the WIPP Underground HWDUs may contain VOCs which could be released from WIPP during the disposal phase of the project. This plan describes how:

- VOCs released from waste panels will be monitored to confirm that the running annual average risk to the surface worker due to concentration of VOCs in the air emissions from the Underground HWDUs do not exceed the risk limits VOC concentrations of concern (COC) identified in Permit Part 4, Section Table 4.6.2.3 and calculated from measured VOC concentrations and risk factors identified in Table 4.6.2.3. Appropriate remedial action, as specified in Permit Section 4.6.2.4, will be taken if the limits in Permit Part 4, Section Table 4.6.2.3 are reached.

- VOCs released from waste containers in disposal rooms of active waste panels will be monitored to confirm that the concentration of VOCs in the air of immediately adjacent closed and active rooms in active panels do not exceed the VOC disposal room limits identified in Permit Part 4, Table 4.4.1. Appropriate remedial action, as specified in Permit Part 4, Section 4.6.3.3, will be taken if the original sample results are greater than or equal to the action levels Action Levels in Permit Part 4, Table 4.6.3.2 are reached.

- VOCs released from waste containers will be monitored in Room 1 of a filled panel that requires monitoring as described in Section N-3a(3) to confirm that the concentration of VOCs in the air do not exceed the VOC disposal room limits identified in Permit Part 4, Table 4.4.1. Appropriate remedial action, as specified in Permit Part 4, Section 4.6.3.3 and Attachment G, Section G-1d(1), will be taken if the original sample results are greater than or equal to the levels specified in Permit Part 4, Table 4.6.3.2 and Permit Attachment G, Section G-1d(1).

N-2 Target VOCs Volatile Organic Compounds

The target VOCs for Repository VOC Monitoring repository monitoring (Station VOC-A and VOC-B) and Disposal Room VOC Monitoring Programs disposal room monitoring are presented in Table N-1.
These target VOCs were selected because individually they represent more than one percent of the risk and collectively they represent over 97% approximately 99% of the risk due to air emissions.

N-3 Monitoring Design

Detailed design features of this plan are presented in this section. This plan uses available sampling and analysis techniques to monitor VOC concentrations in air.

Subatmospheric sample collection units. Sampling equipment includes the WIPP VOC canister samplers used in both the Repository and Disposal Room VOC Monitoring Programs are herein referred to as a passive air sampling kit (PASK). A subatmospheric sampling assembly is the sample collection unit for disposal room VOC monitoring. These sample collection units are described in greater detail in Section N-4a(2).

N-3a Sampling Locations

Air samples will be collected in the WIPP facility underground to quantify airborne VOC concentrations as described in the following sections.

N-3a(1) Sampling Locations for Repository VOC Monitoring

The initial configuration for the repository VOC monitoring stations is shown in Figure N-1. All mine ventilation air which could potentially be impacted by VOC emissions from the underground HWUs identified as Panels 1 through 10A8 will pass monitoring Station VOC-A, located in the E-300 drift as it flows to the Exhaust Shaft exhaust shaft. Air samples will be collected at VOC-A, two locations in the facility to quantify VOCs in the ambient mine air (repository airborne VOC concentrations). VOC concentrations including attributable to VOC emissions from open and closed panels containing TRU mixed waste will be monitored measured by placing Station VOC-A one VOC monitoring station just downstream from Panel 1 at VOC-A. The location of Station VOC-A as shown in Figure N-1 will remain the same throughout the term of this Permit. The second station (Station VOC-B) will always be located upstream from the open panel being filled with waste (starting with Panel 1 at monitoring Station VOC-B (Figure N-1)). In this configuration, Station VOC-B will measure VOC concentrations attributable to releases from the upstream sources and other background sources of VOCs, but not releases attributable to open or closed panels. The location of Station VOC-B will change when disposal activities begin in the next panel. Station VOC-B will be relocated to ensure that it is always upstream of the open panel that is receiving TRU mixed waste. Station VOC-A will collect the also measure upstream VOC concentrations measured at Station VOC-B, plus any additional VOC concentrations resulting from releases from the closed and open panels. A sample will be collected from each monitoring station on designated sample days. For each quantified target VOC, the concentration measured at Station VOC-B will be subtracted from the concentration measured at Station VOC-A to assess the magnitude of VOC releases from closed and open panels.

The sampling location was selected based on operational considerations. There are several different potential sources of release for VOCs into the WIPP mine ventilation air. These sources include incoming air from above ground and facility support operations, as well as open and closed waste panels. In addition, because of the ventilation requirements of the underground facility and atmospheric dispersion characteristics, any VOCs that are released from open or closed panels may be difficult to detect and differentiate from other sources.
VOCs at any underground or above ground location further downstream of Panel 1. By measuring VOC concentrations close to the potential source of release (i.e., at Station VOC-A), it will be possible to differentiate potential releases from background levels (measured at Station VOC-B).

N-3a(2) Sampling Locations for Disposal Room VOC Monitoring

For purposes of compliance with Section 310 of Public Law 108-447, the VOC monitoring of airborne VOCs in underground disposal rooms in which waste has been emplaced will be performed as follows:

1. Excluding Room 1, a sample head will be installed for each inside the disposal room behind the designated ventilation barrier exhaust drift bulkhead and at the exhaust and inlet side of the disposal rooms. For Room 1, a sample head will be installed only at the exhaust location.

2. TRU mixed waste will be emplaced in the active disposal room.

3. VOC monitoring will begin within two weeks of waste emplacement in an active room (Figures N-3 and N-4).

3. When the active disposal room is filled, another sample head will be installed to the inlet of the filled active disposal room. (Figure N-3 and N-4)

4. The exhaust drift bulkhead will be removed and re-installed in the next disposal room so disposal activities may proceed.

5. When an active room is filled, a ventilation barrier will be installed where the bulkhead was located in the active disposal room’s exhaust drift. Another ventilation barrier will be installed in the active disposal room’s air inlet drift, thereby closing that active disposal room. VOC monitoring will begin at the inlet side of the disposal room within two weeks of closure as required by Permit Attachment N, Section N-3d(2).

6. Monitoring of VOCs will continue in the now closed disposal room. Monitoring of VOCs will occur in the active disposal rooms and immediately adjacent all closed disposal rooms in which waste has been emplaced until commencement of panel closure activities (i.e., completion of ventilation barriers in Room 1) as described in Permit Attachment G, Section G-1d(1).

This sequence for installing sample locations will proceed in the remaining disposal rooms until the inlet air ventilation barrier is installed in Room 1. An inlet sampler will not be installed in Room 1 because disposal room sampling proceeds to the next panel.

N-3a(3) Sampling Locations for Ongoing Disposal Room VOC Monitoring in Panels 3 through 8

The Permittees shall continue VOC monitoring in Room 1 of a filled panel Panels 3 through 8 after completion of waste emplacement until final panel closure unless an explosion-isolation wall is installed in the panel.
N-3b Analytes to Be Monitored

The nine VOCs that have been identified for repository and disposal room VOC monitoring are listed in Table N-1. The analysis will focus on routine detection and quantification of these target analytes compounds in collected samples. As part of the analytical evaluations, the presence of other compounds (i.e., non-target VOCs) will also be monitored.

