

**ATTACHMENT I**  
**CLOSURE PLAN**

(This page intentionally blank)

**ATTACHMENT I**  
**CLOSURE PLAN**  
**TABLE OF CONTENTS**

List of Tables .....	<a href="#">I-ii</a>
List of Figures .....	<a href="#">I-ii</a>
Introduction .....	<a href="#">I-1</a>
I-1 <u>Closure Plan</u> .....	<a href="#">I-2</a>
I-1a <u>Closure Performance Standard</u> .....	<a href="#">I-3</a>
I-1a(1) <u>Container Storage Units</u> .....	<a href="#">I-3</a>
I-1a(2) <u>Miscellaneous Unit</u> .....	<a href="#">I-4</a>
I-1a(3) <u>Post-Closure Care</u> .....	<a href="#">I-5</a>
I-1b <u>Requirements</u> .....	<a href="#">I-5</a>
I-1c <u>Maximum Waste Inventory</u> .....	<a href="#">I-5</a>
I-1d <u>Schedule for Closure</u> .....	<a href="#">I-6</a>
I-1d(1) <u>Schedule for Panel Closure</u> .....	<a href="#">I-6</a>
I-1d(2) <u>Schedule for Final Facility Closure</u> .....	<a href="#">I-7</a>
I-1d(3) <u>Extension for Closure Time</u> .....	<a href="#">I-8</a>
I-1d(4) <u>Amendment of the Closure Plan</u> .....	<a href="#">I-9</a>
I-1e <u>Closure Activities</u> .....	<a href="#">I-9</a>
I-1e(1) <u>Panel Closure</u> .....	<a href="#">I-9</a>
I-1e(2) <u>Decontamination and Decommissioning</u> .....	<a href="#">I-11</a>
I-1e(2)(a) <u>Determine the Extent of Contamination</u> .....	<a href="#">I-12</a>
I-1e(2)(b) <u>Decontamination Activities</u> .....	<a href="#">I-13</a>
I-1e(2)(c) <u>Dismantling</u> .....	<a href="#">I-16</a>
I-1e(2)(d) <u>Closure of Open Underground HWDU</u> .....	<a href="#">I-16</a>
I-1e(2)(e) <u>Final Facility Closure</u> .....	<a href="#">I-17</a>
I-1e(2)(f) <u>Final Contouring and Revegetation</u> .....	<a href="#">I-18</a>
I-1e(2)(g) <u>Closure, Monuments, and Records</u> .....	<a href="#">I-18</a>
I-1e(3) <u>Performance of the Closed Facility</u> .....	<a href="#">I-19</a>
I-2 <u>Notices Required for Disposal Facilities</u> .....	<a href="#">I-19</a>
I-2a <u>Certification of Closure</u> .....	<a href="#">I-19</a>
I-2b <u>Survey Plat</u> .....	<a href="#">I-19</a>
References .....	<a href="#">I-21</a>

## List of Tables

<b>Table</b>	<b>Title</b>
I-1	Anticipated Earliest Closure Dates for the Underground HWDUs
I-2	Anticipated Overall Schedule for Closure Activities
I-3	Governing Regulations for Borehole Abandonment

## List of Figures

<b>Figure</b>	<b>Title</b>
I-1	Location of Underground HWDUs and Anticipated Closure Locations
I-2	WIPP Panel Closure Schedule
I-3	WIPP Facility Final Closure Schedule
I-4	Design of a Panel Closure System
I-5	Typical Disposal Panel
I-6	Approximate Locations of Boreholes in Relation to the WIPP Underground

## ATTACHMENT I

### CLOSURE PLAN

#### 1 Introduction

2 This Permit Attachment contains the Closure Plan that describes the activities necessary to  
3 close the Waste Isolation Pilot Plant (**WIPP**) individual units and facility. Since the current plans  
4 for operations extend over several decades, the Permittees will periodically reapply for an  
5 operating permit in accordance with Title 20 of the New Mexico Administrative Code, Chapter 4,  
6 Part 1 (**20.4.1 NMAC**), Subpart 900 (incorporating 40 CFR §270.10(h)). Consequently, this  
7 Closure Plan describes several types of closures. The first type is panel closure, which involves  
8 placing constructing closures in each of the ~~occurs as~~ underground hazardous waste disposal  
9 units (**HWDUs**) ~~when after they are filled~~. The second type is partial closure, which can be less  
10 than the entire facility and therefore less than an entire unit as described herein for the Waste  
11 Handling Building (**WHB**) Unit and the Parking Area Unit (**PAU**). The third type of closure is final  
12 facility ~~Final~~ closure at the end of the Disposal Phase, which will entail “clean” closure of the ~~two~~  
13 ~~all remaining surface~~ storage units ~~on the surface~~ and construction of the four shaft seal  
14 systems. Finally, in the event a new permit is not issued prior to expiration of an existing permit,  
15 a modification to this Closure Plan will be sought to perform contingency closure. Contingency  
16 closure defers the final closure of waste management facilities such as the Waste Handling  
17 Building Container Storage Unit (**WHB Unit**), the conveyances, the shafts, and the haulage  
18 ways because these will be needed to continue operations with non-mixed Transuranic (**TRU**)  
19 waste.