Some non-targets may be included on the laboratory’s target analyte list as additional requested analytes (ARAs) to gain a better understanding of potential concentrations and associated risk. The analytical laboratory will be directed to calibrate for ARAs when requested and classify and report other non-target VOCs all of these compounds as Tentatively Identified (TICs) if tentative identification can be made. The evaluation of TICs in original samples will include those concentrations that are ≥ 10 percent of the relative internal standard. The evaluation of ARAs only includes concentrations that are ≥ the method reporting limit (MRL). The required MRLs for ARAs will be U.S. Environmental Protection Agency (EPA)-specified levels of quantitation proposed for EPA contract laboratories that analyze canister samples by gas chromatography/mass spectrometry (GC/MS) (EPA, 1991).

TICs—Non-targets classified as ARAs or TICs that meet the following criteria: (1) are VOCs listed in Appendix VIII of 40 Code of Federal Regulations (CFR) Part 261 (incorporated by reference in 20.4.1.200 New Mexico Administrative Code (NMAC), and (2) are detected in 10 percent or more of any original VOC monitoring samples (exclusive of those collected from Station VOC-B) that are VOCs listed in Appendix VIII of 20.4.1.200 NMAC (incorporating 40 CFR §261), collected over a running 12-month timeframe. will be added to the analytical laboratory target analyte lists for both the repository and disposal room VOC monitoring programs, unless the Permittees can justify the exclusion from the target analyte list(s). Non-target VOCs reported as “unknown” by the analytical laboratory are not evaluated due to indeterminate identifications.

Additional requested analytes and TICs detected in the repository and disposal room VOC monitoring programs will be placed in the WIPP Operating Record and reported to New Mexico Environment Department (NMED) in annual reports the Semi-Annual VOC Monitoring Report as specified in Permit Part 4, Section 4.6.2.2. As applicable, the Permittees will report the justification for exclusion of the target analyte list(s) (e.g., the compound does not contribute to more than one percent of the risk) as well as justification for exclusion of some non-target TICs from the laboratory’s target analyte list as ARAs. If new target analytes are not required, the Permittees will state such in the annual report provided in October of each year. If new target analytes are required, the Permittees will submit a Class 1 Permit Modification Notification (PMN) annually in accordance with 20.4.1.900 NMAC (incorporating 40 CFR 270.42(a)) to update Tables 4.4.1, 4.6.2.3, and 4.6.3.2 to include the whenever new analytes are identified and associated recommended EPA updates the risk values factors for the inhalation unit risk (IUR) and reference concentration (RfC). This PMN will be submitted with the annual report. Added compounds will be included in the risk assessment described in Section N-3e(1).

In summary, the criteria that a new compound must meet to become a target analyte are:

1. The evaluation of TICs in original samples shall include those concentrations that are ≥ 10 percent of the relative internal standard;
2. The TIC concentration shall be ≥ the method reporting limit (MRL);
3. A TIC must be detected in 10% or more of the VOC samples excluding VOC-B within a 12 month time period.

PERMIT ATTACHMENT N
Page N-5 of 27826

5. To be included in the target analyte list the TICs must be detected in the original samples (duplicates are not included in the evaluation).

6. The compound will be added to the target analyte list if it meets the above criteria and contributes to greater than or equal to 1% of the total risk unless justification can be made to exclude it.

N-3c Sampling and Analysis Methods

The VOC monitoring programs include a comprehensive VOC monitoring program established at the facility; equipment, training, and documentation for VOC measurements are already in place.

The sampling methods used for repository and disposal room VOC monitoring are sampling is based on the concept of subatmospheric pressurized sample collection contained in the U.S. Environmental Protection Agency (EPA) Compendium Method TO-15 (EPA, 1999). The TO-15 sampling concept uses 6-liter SUMMA®-passivated (or equivalent) stainless-steel canisters to collect 24-hour time integrated or time-weighted average air samples at Station VOC-A and short duration time-integrated samples for disposal room VOC monitoring each sample location. This conceptual method will be used as a reference for collecting the samples at WIPP. The samples will be analyzed using GC/MS gas chromatography/mass spectrometry (GC/MS) under an established QA/QC program. Laboratory analytical procedures have been developed based on the concepts contained in both TO-15 and 8260B. Section N-5 contains additional QA/QC information for this project.

The TO-15 method is an EPA-recognized sampling concept for VOC sampling and speciation. It can be used to provide subatmospheric integrated samples or grab samples, and compound quantitation for a broad range of concentrations. The sampling system can be operated unattended but requires detailed operator training. This sampling technique is also viable for use while analyzing the sample using other EPA methods such as 8260B.

Sample collection units operate in the subatmospheric pressurized mode. In this mode, air is drawn through the inlet and sampling system with a pump. The air is pumped into a sample canister, when the canister is opened to the atmosphere, the differential pressure causes the sample to flow into the canister. Flow rate and duration are regulated with a flow-restrictive inlet and/or mechanical or electronic flow controllers. The air will pass through two particulate filters installed in dual in-line filter holders to prevent sample and equipment contamination and for radiation assessment of sampling equipment, as needed. The use of passive tubing and canisters for VOC sampling inhibits adsorption of compounds on the surfaces of the equipment, by the sampler, which regulates the rate and duration of sampling. The treatment of tubing and canisters used for VOC sampling effectively seals the inner walls and prevents compounds from being retained on the surfaces of the equipment. By the end of each sampling period, the canisters will be pressurized to about two atmospheres absolute. In the event of shortened sampling periods or other sampling conditions, the final pressure in the canister may be less than two atmospheres absolute. Sampling duration will be approximately six hours, so that a complete sample can be collected during a single work shift.
The canister sampling system and GC/MS analytical method are particularly appropriate for the VOC Monitoring Programs because a relatively large sample volume is collected, and multiple dilutions and reanalyses can occur to ensure identification and quantification of target VOCs within the working range of the method. For repository VOC monitoring, the contract-required quantitation limits (CRQL) for Repository Monitoring are 5 parts per billion by volume (ppbv) or less for the nine target VOC compounds. Consequently, low concentrations can be measured. CRQLs are the EPA-specified levels of quantitation proposed for EPA contract laboratories that analyze canister samples by GC/MS. (EPA, 1991). The CRQLs for disposal room VOC monitoring are 500 (ppbv) (0.5 parts per million-volume (ppmv)) to allow for sub-ppmv quantitation. For the purpose of this plan, the CRQLs shall be defined as the MRL. The MRL is a function of instrument performance, sample preparation, sample dilution, and all steps involved in the sample analysis process. The MRL for Disposal Room Monitoring is 500 ppbv or less for the nine target compounds.

Disposal room VOC monitoring system in open panels shall employ the same canister sampling method as used in the repository VOC monitoring sample collection units that will provide a subatmospheric sample within a short duration. Passivated or equivalent sampling lines shall be installed in the disposal room as described in Section N-3a(2) and maintained once the room is closed until the panel associated with the room is closed. The independent lines shall run from the sample inlet point to a sampling manifold the individual sampler located in an area accessible to sampling personnel the access drift to the disposal panel. The air will pass through dual particulate filters to prevent sample and equipment contamination.

N-3d Sampling Schedule

The Permittees will evaluate whether the monitoring systems and analytical methods are functioning properly. The assessment period will be determined by the Permittees.

N-3d(1) Sampling Schedule for Repository VOC Monitoring

Repository VOC sampling at Stations VOC-A began and VOC-B will begin with initial waste emplacement in Panel 1. Sampling shall continue until the certified closure of the last Underground HWDU. Routine collection of a 24-hour time-integrated sample shall be conducted once two times per week.

N-3d(2) Sampling Schedule for Disposal Room VOC Monitoring

Disposal room VOC monitoring sampling in open panels shall occur once every two weeks, unless the need to increase the frequency to weekly occurs in accordance with Permit Part 4, Section 4.6.3.3.