20 The hazardous waste management units (**HWMUs**) addressed in this Closure Plan include the  
21 aboveground HWMU in the WHB, the parking area HWMU, and Panels 1 through ~~8~~ 7, each  
22 consisting of seven rooms. ~~In addition, the disposal area access drifts shown as E-300, E-140,~~  
23 ~~W-30, and W-170 between S-1600 and S-3650 on Figure I-1 may, at some time in the future, be~~  
24 ~~needed for waste disposal. These access drifts, if used for disposal, are also subject to this~~  
25 ~~Closure Plan.~~

26 This plan was submitted to the New Mexico Environment Department (**NMED**) and the U.S.  
27 Environmental Protection Agency (**EPA**) in accordance with 20.4.1.900 NMAC (incorporating 40  
28 CFR §270.14(b)(13)). Closure at the panel level will include the construction of barriers to limit  
29 the emission of hazardous waste constituents from the panel into the mine ventilation air stream  
30 below levels that meet environmental performance standards<sup>1</sup> and to mitigate the impacts of

---

<sup>1</sup> The mechanism for air emissions prior to closure is different than the mechanism after closure. Prior to closure, volatile organic compounds (VOC) will diffuse through drum filters based on the concentration gradient between the disposal room and the drum headspace. These VOCs are swept away by the ventilation system, thereby maintaining a concentration gradient that is assumed to be constant. Hence, the VOCs in the ventilation stream are a function of the number of containers only. After closure, the panel air will reach an equilibrium concentration with the drum headspace and no more diffusion will occur. The only mechanism for release into the mine ventilation system is due to pressure that builds up in the closed panel. This pressure arises from the creep closure mechanism that is reducing the volume of the rooms and from the postulated generation of gas as the result of microbial degradation of organic matter in the waste. Consequently, the emissions after panel closure are a direct function of pressurization processes and rates within the panel.

1 methane buildup and deflagration that may be postulated for some closed panels. The Post-  
2 Closure Plan (Permit Attachment J) includes the implementation of institutional controls to limit  
3 access and groundwater monitoring to assess disposal system performance. Until final closure  
4 is complete and has been certified in accordance with 20.4.1.500 NMAC (incorporating 40 CFR  
5 §264.115), a copy of the approved Closure Plan and all approved revisions will be on file at the  
6 WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI  
7 Administrator upon request.

#### 8 I-1 Closure Plan

9 This Closure Plan is prepared in accordance with the requirements of 20.4.1.500 NMAC  
10 (incorporating 40 CFR §264 Subparts G, I, and X), Closure and Post-Closure, Use and  
11 Management of Containers, and Miscellaneous Units. The WIPP underground HWDUs,  
12 including Panels 1 through ~~7-8 and the disposal area access drifts, designated as Panels 9 and~~  
13 ~~10~~ on Figure I-1, will be closed **under this permit** to meet the performance standards in  
14 20.4.1.500 NMAC (incorporating 40 CFR §264.601). The WIPP surface facilities, including  
15 Waste Handling Building Container Storage Unit and the Parking Area Container Storage Unit,  
16 will be closed in accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.178). **The**  
17 **Permittees may perform partial closure of the WHB and PAU HWMUs prior to final facility**  
18 **closure and certification.** For final facility closure, this plan also includes **closure of future waste**  
19 **disposal areas including Panels 8 through 10 and** closure and sealing of the facility shafts in  
20 accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.601).

21 Following completion of waste emplacement in each underground HWDU, the HWDU will be  
22 closed. The Permittees will notify the NMED of the closure of each underground HWDU as  
23 specified in the schedule in Figure I-2. For the purpose of this Closure Plan, panel closure is  
24 defined as the process of rendering underground HWDUs in the repository inactive and closed  
25 according to the facility Closure Plan. The Post-Closure Plan (Permit Attachment J) addresses  
26 requirements for future monitoring that are deemed necessary for the post-closure period,  
27 including monitoring closed panels prior to final facility closure.

28 For the purposes of this Closure Plan, final facility closure is defined as closure that will occur  
29 when all waste disposal areas are filled or when the WIPP achieves its capacity of 6.2 million  
30 cubic feet (ft<sup>3</sup>) (175,600 cubic meters (m<sup>3</sup>)) of TRU waste. At final facility closure, the surface  
31 container storage areas will be closed, and equipment that can be decontaminated and used at  
32 other facilities will be cleaned and sent off site. Equipment that cannot be decontaminated plus  
33 any derived waste resulting from decontamination will be placed in the last open underground  
34 HWDU. Stockpiled salt may be placed in the underground; it may be used as the core material  
35 for the berm component of the permanent marker system; or it must be otherwise disposed of in  
36 accordance with Sections 2 and 3 of the Minerals Act of 1947 (30 U.S.C. §§602 and 603). In  
37 addition, shafts and boreholes which lie within the WIPP Site Boundary and penetrate the  
38 Salado will be plugged and sealed, and surface and subsurface facilities and equipment will be  
39 decontaminated and removed. Final facility closure will be completed to demonstrate  
40 compliance with the Closure Performance Standards contained in 20.4.1.500 NMAC  
41 (incorporating 40 CFR §264.111, 178, and 601).

1 In the event the Permittees fail to obtain an extension of the hazardous waste permit in  
2 accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.51) or fail to obtain a new  
3 permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.10(h)), the Permittees  
4 will seek a modification to this Closure Plan in accordance with 20.4.1.900 NMAC (incorporating  
5 40 CFR §270.42) to accommodate a contingency closure. Under contingency closure, storage  
6 units will undergo clean closure in accordance with 20.4.1.500 NMAC (incorporating 40 CFR  
7 §264.178); waste handling equipment, shafts, and haulage ways will be inspected for  
8 hazardous waste residues (using, among other techniques, radiological surveys to indicate  
9 potential hazardous waste releases as described in Permit Attachment I3) and decontaminated  
10 as necessary; and underground HWDUs that contain radioactive mixed waste will be closed in  
11 accordance with the panel closure design described in this Closure Plan. Final facility closure,  
12 however, will be redefined and a request for a time extension for final closure will be requested.  
13 A copy of this Closure Plan will be maintained by the Permittees at the WIPP facility and at the  
14 Department of Energy (DOE) Carlsbad Field Office. The primary contact person at the WIPP  
15 facility is:

16 Manager, Carlsbad Field Office  
17 U.S. Department of Energy  
18 Waste Isolation Pilot Plant  
19 P. O. Box 3090  
20 Carlsbad, New Mexico 88221-3090  
21 (505) 234-7300

## 22 I-1a Closure Performance Standard

23 The closure performance standard specified in 20.4.1.500 NMAC (incorporating 40 CFR  
24 §264.111), states that the closure shall be performed in a manner that minimizes the need for  
25 further maintenance; that minimizes, controls, or eliminates the escape of hazardous waste; and  
26 that conforms to the closure requirements of §264.178 and §264.601. These standards are  
27 discussed in the following paragraphs.

### 28 I-1a(1) Container Storage Units

29 ~~Closure~~ **Final or partial closure** of the permitted container storage units (the Waste Handling  
30 Building Unit and Parking Area Unit) will be accomplished by removing all waste and waste  
31 residues. Indication of waste contamination will be based, among other techniques, on the use  
32 of radiological surveys as described in Permit Attachment I3. Radiological surveys use very  
33 sensitive radiation detection equipment to indicate if there has been a potential release of TRU  
34 mixed waste, including hazardous waste components, from a container. This allows the  
35 Permittees to indicate potential releases that are not detectable from visible evidence such as  
36 stains or discoloration. Visual inspection and operating records will also be used to identify  
37 areas where decontamination is necessary. Contaminated surfaces will be decontaminated until  
38 radioactivity is below free release limits<sup>2</sup>. Once surfaces are determined to be free of radioactive  
39 waste constituents, they will be tested for hazardous waste contamination. These surface  
40 decontamination activities will ensure the removal of waste residues to levels protective of

---

<sup>2</sup> The free release criteria for items, equipment, and areas is < 20 dpm/100 cm<sup>2</sup> for alpha radioactivity and < 200 dpm/100 cm<sup>2</sup> for beta-gamma radioactivity.

1 human health and the environment. The facility is expected to require no decontamination at  
2 closure because any waste spilled or released during operations will be contained and removed  
3 immediately. Solid waste management units associated described in Permit Module VII will be  
4 subject to closure. In the event portions of these units which require decontamination cannot be  
5 decontaminated, these portions will be removed and the resultant wastes will be managed as  
6 appropriately.

7 Once the container storage units are decontaminated and certified by the Permittees to be  
8 clean, no further maintenance is required. The facilities and equipment in these units will be  
9 reused for other purposes as needed.

#### 10 I-1a(2) Miscellaneous Unit

11 Post-closure migration of hazardous waste or hazardous waste constituents to ground or  
12 surface waters or to the atmosphere, above levels that will harm human health or the  
13 environment, will not occur due to facility engineering and the geological isolation of the unit.  
14 The engineering aspects of closure are centered on the use of panel closures on each of the  
15 underground HWDUs and final facility seals placed in the shafts. The design of the panel  
16 closure system is based on the criteria that the closure system for closed underground HWDUs  
17 will prevent migration of hazardous waste constituents in the air pathway in concentrations  
18 above health-based levels beyond the WIPP land withdrawal boundary during the thirty-five (35)  
19 year operational and facility closure period and to withstand any flammable gas deflagration that  
20 may occur prior to final facility closure.

21 Consistent with the definitions in 20.4.1.101 NMAC (incorporating 40 CFR §260.10), the  
22 process of panel closure is considered partial closure because it is a process of rendering a part  
23 of the repository inactive and closed according to the approved underground HWDU partial  
24 closure plan. Panel closure will be complete when the panel closure system is emplaced and  
25 operational, when that underground HWDU and related equipment and structures have been  
26 decontaminated (if necessary), and when the NMED has been notified of the closure.