Ongoing Beginning with Panel 3, disposal room VOC monitoring sampling in filled panels shall occur monthly until final panel closure unless an explosion-isolation wall is installed. The Permittees shall sample VOCs in Room 1 of each filled panel requiring monitoring.
N-3e Data Evaluation and Reporting

N-3e(1) Data Evaluation and Reporting for Repository VOC Monitoring

When the Permittees receive laboratory analytical data from an air sampling event, the data shall be validated as specified in Section N-5d. After obtaining validated data from an original Repository VOC Monitoring sample obtained during an air sampling event, the data shall be evaluated to determine whether the VOC emissions from the Underground HWDUs exceed the risk limits COCs. The COCs for each of the nine target VOCs are presented in Permit Part 4, Section Table 4.6.2.3. The values are presented in terms of risk of excess cancer death for compounds believed to be carcinogenic and hazard index (HI) for non-carcinogens micrograms per cubic meter (µg/m³) and ppbv.

The COCs risk and HI are calculated as follows:

Determine the concentration at Station VOC-A in mg/m³ for each VOC. This measurement represents the emissions from all closed and open panels and is $C_{E-300, VOC_j}$ in equation (N-1).

Calculate the concentration at the top of the Exhaust Shaft based on the ratio of actual flow rate at Station VOC-A and the total Exhaust Flow Rate:

$$C_{ES, VOC_j} = \frac{C_{E-300, VOC_j} \times V_{E-300}}{V_{ES}}$$  \hspace{1cm} (N-1)

Where:

$C_{ES, VOC_j}$ = Concentration of VOC$_j$ at the top of the Exhaust Shaft in mg/m³

$C_{E-300, VOC_j}$ = Concentration of VOC$_j$ at E-300 in mg/m³

$V_{E-300}$ = E-300 ventilation flow rate in ft³/min

$V_{ES}$ = Exhaust Shaft ventilation flow rate in ft³/min

Apply the Air Dispersion Factor (0.0114) to determine the concentration at the receptor:

$$Conc_{VOC_j} = C_{ES, VOC_j} \times 0.0114$$  \hspace{1cm} (N-2)

Where:

$Conc_{VOC_j}$ = Concentration VOC$_j$ at the receptor (mg/m³)

Calculate the carcinogenic risk (for each VOC) using the following equation:

$$R_{VOC_j} = \frac{Conc_{VOC_j} \times EF \times ED \times IUR_{VOC_j} \times 1000}{AT}$$  \hspace{1cm} (N-3)
Where:

\[ R_{VOCj} = \text{Risk due to exposure to VOC}_j \]

\[ \text{Conc}_{VOCj} = \text{Concentration VOC}_j \text{ at the receptor (mg/m}^3\text{)} \]

\[ EF = \text{Exposure frequency (hours/year), } = 1,920 \text{ hours per year} \]

\[ ED = \text{Exposure duration, years, } = 10 \text{ years} \]

\[ IU_{VOCj} = \text{Inhalation risk factor from EPA Integrated Risk Information System (IRIS) database (} \text{ug/m}^3\text{)} \]

\[ (\text{ug/m}^3)^{-1} \text{ (from Table 4.6.2.3)} \]

\[ AT = \text{Averaging time for carcinogens, } = 613,200 \text{ hours based on 70 years} \]

\[ 1,000 = \text{ug/mg} \]

The total risk is then the sum of the risk due to each carcinogenic VOC:

\[ \text{Total Risk} = \sum_{j=1}^{m} R_{VOCj} \] (N-4)

Where:

\[ \text{Total Risk must be less than } 10^{-5} \]

\[ m = \text{the number of carcinogenic VOCs} \]

The formula for non-carcinogenic hazard is similar:

\[ HI_{VOCj} = \frac{\text{Conc}_{VOCj} \times EF \times ED}{AT \times RfC_{VOCj}} \] (N-5)

Where:

\[ HI_{VOCj} = \text{Hazard Index for exposure to VOC}_j \]

\[ \text{Conc}_{VOCj} = \text{Concentration VOC}_j \text{ at the receptor (mg/m}^3\text{)} \]

\[ EF = \text{Exposure frequency (hours/year), } = 1,920 \text{ hours per year} \]

\[ ED = \text{Exposure duration, years, } = 10 \text{ years} \]

\[ RfC_{VOCj} = \text{Reference concentration from EPA IRIS database (mg/m}^3\text{)} \]

\[ AT = \text{Averaging time for non-carcinogens, } = 87,600 \text{ hours, based on exposure duration} \]

The total hazard is then the sum of the hazard index due to each non-carcinogenic VOC:

\[ \text{Hazard Index} = \sum_{j=1}^{m} HI_{VOCj} \] (N-6)
Where:

1. **Hazard Index must be less than 1.0**
2. \( m = \) the number of non-carcinogenic VOCs

were calculated assuming typical operational conditions for ventilation rates in the mine. The typical operational conditions were assumed to be an overall mine ventilation rate of 425,000 standard cubic feet per minute and a flow rate through the E-300 Drift at Station VOC-A of 130,000 standard cubic feet per minute.

Since the mine ventilation rates at the time the air samples are collected may be different than the mine ventilation rates during typical operational conditions, the Permittees will measure and record the overall mine ventilation rate and the ventilation rate in the E-300 Drift at Station VOC-A that are in use during each sampling event. The Permittees shall also measure and record temperature and pressure conditions during the sampling event to allow all ventilation rates to be converted to standard flow rates.

If the air samples were collected under the typical mine ventilation rate conditions, then the analytical data will be used without further manipulation. The concentration of each target VOC detected at Station VOC-B will be subtracted from the concentration detected at Station VOC-A. The resulting VOC concentration represents the concentration of VOCs being emitted from the open and closed Underground HWDUs upstream of Station VOC-A (or the Underground HWDU VOC emission concentration).

If the air samples were not collected under typical mine ventilation rate operating conditions, the air monitoring analytical results from both Station VOC-A and Station VOC-B will be normalized to the typical operating conditions. This will be accomplished using the mine ventilation rates in use during the sampling event and the following equation:

\[
 NVOC_{AB} = VOC_{AB} \left( \frac{425,000 \, \text{scfm}}{130,000 \, \text{scfm}} \right) \left( \frac{VO \, \text{scfm}}{VE-300 \, \text{scfm}} \right)^{N-1}
\]

Where:

- \( NVOC_{AB} = \) Normalized target VOC concentration from Stations VOC-A or VOC-B
- \( VOC_{AB} = \) Concentration of the target VOC detected at Station VOC-A or VOC-B under non-typical mine ventilation rates
- \( \text{scfm} = \) Standard cubic feet per minute
- \( VO = \) Sampling event overall mine ventilation rate (in standard cubic feet per minute)
- \( VE-300 = \) Sampling event mine ventilation rate through the E-300 Drift (in standard cubic feet per minute)
The normalized concentration of each target VOC detected at Station VOC-B will be subtracted from the normalized concentration detected at Station VOC-A. The resulting concentration represents the Underground HWDU VOC emission concentration.

The summed risk and HI calculated from the Underground HWDU VOC emission concentrations for each target VOC that is calculated for each sampling event will be compared directly to the limits in its COC listed in Permit Part 4, Section Table 4.6.2.3. This will establish whether any of the concentrations of VOCs in the emissions from the Underground HWDUs exceeded the risk and HI limits COCs at the time of the sampling.

As specified in Permit Part 4, the Permittees shall notify the Secretary in writing, within seven calendar days of obtaining validated analytical results, whenever the risk or HI concentrations of any target VOC listed in exceeds the limits concentration of concern specified in Permit Part 4, Section Table 4.6.2.3.

The Underground HWDU VOC emission concentration for each target VOC that is calculated for each sampling event will be considered the running annual average concentration for each target VOC. The risk and HI at the location of the surface worker will be calculated using the methodology above for the running annual average concentrations. For the first year of air sampling, the running annual average concentration for each target VOC will be calculated using all of the previously collected data.

As specified in Permit Part 4, the Permittees shall notify the Secretary in writing, within seven calendar days of obtaining validated analytical results, whenever the running annual average concentration for any target VOC exceeds the limits concentration of concern specified in Permit Part 4, Section Table 4.6.2.3.

If the results obtained from an individual air sampling event do not trigger the notification requirements of Permit Part 4, then the Permittees will maintain a database with the VOC air sampling data and the results will be reported to the Secretary as specified in Permit Part 4.

N-3e(2) Data Evaluation and Reporting for Disposal Room VOC Monitoring

When the Permittees receive laboratory analytical data from an air sampling event, the data shall be validated as specified in Section N-5d5a, within 14 calendar days of receiving the laboratory analytical data. After obtaining validated data from an air sampling event, the data shall be evaluated to determine whether the VOC concentrations in the air of any closed room, the active open room or the immediately adjacent closed room are greater than or equal to the action levels exceeded the Action Levels for Disposal Room Monitoring specified in Permit Part 4, Table 4.6.3.2.

The Permittees shall notify the Secretary in writing, within seven calendar days of obtaining validated analytical results, whenever the concentration of any VOC specified in Permit Part 4, Table 4.4.1 is greater than or equal to exceeds the action levels specified in Permit Part 4, Table 4.6.3.2. Remedial action will be taken as specified in Section N-1b.
The Permittees shall report disposal room VOC monitoring results submit to the Secretary in the annual reports as the Semi-Annual VOC Monitoring Report specified in Permit Part 4, Section 4.6.2.2 that also includes results from disposal room VOC monitoring.

N-3e(3) Calculation of Disposal Room Monitoring Limits

Whenever the TIC process described in Section N-3b identifies a target analyte that is to be added to the Permit, the Permittees shall calculate a Disposal Room Limit and Action Levels for addition to Tables 4.4.1 and 4.6.3.2 respectively. The calculation shall be based as follows:

$$\text{Conc}_{VOC} = 48 \times \text{IDLH}$$  \hspace{1cm} (N-7)

Where Conc$_{VOC}$ is the concentration of concern to be added to Table 4.4.1 in parts per million (volume);

48 is a factor calculated according the process found in Attachment 1 of Appendix D9 of the Permittees 1996 RCRA Permit Application; and

Immediately Dangerous to Life and Health (IDLH) is the concentration of the VOC that is determined by Occupational Safety and Health Administration (OSHA) to be immediately dangerous to life and health.

Under no conditions shall Conc$_{VOC}$ be greater than the lower explosive limit for the VOC. The values for Table 4.6.3.2 will be calculated as Conc$_{VOC}$ times 0.5 and Conc$_{VOC}$ times 0.95.

N-4 Sampling and Analysis Procedures

This section describes the equipment and procedures that will be implemented during sample collection and analysis activities for VOCs at WIPP.

N-4a Sampling Equipment

The sampling equipment that will be used includes the following: 6-liter (L) stainless-steel passivated SUMMA® canisters, sample collection units, passivated VOC canister samplers, treated stainless-steel tubing, and a dual in-line stainless-steel filter holders housing. A discussion of each of these items is presented below.

N-4a(1) Sample SUMMA® Canisters

Six-liter, stainless-steel canisters with SUMMA®-passivated interior surfaces will be used to collect and store all ambient air and disposal room gas samples for VOC analyses collected as part of the monitoring processes. These canisters will be cleaned and certified (batch certification acceptable) prior to their use, in a manner similar to that described by Compendium Method TO-15. The canisters will be certified clean to below 0.2 ppbv the required reporting limits for the VOC analytical method for the target VOCs (see Table N-2). The vacuum of certified clean canisters samplers will be verified as adequate at the sampler upon initiation of a sample cycle as described in standard operating procedures (SOPs). The sample canisters are shall be initially evacuated at the analytical laboratory to <0.05 mm Hg (50 mtorr).
N-4a(2) Sample Collection Units

Volatile Organic Compound Canister Samplers

The sample collection unit for Station VOC-A samples is a commercially available sample train (herein referred as PASK) comprised of components that regulate the rate and duration of sampling into a sample canister. It can be operated unattended using a programmable timer or manually using canister valves.

The sample collection unit for disposal room VOC monitoring samples is a designed subatmospheric sampling assembly that regulates the rate and duration of sampling into a sample canister (Figure N-2). The design of the subatmospheric sampling assembly also allows for purging of sample lines to ensure that a representative sample is collected.

Sample collection units will use passivated components for the sample flow path. This effectively seals the inner walls and prevents sample constituents from being retained on the surfaces of the equipment. When sample canisters installed on sample collection units are opened to the atmosphere, the differential pressure causes the sample to flow into the canister at a regulated rate. By the end of each sampling period, the canisters will be near atmospheric pressure. Additional detail on sample collection will be given in SOPs.

A conceptual diagram of a VOC sample collection unit is provided in Figure N-2. Such units will be used at monitoring Stations VOC-A and VOC-B and at sampling locations for disposal room measurements. The sampling unit consists of a sample pump, flow controller, sample inlet, inlet filters in series to remove particulate matter, vacuum/pressure gauge, electronic timer, inlet purge vent, two sampling ports, and sufficient collection canisters so that any delays attributed to laboratory turnaround time and canister cleaning and certification will not result in canister shortages. Knowledge of sampler flow rates and duration of sampling will allow calculation of sample volume. The set point flow rate will be verified before and after sample collection from the mass flow indication. Prior to their initial use and annually thereafter, the sample collection units will be tested and certified to demonstrate that they are free of contamination above the reporting limits of the VOC analytical method (see Section N-5). Ultra-high purity humidified zero air will be pumped through the inlet line and sampling unit and collected in previously certified canisters as sampler blanks for analysis. The cleaning and certification procedure is derived from concepts contained in the EPA Compendium Method TO-15 (EPA, 1999).

N-4a(3) Sample Tubing

Passivated Treated stainless-steel tubing is used as a sample path, from the desired sample point to the sample collection unit. This tubing is passivated treated to prevent the inner walls from adsorbing sample constituents absorbing contaminants when they are pulled from the sample point to the sample collection unit.

N-4b Sample Collection

Sample collection for VOCs in the WIPP repository will be conducted in accordance with written SOPs that are kept on file at the facility. These SOPs will specify the steps necessary to assure the collection of samples that are of acceptable quality to meet the applicable data quality objectives in Section 5 of this Attachment.

Samples collected from Station VOC-A will be 24Six-hour time-integrated samples will be collected on each sampling event sample day. Alternative sampling durations may be defined.
for** assessment experimental purposes and to meet the data quality objectives. The VOC canister sampler at each location will sample ambient air on the same programmed schedule. The sample pump will be programmed to sample continuously over a six-hour period during the workday. The units will sample at a nominal flow rate of 33.3 actual milliliters per minute over a six-hour sample period. This schedule will yield a final sample volume of approximately 12 L. Flow rates and sampling duration may be modified as necessary for experimental purposes and to meet the data quality objectives.