27 Shaft seals are designed to provide effective barriers to the inward migration of ground water  
28 and the outward migration of gas and contaminated brine over two discrete time periods.  
29 Several components become effective immediately and are expected to function for one  
30 hundred (100) years. Other components become effective more slowly, but provide permanent  
31 isolation of the waste. The final shaft seal design is specified in Permit Attachment I2.

32 The facility will be finally closed (i.e., decontaminated and decommissioned) to minimize the  
33 need for continued maintenance. Protection of human health and the environment includes, but  
34 is not limited to:

- 35 ● Prevention of any releases that may have adverse effects on human health or  
36 the environment due to the migration of waste constituents in the groundwater or  
37 in the subsurface environment [20.4.1.500 NMAC, incorporating 40 CFR  
38 §264.601(a)].
- 39 ● Prevention of any releases that may have adverse effects on human health or  
40 the environment due to migration of waste constituents in surface water, in



1 wetlands, or on the soil surface [20.4.1.500 NMAC, incorporating 40 CFR  
2 §264.601(b)].

- 3 ● Prevention of any release that may have adverse effects on human health or the  
4 environment due to migration of waste constituents in the air [20.4.1.500 NMAC,  
5 incorporating 40 CFR §264.601(c)].

6 As part of final facility closure, surface recontouring and reclamation will establish a stable  
7 vegetative cover, and further surface maintenance will not be necessary to protect human  
8 health and the environment. Prior to cessation of active controls, monuments will be emplaced  
9 to serve as long-term site markers to discourage activities that would penetrate the facility or  
10 impair the ability of the salt formation to isolate the waste from the surface environment for at  
11 least 10,000 years. The Federal government will maintain administrative responsibility for the  
12 repository site in perpetuity and will limit future use of the area.

13 If, during panel or final facility closure activities, unexpected events require modification of this  
14 Closure Plan to demonstrate compliance with closure performance standards, a Closure Plan  
15 amendment will be submitted in accordance with 20.4.1.900 NMAC (incorporating 40 CFR  
16 §270.42).

#### 17 I-1a(3) Post-Closure Care

18 The post-closure care period will begin after completion of the first panel closure and will  
19 continue for thirty (30) years after final facility closure. The post-closure care period may be  
20 shortened or lengthened at the discretion of the regulatory agency based on evidence that  
21 human health and the environment are being protected or that they are at risk. During the post-  
22 closure period, the WIPP shall be maintained in a manner that complies with the environmental  
23 performance standards in 20.4.1.500 NMAC (incorporating 40 CFR §264.601). Post-closure  
24 activities are described in Permit Attachment J.

#### 25 I-1b Requirements

26 The Permit specifies a sequential process for the closure of individual HWMUs at the WIPP.  
27 Each underground HWDU will undergo panel closure when waste emplacement in that panel is  
28 complete. Following waste emplacement in each underground HWDU, construction-side  
29 ventilation will be terminated and waste-disposal-side ventilation will be established in the next  
30 underground HWDU to be used, and the underground HWDU containing the waste will be  
31 closed. The Permittees will notify the NMED of the closure of each of the underground HWDUs  
32 as they are sequentially filled on a HWDU-by-HWDU basis. The HWMUs in the WHB and in the  
33 parking area will be closed as part of final facility closure of the WIPP facility.

34 The Permittees will notify the Secretary of the NMED in writing at least sixty (60) days prior to  
35 the date on which closure activities are scheduled to begin.

#### 36 I-1c Maximum Waste Inventory

37 The WIPP will receive no more than 6.2 million ft<sup>3</sup> (175,600 m<sup>3</sup>) of TRU mixed waste, **which may**  
38 **include up to 250,000 ft<sup>3</sup> (7,080 m<sup>3</sup>) of remote-handled (RH) TRU mixed waste.** Excavations are

1 mined as permitted when needed during operations to maintain a reserve of disposal areas. The  
2 amount of waste placed in each room is limited by structural and physical considerations of  
3 equipment and design. Waste volumes include waste received from off-site generator locations  
4 as well as derived waste from disposal and decontamination operations. ~~Maximum waste~~  
5 ~~volumes in the disposal panels are calculated as follows: for 100 percent 55-gallon drums--~~  
6 ~~11,502 7-packs consisting of 80,514 drums and 591,800 ft<sup>3</sup> (16,760 m<sup>3</sup>) of waste; for 100~~  
7 ~~percent standard waste boxes (SWB)--11,580 SWBs and 767,750 ft<sup>3</sup> (21,740 m<sup>3</sup>) of waste.~~  
8 ~~Since the waste can arrive in any combination of 7-packs and SWBs, a fixed volume is not set~~  
9 ~~for each panel. Furthermore, the placement of backfill materials to modify chemical nature of~~  
10 ~~brines over the long-term will likely result in fewer containers per panel as described in Permit~~  
11 ~~Attachment M2: The maximum volume of TRU mixed waste in a disposal panel is established in~~  
12 ~~Module IV, Table IV.A.1 For closure planning purposes, a maximum achievable volume of~~  
13 ~~685,100 ft<sup>3</sup> (19,400 m<sup>3</sup>) of TRU mixed waste per panel is used. This equates to 662,400~~  
14 ~~662,150 ft<sup>3</sup> (18,750 m<sup>3</sup>) of contact-handled (CH) TRU mixed waste and 22,950 ft<sup>3</sup> (650 m<sup>3</sup>) of~~  
15 ~~RH TRU mixed waste per panel. 81,000 containers were assumed in design calculations since,~~  
16 ~~for air dispersion modeling, it is important to maximize the number of container vents through~~  
17 ~~which volatile organic compounds (VOC) may be released. In reality, using the 40 percent-60~~  
18 ~~percent mix, there would be only 51,000 containers in a panel, containing 56,000 vents (2 vents~~  
19 ~~per SWB).~~