Sample flow for PASK shall be set checked each sample day using an in-line mass flow controller. The flow controllers are initially factory-calibrated and specify a typical accuracy of better than 10 percent full scale. Additionally, each air flow controller is calibrated at a manufacturer-specified frequency using a National Institute of Standards and Technology (NIST) primary flow standard.

Samples Upon initiation of waste disposal activities in Panel 1, samples will be collected once twice each week (at Stations VOC-A and VOC-B). Samples collected at the panel locations should represent the same matrix type (i.e., elevated levels of salt aerosols). To verify the matrix similarity and assess field sampling precision, field duplicate samples will be collected from each VOC monitoring program sampling station (at Stations VOC-A and VOC-B) during the first sampling event and at an overall frequency of at least 5 percent thereafter (see Section N-5a).

Prior to collecting the active open disposal room and closed room samples, the sample lines are purged to ensure that the air collected is not air that has been stagnant in the tubing. This is important in regard to the disposal room sample particularly because of the long lengths of tubing associated with these samples. The repository samples do not require this action due to the short lengths of tubing required at these locations.

N-4c Sample Management

Field sampling logbooks and data sheets will be used for to document the sampler conditions under which each sample is collected as specified in SOPs for VOC sampling. These data sheets are included in the SOPs and have been developed specifically for VOC monitoring at the WIPP facility. Logbooks are used to document sampler information as required by SOPs. The individuals assigned to collect the specific samples will be required to fill in all of the appropriate sample data and to maintain this record in sample logbooks. A cognizant individual, the program team leader will review these forms for each sampling event and the completed data sheets will be maintained in with the departmental Records Inventory and Disposition Schedule (RIDS).

All sample containers shall be marked with identification at the time of collection of the sample. A Request-for-Analysis Form shall be completed to identify the sample canister number(s), sample type and type of analysis requested.

All samples shall be maintained, and shipped if necessary, at ambient temperatures. Collected samples will be transported in appropriate containers. Prior to leaving the underground for analysis, sample containers may undergo radiological screening. No potentially contaminated samples or equipment will be transported to the surface. No samples shall be accepted by the receiving laboratory personnel unless they are properly labeled and custody maintained/sealed to ensure a tamper free shipment.

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An important component of the sampling program is a demonstration that collected samples were obtained from the locations stated and that they reached the laboratory without alteration. To satisfy this requirement, evidence of collection, shipment, laboratory receipt, and custody will be documented with a completed Chain-of-Custody Form. Chain-of-custody procedures shall be followed closely, and additional requirements imposed by the laboratory for sample analysis will be included as necessary.

Individuals collecting samples will be responsible for the initiation of custody procedures. The chain of custody will include documentation as to the canister certification, location of sampling event, sample collection time-date, and individual(s) handling the samples.

Unintentional procedure deviations, equipment malfunctions, and other problems that do not conform to established requirements are nonconformances. The disposition and documentation of nonconformances shall be handled according to QA requirements. Deviations from procedure will be considered variances. Variances must be preapproved by the program manager and recorded in the project files. Unintentional deviations, sampler malfunctions, and other problems are nonconformances. Nonconformances must be documented and recorded in the project files. All field logbooks/data sheets must be incorporated into WIPP’s records management program.

N-4d Sampler Maintenance of Sample Collection Units

Periodic maintenance for sample collection units, canister samplers, and associated equipment will be performed as needed during each cleaning cycle. This maintenance may include cleaning, but not be limited to, replacement of damaged or malfunctioning parts without compromising the integrity of the sample collection units, and leak testing, and instrument calibration. Additionally, complete spare sample collection units will be maintained on-site to minimize downtime because of equipment malfunction. At a minimum, canister samplers will be certified for cleanliness initially and annually thereafter upon initial use, after any parts that are included in the sample flow path are replaced, or any time analytical results indicate potential contamination. All sample canisters will be certified prior to each usage.

N-4e Analytical Procedures

Analytical procedures used in the analysis of VOC samples from canisters are based on concepts contained in Compendium Method TO-15 (EPA, 1999) and in SW-846 Method 8260B (EPA, 1996).

Analysis of samples shall be performed by a laboratory that the Permittees select and approve through established QA processes. Analysis of samples will be performed by a certified laboratory. Analytical methods will be specified in procurement documents and shall be selected to be consistent with Compendium Method TO-15 (EPA, 1999) or EPA recommended procedures in SW-846 (EPA, 1996). Additional detail on analytical techniques and methods will be given in laboratory SOPs.

The Permittees will establish the criteria for laboratory selection, including the stipulation that the laboratory follow the procedures specified in the appropriate Air Compendium or SW-846 method and that the laboratory follow EPA protocols. The selected laboratory shall demonstrate, through laboratory SOPs, that it will follow appropriate EPA SW-846 requirements and the requirements specified by the EPA Air Compendium protocols. The laboratory shall also
provide documentation to the Permittees describing the sensitivity of laboratory instrumentation. This documentation will be retained in the facility operating record and will be available for review upon request by NMED.

The SOPs for the laboratory currently under contract will be maintained in the operating record by the Permittees. The Permittees will provide NMED with an initial set of applicable laboratory SOPs for information purposes, and shall provide NMED with any updated SOPs on an annual basis.

Data validation will be performed by cognizant qualified individuals the Permittees. Copies of the data validation records report will be kept on file in the operating record for review upon request by NMED.

N-5 Quality Assurance

The QA activities for the VOC monitoring programs will be conducted in accordance with the documents: EPA Guidance for Quality Assurance Project Plans QA/G-5 (EPA, 2002) and the EPA Requirements for Preparing Quality Assurance Project Plans, QA/R-5 (EPA, 2001).

The QA criteria for the VOC monitoring programs are listed in Table N-2. This section addresses the methods to be used to evaluate the components of the measurement system and how this evaluation will be used to assess data quality. The QA limits for the sampling procedures and laboratory analysis shall be in accordance with the limits set forth in the specific EPA Method referenced in SOPs used standard operating procedures employed by either the Permittees or the laboratory. The Permittees’ SOPs standard operating procedures will be in the facility Operating Record and available for review by NMED at anytime. The laboratory SOPs standard operating procedures will also be in the facility Operating Record and will be supplied to the NMED as indicated in Section N-4e.

N-5a Quality Assurance Objectives for the Measurement of Precision, Accuracy, Sensitivity, and Completeness

QA objectives for this plan will be defined in terms of the following data quality parameters.

Precision. For the duration of this program, precision will be defined and evaluated by the RPD values calculated between field duplicate samples and between laboratory duplicate samples.

\[
\text{RPD} = \left( \frac{(A - B)}{(A + B)/2} \right) \times 100
\]

where: A = Original sample result

\[
\text{RPD} = \left( \frac{|A - B|}{(A + B)/2} \right) \times 100
\]

B = Duplicate sample result

Accuracy. Analytical accuracy will be defined and evaluated through the use of analytical standards. Because recovery standards cannot reliably be added to the sampling stream, overall system accuracy will be based on analytical instrument performance evaluation criteria. These criteria will include performance verification for instrument calibrations, laboratory control samples, sample surrogate recoveries (when required by method or
laboratory SOPs), and sample internal standard areas. Use of the appropriate criteria as determined by the analytical method performed, will constitute the verification of accuracy for target analyte quantitation (i.e., quantitative accuracy). Evaluation of standard ion abundance criteria for bromofluorobenzene Chemical Abstract Service (CAS# 460-00-4) BFB will be used to evaluate the accuracy of the analytical system in the identification of targeted analytes, as well as the evaluation of unknown constituents (i.e., qualitative accuracy).

**Sensitivity.** Sensitivity will be defined by the required MRLs for the program. Attainment of required MRLs will be verified by the performance of statistical method detection limit (MDL) studies in accordance with 40 CFR Part Code of Federal Regulations § 136 (Appendix B). The MDL represents the minimum concentration that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. An MDL study must be performed by the program analytical laboratory prior to sampling and analysis, and at least annually thereafter.

**Completeness.** Completeness will be defined as the percentage of the ratio of the number of valid sample results received (i.e., those which meet data quality objectives) versus the total number of samples required to be collected. Completeness may be affected, for example, by sample loss or destruction during shipping, by laboratory sample handling errors, inability to collect the required samples, or by rejection of analytical data during data validation.

**N-5a(1) Evaluation of Laboratory Precision**

Laboratory sample duplicates and laboratory control sample/laboratory control sample blank spike/blank spike duplicates (LCS/LCSDBS/BSD) will be used to evaluate laboratory precision. QA objectives for laboratory precision are listed in Table N-2, and are based on precision criteria proposed by the EPA for canister sampling programs (EPA, 1991-1994). These values will be appropriate for the evaluation of samples with little or no matrix effects. Because of the potentially high level of salt-type aerosols in the WIPP underground environment, the analytical precision achieved for WIPP samples may vary with respect to the EPA criteria. RPDs for LCS/LCS DBS/BSD analyses will be tracked by the analytical laboratory through the use of control charts. RPDs obtained for laboratory sample duplicates will be compared to those obtained for LCS/LCS DBS/BSDs to ascertain any sample matrix effects on analytical precision. LCS/LCS DBS/BSDs and laboratory sample duplicates will be analyzed at a frequency of 10 percent, or one per analytical lot, whichever is more frequent.

**N-5a(2) Evaluation of Field Precision**

Field duplicate samples will be collected at a frequency of at least 5 percent for each VOC both monitoring program location. The data quality objective for field precision is 35 percent for each set of field duplicate samples.

**N-5a(3) Evaluation of Laboratory Accuracy**

Quantitative analytical accuracy will be evaluated through performance criteria on the basis of (1) relative response factors generated during instrument calibration, (2) analysis of LCS laboratory control samples (LCS), and (3) recovery of internal standard compounds. The criterion criteria for the initial calibration (minimum 5-point calibration) is ≤ 30 percent relative standard deviation for target analytes. After the successful completion of the 5-point calibration, it is sufficient to analyze only a midpoint standard for every 24 hours of operation. The midpoint
A standard will shall pass a ≤ 30 percent difference acceptance criterion for each target VOC compound before sample analysis may begin.

An blank spike or LCS is an internal QC sample generated by the analytical laboratory by spiking a standard air matrix (humid zero air or ultra-high purity nitrogen) with a known amount of a certified reference gas. The reference gas will shall contain the target VOCs at known concentrations. Percent recoveries for the target VOCs will shall be calculated for each LCS relative to the reference concentrations. Objectives for percent recovery are listed in Table N-2, and are based on accuracy criteria proposed by the EPA for canister sampling programs (EPA, 19911994). LCSs will shall be analyzed at a frequency of 10 percent, or one per analytical lot, whichever is more frequent.

Internal standards will shall be introduced with into each sample analyzed, and will shall be monitored as a verification of stable instrument performance. In the absence of any unusual interferences, areas should not change by more than 40 percent over a 24-hour period.

Deviations larger than 40 percent are an indication of a potential instrument malfunction. If an internal standard area in a given sample changes by more than 40 percent, the sample will shall be reanalyzed. If the 40 percent criterion is not achieved during the reanalysis, the instrument will shall undergo a performance check and the midpoint standard will shall be reanalyzed to verify proper operation. Response and recovery of internal standards will shall also be compared between samples, LCSs, and calibration standards to identify any matrix effects on analytical accuracy.

N-5a(4) Evaluation of Sensitivity

The presence of aerosol salts in underground locations may affect the MDL of the samples collected in those areas. The sample inlet of the sample collection units intake manifold of the sampling systems will shall be protected sufficiently from the underground environment to minimize salt aerosol interference. Two filters inert to VOCs will shall be installed in dual in-line filter holders in the sample flow path to minimize particulate interference.

The MDL for each of the nine target VOCs compounds will shall be evaluated by the analytical laboratories before sampling begins. The initial and subsequent annual MDL evaluations will shall be performed in accordance with 40 CFR Part Code of Federal Regulations §136 (Appendix B) and with EPA/530-SW-90-021, as revised and retitled, “Quality Assurance and Quality Control”—Chapter 1 of SW-846) (EPA, 1996).

N-5a(5) Completeness

The expected completeness for this program is greater than or equal to 95 percent. Data completeness will shall be tracked monthly.

N-5b Sample Handling and Custody Procedures

Sample packaging, shipping, and custody procedures are addressed in Section N-4c.

N-5c Calibration Procedures and Frequency

Calibration procedures and frequencies for analytical instrumentation are listed in Section N-4e.
N-5d Data Reduction, Validation, and Reporting

Field sampling data sheets and equipment logbooks A dedicated logbook will be maintained by the operators. This logbook will shall contain documentation of all pertinent data for the sampling according to applicable SOPs. Sample collection conditions, maintenance, and calibration activities will be included in this logbook. Additional data collected by other groups at WIPP, such as ventilation airflow, temperature, barometric pressure, and relative humidity etc., will shall be obtained to document the sampling conditions.

Data validation procedures will shall include at a minimum, a check of all field data sheets/equipment/logbooks forms and sampling logbooks will be checked for completeness and correctness according to the applicable SOP. Sample custody and analysis records will shall be reviewed routinely by the analytical laboratory QA officer and the analytical laboratory supervisor at a frequency of at least 10 percent.

Electronic Data Deliverables (EDDs) are shall be provided by the laboratory prior to receipt of hard copy data packages. EDDs will shall be evaluated within five calendar days of receipt to determine if VOC concentrations are at or above action levels in Permit Part 4, Table 4.6.3.2 for disposal room VOC monitoring data or the action levels specified in Permit Part 4, Section concentrations of concern in Table 4.6.2.3 for repository monitoring data. If the EDD indicates that VOC concentrations are at or above these action levels or concentrations, the hard copy data package will shall be validated within five calendar days as opposed to the fourteen (14) calendar day time frame provided by Section N-3e(2).

Data will shall be reported as specified in Section N-3(e) and Permit Part 4.

Acceptable data for this VOC monitoring plan will shall meet stated precision and accuracy criteria. The QA objectives for precision, accuracy, and completeness as shown in Table N-2 can be achieved when established methods of analyses are used as proposed in this plan and standard sample matrices are being assessed.

N-5e Performance and System Audits

System audits will shall initially address start-up functions for each phase of the project. These audits will shall consist of on-site evaluation of materials and equipment, review of certifications for canisters and measurement and test equipment, sampler certification, review of laboratory qualification and operation and, at the request of the QA officer, an on-site audit of the laboratory facilities. The function of the system audit is to verify that the requirements in this plan have been met prior to initiating the program. System audits will shall be performed at or shortly after the initiation of the VOC monitoring programs and on an annual basis thereafter.

Performance audits will shall be accomplished as necessary through the evaluation of analytical QC data by performing periodic site audits throughout the duration of the project, and through the introduction of third-party audit cylinders (laboratory blinds) into the analytical sampling stream. Performance audits will shall also include a surveillance/review of data associated with canister and sampler certifications and measurement and test equipment, a project-specific technical audit of field operations, and a laboratory performance audit. Field logs, logbooks, and data sheets will be reviewed weekly. Blind-audit canisters will shall be introduced once during the sampling period. Details concerning scheduling, personnel, and data quality evaluation are addressed in the Quality Assurance Project Plan (QAP).
N-5f Preventive Maintenance

Maintenance of sample collection units is described briefly in Section N-4d. Maintenance of analytical equipment will be addressed in the analytical lab.