20 The maximum extent of operations during the term of this permit is expected to be Panels 1  
21 through 7+0 as shown on Figure I-1, the WHB Container Storage Unit, and the Parking Area  
22 Container Storage Unit. Note that panels 8, 9, and 10 are scheduled for excavation only under  
23 the initial term of this permit. If other waste management units are permitted during the Disposal  
24 Phase, this Closure Plan will be revised to include the additional waste management units. At  
25 any given time during disposal operations, it is possible that ~~two~~ multiple rooms may be  
26 receiving TRU mixed waste for disposal at the same time. Underground HWDUs in which  
27 disposal has been completed (i.e., in which CH and RH TRU mixed waste emplacement  
28 activities have ceased) will undergo panel closure.

#### 29 I-1d Schedule for Closure

30 For the purpose of establishing a schedule for closure, an operating and closure period of no  
31 more than thirty-five (35) years (twenty-five (25) years for disposal operations and ten (10) years  
32 for closure) is assumed. This operating period may be extended or shortened depending on a  
33 number of factors, including the rate of waste approved for shipment to the WIPP facility and the  
34 schedules of TRU mixed waste generator sites, and future decommissioning activities.

#### 35 I-1d(1) Schedule for Panel Closure

36 The anticipated schedule for the closure of the underground HWDUs known as Panels 3  
37 through 8 is shown in Figure I-2. This schedule assumes there will be little contamination within  
38 the exhaust drift of the panel. Underground HWDUs should be ready for closure according to  
39 the schedule in Table I-1. These dates are estimates for planning and permitting purposes.  
40 Actual dates may vary depending on the availability of waste from the generator sites.

41 In the schedule in Figure I-2, notification of intent to close occurs thirty (30) days before placing  
42 the final waste in a panel. Once a panel is full, the Permittees will initially block ventilation

1 through the panel as described in Permit Attachment M2 and then will assess the closure area  
2 for ground conditions and contamination so that a definitive schedule and closure design can be  
3 determined. If as the result of this assessment the Permittees determine that a panel closure  
4 cannot be emplaced in accordance with the schedule in this Closure Plan, a modification will be  
5 submitted requesting an extension to the time for closure.

6 The Permittees will initially block ventilation through Panel 2 as described in Permit Attachment  
7 M2 once Panel 2 is full to ensure continued protection of human health and the environment.  
8 The Permittees will then install the explosion isolation wall portion of the panel closure system  
9 that is described in Permit Attachment I1, Section 3.3.2, Explosion-and Construction-Isolation  
10 Walls. Construction of the explosion isolation wall will not exceed 180 days after the last receipt  
11 of waste in Panel 2. Final closure of Panels 1 and 2 will be completed as specified in this Permit  
12 no later than five years after completion of their respective explosion isolation wall.

### 13 I-1d(2) Schedule for Final Facility Closure

14 The Disposal Phase for the WIPP facility is expected to require a period of twenty-five  
15 (25) years beginning with the first receipt of TRU waste at the WIPP facility and followed by a  
16 period ranging from seven to ten (7-10) years for decontamination, decommissioning, and final  
17 closure. Assuming the first waste receipt occurs in July 1998, the Disposal Phase may extend  
18 until 2023, and so the latest expected year of final closure of the WIPP facility (i.e., date of final  
19 closure certification) would be 2033. If, as is currently projected, the WIPP facility is dismantled  
20 at closure, all surface and subsurface facilities (except the hot cell portion of the WHB, which  
21 will remain as an artifact of the Permanent Marker System [**PMS**]) will be disassembled and  
22 either salvaged or disposed in accordance with applicable standards. In addition, asphalt and  
23 crushed caliche that was used for paving will be removed, and the area will be recontoured and  
24 revegetated in accordance with a land management plan. A detailed closure schedule will be  
25 submitted in writing to the Secretary of the NMED, along with the notification of closure.  
26 Throughout the closure period, all necessary steps will be taken to prevent threats to human  
27 health and the environment in compliance with all applicable Resource Conservation and  
28 Recovery Act (**RCRA**) permit requirements. Figure I-3 presents the best estimate of a final  
29 facility closure schedule.