N-5g Corrective Actions

If the required completeness of valid data (\(\geq 95\) percent) is not maintained, corrective action may be required. Corrective action for field sampling activities may include maintenance and recalibration and cleaning of field equipment, reanalysis of samples, additional training of personnel, modification to field and laboratory procedures, and recalibration of measurement and test equipment.

Laboratory corrective actions may be required to maintain data quality. The laboratory continuing calibration criteria indicate the relative response factor for the midpoint standard will be \(\leq 30\) percent different from the mean relative response factor for the initial calibration. Differences greater than 30 percent will require recalibration of the instrument before samples can be analyzed. If the internal standard areas in a sample change by more than 40 percent, the sample will be reanalyzed. If the 40 percent criterion is not achieved during the reanalysis, the instrument will undergo a performance check and the midpoint standard reanalyzed to verify proper operation. Deviations larger than 40 percent are an indication of potential instrument malfunction.

The laboratory results for samples, laboratory duplicate analyses, LCSs, and blanks should routinely be within the QC limits. If results exceed control limits, the reason for the nonconformances and appropriate corrective action must be identified and implemented.

N-5h Records Management

The VOC Monitoring Programs require administration of record files (both laboratory and field data collection files). The records control systems provide adequate control and retention for program-related information. Records administration, including QA records, will be conducted in accordance with applicable DOE, Management and Operating Contractor (MOC), and WIPP requirements.

Unless otherwise specified, VOC monitoring plan records will be retained as lifetime records. Temporary and permanent storage of QA records will occur in facilities that prevent damage from temperature, fire, moisture, pressure, excessive light, and electromagnetic fields. Access to stored VOC Monitoring Program QA Records will be controlled and documented to prevent unauthorized use or alteration of completed records.

Revisions to completed records (i.e., as a result of audits or data validation procedures) may be made only with the approval of the responsible program manager and in accordance with applicable QA procedures. Records associated with the VOC Monitoring Program will be maintained as specified in VOC program SOPs. Electronic records that cannot be altered by the user and capable of producing a paper copy shall be deemed to be a written record. Records required to be retained by VOC program SOPs will be maintained at or readily accessible from the WIPP site. Original and duplicate or backup records of project activities will be
maintained at the WIPP site. Documentation will be available for inspection by internal and external auditors.

N-6. Sampling and Analysis Procedures for Disposal Room VOC Monitoring in Filled Panels

Disposal room VOC samples in filled panels will be collected using the subatmospheric pressure grab sampling technique described in Compendium Method TO-15 (EPA, 1999). This method uses an evacuated SUMMA® passivated canister (or equivalent) that is under vacuum (0.06 mm Hg) to draw the air sample from the sample lines into the canister. The sample lines will be purged prior to sampling to ensure that a representative sample is collected. The passivation of tubing and canisters used for VOC sampling effectively seals the inner walls and prevents compounds from being retained on the surfaces of the equipment. By the end of each sampling period, the canisters will be near atmospheric pressure.

The analytical procedures for disposal room VOC monitoring in filled panels are the same as specified in Section N-4e.
N-67 References

<table>
<thead>
<tr>
<th>Target Analyte</th>
<th>EPA Standard Analytical Method</th>
</tr>
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<tbody>
<tr>
<td>Carbon tetrachloride</td>
<td>EPA TO-15&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Chlorobenzene</td>
<td>EPA 8260B&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chloroform</td>
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<tr>
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<td></td>
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<tr>
<td>1,2-Dichloroethane</td>
<td></td>
</tr>
<tr>
<td>Methylene chloride</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>1,1,1-Trichloroethene</td>
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<tr>
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</table>


### Table N-2

**Quality Assurance Objectives for Accuracy, Precision, Sensitivity, and Completeness**

<table>
<thead>
<tr>
<th>Target VOC Compound</th>
<th>Accuracy (Percent Recovery)</th>
<th>Precision (RPD) Laboratory Field</th>
<th>Required Repository Monitoring MRL (ppbv)</th>
<th>Required Disposal Room MRL (ppbv)</th>
<th>Completeness (Percent)</th>
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<tbody>
<tr>
<td>Carbon tetrachloride</td>
<td>60 to 140</td>
<td>25</td>
<td>35</td>
<td>2</td>
<td>500</td>
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<tr>
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<td>Trichloroethylene</td>
<td>60 to 140</td>
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<td>35</td>
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</tbody>
</table>

MRL = maximum method reporting limit for undiluted samples.

RPD = relative percent difference; allowances for conditions that may produce non-representative RPD values will be specified in SOPs.
FIGURES
Figure N-1
Location of Station VOC-A
Figure N.2
VOC Monitoring System Design
Figure N-2
Subatmospheric VOC Monitoring System
Figure N-3
Disposal Room VOC Monitoring
Figure N-3
Typical Disposal Room VOC Monitoring Locations and Path of Ventilation Air Flow
Figure N-4
VOC Sample Head Arrangement
Figure N-4
Disposal Room VOC Sample Head Arrangement
ATTACHMENT N1

HYDROGEN AND METHANE MONITORING PLAN
# ATTACHMENT N1

## HYDROGEN AND METHANE MONITORING PLAN

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1-1</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>N1-2</td>
<td>Parameters to be Analyzed and Monitoring</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Design</td>
<td></td>
</tr>
<tr>
<td>N1-3</td>
<td>Sampling Frequency</td>
<td>2</td>
</tr>
<tr>
<td>N1-4</td>
<td>Sampling</td>
<td>2</td>
</tr>
<tr>
<td>N1-5</td>
<td>Sampling Equipment</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>N1-5a SUMMA® Canisters</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>N1-5b Sample Tubing</td>
<td>2</td>
</tr>
<tr>
<td>N1-6</td>
<td>Sample Management</td>
<td>3</td>
</tr>
<tr>
<td>N1-7</td>
<td>Analytical Procedures</td>
<td>3</td>
</tr>
<tr>
<td>N1-8</td>
<td>Data Evaluation and Notifications</td>
<td>3</td>
</tr>
<tr>
<td>N1-9</td>
<td>References</td>
<td>4</td>
</tr>
<tr>
<td>Figure N1-1</td>
<td>Typical Substantial Barrier and Bulkhead</td>
<td></td>
</tr>
<tr>
<td>Figure N1-2</td>
<td>Typical Bulkhead</td>
<td></td>
</tr>
<tr>
<td>Figure N1-3</td>
<td>Typical Hydrogen and Methane Monitoring System</td>
<td></td>
</tr>
<tr>
<td>Figure N1-4</td>
<td>Typical Hydrogen and Methane Sampling Locations</td>
<td></td>
</tr>
<tr>
<td>Figure N1-5</td>
<td>Logic Diagram for Evaluating Sample Line Loss</td>
<td></td>
</tr>
</tbody>
</table>
ATTACHMENT N1

VOLATILE ORGANIC COMPOUND MONITORING PLAN

N1-1 Introduction

This Permit Attachment describes the monitoring plan for hydrogen and methane generated in Underground Hazardous Waste Disposal Units (HWDUs) 3 through 8, also referred to as Panels 3 through 8.

Monitoring for hydrogen and methane in Panels 3 through 8 until final panel closure, unless an explosion-isolation wall is installed, may be an effective way to gather data to establish realistic gas generation rates. This plan includes the monitoring design, a description of sampling and analysis procedures, quality assurance (QA) objectives, and reporting activities.

N1-2 Parameters to be Analyzed and Monitoring Design

The Permittees will monitor for hydrogen and methane in filled Panels 3 through 8 until final panel closure, unless an explosion isolation wall is installed. A “filled panel” is an Underground HWDU that will no longer receive waste for emplacement.

Monitoring of a filled panel will commence after installation of the following items in each filled panel:

- substantial barriers
- bulkheads
- five additional monitoring locations.

The substantial barriers serve to protect the waste from events such as ground movement or vehicle impacts. The substantial barrier will be constructed from available non-flammable materials such as mined salt (Figure N1-1).

The bulkheads (Figure N1-2) serves to block ventilation at the intake and exhaust of the filled panel and prevent personnel access. The bulkhead is constructed as a typical WIPP bulkhead with no access doors or panels. The bulkhead will consist of a steel member frame covered with galvanized sheet metal, and will not allow personnel access. Flexible flashing will be used as a gasket to attach the steel frame to the salt, thereby providing an effective yet flexible blockage to ventilation air. Over time, it is possible that the bulkhead may be damaged by creep closure around it. If the damage is such as to indicate a possible loss of functionality, then the bulkhead will be repaired or an additional bulkhead will be constructed outside of the original one.

The existing VOC monitoring lines as specified in Attachment N, Section N-3a(2), “Sampling Locations for Disposal Room VOC Monitoring”, will be used for sample collection in each disposal room for Panels 3 and 4. The sample lines and their construction are shown in Figure N1-3. In addition to the existing VOC monitoring lines, five more sampling locations will be used to monitor for hydrogen and methane. These additional locations include:

- the intake of room 1
- the waste side of the exhaust bulkhead,
• the accessible side of the exhaust bulkhead,
• the waste side of the intake bulkhead,
• the accessible side of the intake bulkhead.

These additional sampling locations (Figure N1-4) will use a single inlet sampling point placed near the back (roof) of the panel access drifts. This will maximize the sampling efficiency for these lighter compounds.

N1-3 Sampling Frequency

Sampling frequency will vary depending upon the levels of hydrogen and methane that are detected:

• If monitored concentrations are at or below Action Level 1 as specified in Permit Part 4, Table 4.6.5.3, monitoring will be conducted monthly.

• If monitored concentrations exceed Action Level 1 as specified in Permit Part 4, Table 4.6.5.3, monitoring will be conducted weekly in the affected filled panel.

N1-4 Sampling

Samples for hydrogen and methane will be collected using subatmospheric pressure grab sampling as described in Environmental Protection Agency (EPA) Compendium Method TO-15 (EPA, 1999). The TO-15 sampling method uses passivated stainless-steel sample canisters to collect integrated air samples at each sample location. Flow rates and sampling duration may be modified as necessary to meet data quality objectives.

Sample lines shall be purged prior to sample collection.

N1-5 Sampling Equipment

N1-5a SUMMA® Canisters

Stainless-steel canisters with passivated or equivalent interior surfaces will be used to collect and store gas samples for hydrogen and methane analyses collected as part of the monitoring processes. These canisters will be cleaned and certified prior to their use in a manner similar to that described by Compendium Method TO-15 (EPA, 1999). The vacuum of certified clean canisters will be verified upon initiation of a sample cycle. Sampling will be conducted using subatmospheric pressure grab sampling techniques as described in TO-15.

N1-5b Sample Tubing

Treated stainless steel tubing shall be used as a sample path and treatment shall prevent the inner walls from absorbing contaminants.

Any loss of the ability to purge a sample line will be evaluated. The criteria used for evaluation are shown in Figure N1-5.

The Permittees will first suspect that a line is not useable when it is purged prior to sampling. If the line cannot be purged, then it will not be used for sampling unless the line is a bulkhead line.
that can be easily replaced. Replacement of bulkhead lines will occur before the next scheduled sample. Non-bulkhead lines will be evaluated by first determining if adjacent sampling lines are working. If the answer is no, then the previous sample from the failed line will be examined. If the previous sample was between the first and second action levels, then the explosion-isolation wall will be installed since without the ability to monitor it is unknown whether the area is approaching the second action level or decreasing. If the previous sample was below the first action level then continued sampling is acceptable without the lost sample.

If an adjacent line is working, the prior concentrations measured in that line will be evaluated to determine if it is statistically similar to the prior measurements from the lost line. If the prior sampling results are statistically similar, the lines can be grouped. Statistical similarity will be determined using the Student’s “t” test to evaluate differences.

The magnitude of t will be compared to the critical t value from SW-846, Table 9-2 (EPA, 1996), for this statistical test.

If the lost line can be grouped with an adjacent line, no further action is necessary because the unmonitored area is considered to be represented by the adjacent areas. If the lost sample line cannot be grouped with an adjacent line, the previous concentration measurement will be compared to the Action Levels. If the concentration is below Action Level 1, monitoring will continue. If the concentration is between Action Level 1 and Action Level 2, the explosion-isolation wall will be installed in the panel.

N1-6 Sample Management

Sample containers shall be sealed and uniquely marked at the time of collection of the sample. A Request-for-Analysis Form shall be completed to identify the sample canister number(s), sample type, and type of analysis requested.

N1-7 Analytical Procedures

The samples will be analyzed using gas chromatography equipped with the appropriate detector under an established QA/quality control (QC) program. Analysis of samples shall be performed by a laboratory that the Permittees select and approve through established QA processes.

N1-8 Data Evaluation and Notifications

Analytical data from sampling events will be evaluated to determine whether the sample concentrations of flammable gases exceed the Action Levels.

If any Action Level is exceeded, notification will be made to NMED and the notification posted to the WIPP web page and accessed through the email notification system within seven calendar days of obtaining validated analytical data.

If any sampling line loss occurs, notification will be made to NMED and the notification posted to the WIPP web page and accessed through the email notification system within seven calendar days of learning of a sampling line loss. After the evaluation of the impact of sampling line loss as shown in Figure N1-5, notification will be made to NMED and the notification posted to the WIPP web page and accessed through the email notification system within seven calendar days of completing the sampling line loss evaluation.
References


NOTES

1. CONFIGURATION AND PLACEMENT OF THE SUBSTANTIAL BARRIER AND THE BULKHEAD WILL BE DICTATED BY AS-FOUND (FIELD) CONDITIONS AS DESIGNATED BY THE COGNIZANT ENGINEER.

2. SUBSTANTIAL BARRIER MATERIAL WILL CONSIST OF RUN-OFF-MINE SALT OR OTHER SUITABLE NON-FLAMMABLE MATERIAL AS DESIGNATED BY THE COGNIZANT ENGINEER.

3. SUBSTANTIAL BARRIER MATERIAL SHOULD BE AGAINST THE WASTE FACE. THE HEIGHT OF THE SUBSTANTIAL BARRIER NEAR THE WASTE WILL BE AT LEAST EQUAL TO THE HEIGHT OF THE TOP ROW OF WASTE.


Figure N1-1
Typical Substantial Barrier and Bulkhead
Flexible Flashing Attachment

DETAIL 1

Not to Scale. All dimensions are nominal.

Figure N1-2
Typical Bulkhead
Typical Hydrogen and Methane Monitoring System
Figure N1-4
Typical Hydrogen and Methane Sampling Locations
Figure N1-5
Logic Diagram for Evaluating Sample Line Loss