30 The schedule for final facility closure is considered to be a best estimate because closure of the  
31 facility is driven by policies and practices established for the decontamination, if necessary, and  
32 decommissioning of radioactively contaminated facilities. These required activities include  
33 extensive radiological contamination surveys and hazardous constituent surveys using, among  
34 other techniques, radiological surveys to indicate potential hazardous waste releases. Both  
35 types of surveys will be performed at all areas of the WIPP site where hazardous waste were  
36 managed. These surveys, along with historical radiological survey records, will provide the basis  
37 for release of structures, equipment, and components for disposal or decontamination for  
38 release off site. Specifications will be developed for each structure to be removed. A cost  
39 benefit analysis will be needed to evaluate decontamination options if extensive  
40 decontamination is necessary. Individual equipment surveys, structure surveys, and debris  
41 surveys will be required prior to disposition. Size-reduction techniques may be required to  
42 dispose of mixed or radioactive waste at the WIPP site. Current DOE policy, as reflected in the  
43 WIPP facility Safety Analysis Report (**SAR**) (DOE 1997), requires the preparation of a final  
44 decommissioning and decontamination (**D&D**) plan immediately prior to final facility closure. In

1 this way, the specific conditions of the facility at the time D&D is initiated will be addressed.  
2 Section I-1e(2) provides a more detailed discussion of final facility closure activities.

3 Figure I-3 shows the schedule for the final facility closure consisting of decontamination, as  
4 needed, of the TRU waste-handling equipment, and of the aboveground equipment and  
5 facilities, including closure of surface HWMUs; decontamination of the shaft and haulage ways;  
6 disposal of decontamination derived wastes in the last open underground HWDU; and  
7 subsequent closure of this underground HWDU. Subsequent activities will include installation of  
8 repository shaft seals.

9 An overall schedule for final facility closure, showing currently scheduled dates for the start and  
10 end of final facility closure activities is shown in Table I-2. The dates assume a start up date of  
11 March 1999 and hazardous waste permit effective dates of September 1999, September 2009,  
12 and September 2019. Details for panel closures are shown on Table I-1.

### 13 I-1d(3) Extension for Closure Time

14 As indicated by the closure schedule presented in Figure I-3, the activities necessary to perform  
15 facility closure of the WIPP facility will require more than one hundred eighty (180) days to  
16 complete because of additional stringent requirements for managing radioactive materials.  
17 Therefore, the Permit provides an extension of the 180-day final closure requirement in  
18 accordance with 20.4.1.500 NMAC (incorporating 40 CFR §264.113). During the extended  
19 closure period, the Permittees will continue to demonstrate compliance with applicable permit  
20 requirements and will take all steps necessary to prevent threats to human health and the  
21 environment as a result of TRU mixed waste management at the WIPP facility including all of  
22 the applicable measures in Permit Attachment E (Preparedness and Prevention).

23 In addition, according to the schedules in Figure I-3, the final derived wastes that are generated  
24 as the result of decontamination activities will not be disposed of for sixteen (16) months after  
25 the initiation of final facility closure. In accordance with 20.4.1.500 NMAC (incorporating 40 CFR  
26 §264.113(a)), the Permit provides an extension of the 90-day limit to dispose of final derived  
27 waste resulting from the closure process. This provision is necessitated by the fact that the  
28 radioactive nature of the derived waste makes placement in the WIPP the best disposition, and  
29 the removal of these wastes will, by necessity, take longer than ninety (90) days in accordance  
30 with the closure schedules. During this extended period of time, the Permittees will take all  
31 steps necessary to prevent threats to human health and the environment, including compliance  
32 with all applicable permit requirements. These steps include all of the applicable preparedness  
33 and prevention measures in Permit Attachment E.

34 Finally, in the event the hazardous waste permit is not renewed as assumed in the schedule,  
35 the Permittees will submit a modification to the Closure Plan to implement a contingency closure  
36 that will allow the Permittees to continue to operate for the disposal of non-mixed TRU waste.  
37 This modification will include a request for an extension of the time for final facility closure. This  
38 modified Closure Plan will be submitted to the NMED for approval.

1 I-1d(4) Amendment of the Closure Plan

2 If it becomes necessary to amend the Closure Plan for the WIPP facility, the Permittees will  
3 submit, in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.42), a written  
4 notification of or request for a permit modification describing any change in operation or facility  
5 design that affects the Closure Plan. The written notification or request will include a copy of the  
6 amended Closure Plan for approval by the NMED. The Permittees will submit a written  
7 notification of or request for a permit modification to authorize a change in the approved plan, if:

- 8 ● There are changes in operating plans or in the waste management unit facility  
9 design that affect the Closure Plan
- 10 ● There is a change in the expected year of closure
- 11 ● Unexpected events occur during panel or final facility closure that require  
12 modification of the approved Closure Plan
- 13 ● Changes in State or Federal laws affect the Closure Plan
- 14 ● Permittees fail to obtain permits for continued operations as discussed above

15 The Permittees will submit a written request for a permit modification with a copy of the  
16 amended Closure Plan at least sixty (60) days prior to the proposed change in facility design or  
17 operation or within sixty (60) days of the occurrence of an unexpected event that affects the  
18 Closure Plan. If the unexpected event occurs during final closure, the permit modification will be  
19 requested within thirty (30) days of the occurrence. If the Secretary of the NMED requests a  
20 modification of the Closure Plan, a plan modified in accordance with the request will be  
21 submitted within sixty (60) days of notification or within thirty (30) days, if the change in facility  
22 condition occurs during final closure.

23 I-1e Closure Activities

24 Closure activities include those instituted for panel closure (i.e., closure of filled underground  
25 HWDUs), contingency closure (i.e., closure of surface HWMUs and decontamination of other  
26 waste handling areas), and final facility closure (i.e., closure of surface HWMUs, D&D of surface  
27 facilities and the areas surrounding the WHB, and placement of repository shaft seals). Panel  
28 closure systems will be emplaced to separate areas of the facility and to isolate panels. Permit  
29 Attachments I1 and I2 provide panel closure system and shaft seal designs. All closure activities  
30 will meet the applicable quality assurance (QA)/quality control (QC) program standards in place  
31 at the WIPP facility. Facility monitoring procedures in place during operations will remain in  
32 place through final closure, as applicable.

33 I-1e(1) Panel Closure

34 Following completion of waste emplacement in each underground HWDU, disposal-side  
35 ventilation will be established in the next panel to be used, and the panel containing the waste  
36 will be closed. A panel closure system will be emplaced in the panel access drifts, in  
37 accordance with the design in Permit Attachment I1 and the schedule in Figure I-2 and Table I-

1 1. The panel closure system is designed to meet the following requirements that were  
2 established by the DOE for the design to comply with 20.4.1.500 NMAC (incorporating 40 CFR  
3 §264.601(a)):

- 4 C the panel closure system shall limit the migration of VOCs to the compliance  
5 point so that compliance is achieved by at least one order of magnitude
- 6 C the panel closure system shall consider potential flow of VOCs through the  
7 disturbed rock zone (**DRZ**) in addition to flow through closure components
- 8 C the panel closure system shall perform its intended functions under loads  
9 generated by creep closure of the tunnels
- 10 C the panel closure system shall perform its intended function under the conditions  
11 of a postulated methane explosion
- 12 C the nominal operational life of the closure system is thirty-five (35) years
- 13 C the panel closure system for each individual panel shall not require routine  
14 maintenance during its operational life
- 15 C the panel closure system shall address the most severe ground conditions  
16 expected in the waste disposal area
- 17 C the design class of the panel closure system shall be IIIb (which means that it is  
18 to be built to generally accepted national design and construction standards)
- 19 C the design and construction shall follow conventional mining practices
- 20 C structural analysis shall use data acquired from the WIPP underground
- 21 C materials shall be compatible with their emplacement environment and function
- 22 C treatment of surfaces in the closure areas shall be considered in the design
- 23 C thermal cracking of concrete shall be addressed
- 24 C during construction, a QA/QC program shall be established to verify material  
25 properties and construction practices
- 26 C construction of the panel closure system shall consider shaft and underground  
27 access and services for materials handling

28 The performance standard for air emissions from the WIPP facility is established in Module IV  
29 and Permit Attachment M2. Releases shall be below these limits for the facility to remain in  
30 compliance with standards to protect human health and the environment. The following panel  
31 closure design has been shown, through analysis, to meet these standards, if emplaced in  
32 accordance with the specifications in Permit Attachment I1.

1 The approved design for the panel closure system calls for a composite panel barrier system  
2 consisting of a rigid concrete plug with removal of the DRZ, and an explosion-isolation wall. The  
3 design basis for this closure is such that the migration of hazardous waste constituents from  
4 closed panels during the operational and closure period would result in concentrations well  
5 below health-based standards. The source term used as the design basis included the average  
6 concentrations of VOCs from CH waste containers as measured in headspace gases through  
7 January 1995. The VOCs are assumed to have been released by diffusion through the  
8 container vents and are assumed to be in equilibrium with the air in the panel. Emissions from  
9 the closed panel occur at a rate determined by gas generation within the waste and creep  
10 closure of the panel.

11 Figures I-4 and I-5 show a diagram of the panel closure design and installation envelopes.  
12 Permit Attachment I1 provides the detailed design and the design analysis for the panel closure  
13 system. Although the permit application proposed several panel closure design options,  
14 depending on the gas generated by wastes and the age of the mined openings, the NMED and  
15 EPA determined that only the most robust design option (D) would be approved. This decision  
16 does not prevent the Permittees from continuing to collect data on the behavior of the wastes  
17 and mined openings, or proposing a modification to the Closure Plan in the future, using the  
18 available data to support a request for reconsideration of one or more of the original design  
19 options. If a design different from Option D as defined in Permit Attachment I1 is proposed, the  
20 appropriate permit modification will be sought.

#### 21 I-1e(2) Decontamination and Decommissioning

22 Decontamination is defined as those activities which are performed to remove contamination  
23 from surfaces and equipment that are not intended to be disposed of at the WIPP facility. The  
24 policy at the WIPP will be to decontaminate as many areas as possible, consistent with  
25 radiation protection policy. Decontamination is part of all closure activities and is a necessary  
26 activity in the clean closure of the surface container management units. Decontamination  
27 determinations are based upon radiological and hazardous constituent surveys.

28 Decommissioning is the process of removing equipment, facilities, or surface areas from further  
29 use and closing the facility. Decommissioning is part of final facility closure only and will involve  
30 the removal of equipment, buildings, closure of the shafts, and establishing active and passive  
31 institutional controls for the facility. Passive institutional controls are not included in the Permit.

32 The objective of D&D activities at the WIPP facility is to return the surface to as close to the  
33 preconstruction condition as reasonably possible, while protecting the health and safety of the  
34 public and the environment. Major activities required to accomplish this objective include, but  
35 are not limited to the following:

- 36 1. Review of operational records for historical information on releases
- 37 2. Visual examination of surface structures for evidence of spills or releases
- 38 3. Performance of site contamination surveys

- 1           4.     Decontamination, if necessary, of usable equipment, materials, and structures  
2           including surface facilities and areas surrounding the WHB.
- 3           5.     Disposal of equipment/materials that cannot be decontaminated but that meet  
4           the treatment, storage, and disposal facility waste acceptance criteria (**TSDF-**  
5           **WAC**) in an underground HWDU
- 6           6.     Emplacement of final panel closure system
- 7           7.     Emplacement of shaft seals<sup>3</sup>
- 8           8.     Regrading the surface to approximately original contours
- 9           9.     Initiation of active controls

10          This Closure Plan will be amended prior to the initiation of closure activities to specify the  
11          methods to be used.

## 12          Health and Safety

13          Before final closure activities begin, health physics personnel will conduct a hazards survey of  
14          the unit(s) being closed. A release of radionuclides could also indicate a release of hazardous  
15          constituents. If radionuclides are not detected, sampling for hazardous constituents will still be  
16          performed if there is documentation or visible evidence that a spill or release has occurred. The  
17          purpose of the hazards survey will be to identify potential contamination concerns that may  
18          present hazards to workers during the closure activities and to specify any control measures  
19          necessary to reduce worker risk. This survey will provide the information necessary for the  
20          health physics personnel to identify worker qualifications, personal protective equipment (**PPE**),  
21          safety awareness, work permits, exposure control programs, and emergency coordination that  
22          will be required to perform closure related activities.

### 23          I-1e(2)(a) Determine the Extent of Contamination

24          The first activities performed as part of decontamination include those needed to determine the  
25          extent of any contamination that needs to be removed prior to decommissioning a facility. This  
26          includes activities 1 to 3 above and, as can be seen by the schedules in Figures I-3 and I-4  
27          (Items B and C), these surveys are anticipated to take ten (10) months to perform, including  
28          obtaining the results of any sample analyses. The process of identifying areas that require  
29          decontamination include three sources of information. First, operating records will be reviewed  
30          to determine where contamination has previously been found as the result of historical releases  
31          and spills. Even though releases and spills will have been cleaned up at the time of occurrence,  
32          newer equipment and technology may allow further cleaning. Second, surfaces of facilities and  
33          structures will be examined visually for evidence of spills or releases. Finally, extensive detailed  
34          contamination surveys will be performed to document the level of cleanliness for all surface  
35          structures and equipment. If equipment or areas are identified as contaminated, the Permittees

---

<sup>3</sup> For the purposes of planning, the conclusion of shaft sealing is used by the DOE as the end of closure activities and the beginning of the Post-Closure Care Period.



1 will notify NMED as specified in Permit Module I, and a plan and procedure(s) will be developed  
2 and implemented to address decontamination-related questions, including:

- 3 ● Should the component be decontaminated or disposed of as waste?
- 4 ● What is the most cost-effective method of decontaminating the component?
- 5 ● Will the decontamination procedures adequately contain the contamination?

6 Radiological and hazardous constituent surveys will be used in determining the presence of  
7 hazardous waste and hazardous waste residues in areas where spills or releases have  
8 occurred. Radiological surveys are described in Permit Attachment I3. Once cleanup of the  
9 radioactivity has been completed, the surface will be sampled for hazardous constituents  
10 specified in Permit Attachment O to determine that they, too, have been cleaned up. Sampling  
11 and analysis protocols will be consistent with EPA's document SW-846 (EPA, 1996).

12 I-1e(2)(b) Decontamination Activities

13 Once the extent of contamination is known, decontamination activities will be planned and  
14 performed. Radiological control and the control of hazardous waste residues are the primary  
15 criteria used in the design of decontamination activities. Radiation control procedures require  
16 that careful planning and execution be used in decontamination activities to prevent the  
17 exposure of workers beyond applicable standards and to prevent the further spread of  
18 contamination. Careful control of entry, cleanup, and ventilation are vital components of  
19 radiation decontamination. The level of care mandated by DOE orders and occupational  
20 protection requirements results in closure activities that will exceed the one hundred eighty  
21 (180) days allowed in 20.4.1.500 NMAC (incorporating 40 CFR §264.113(b)). Decontamination  
22 activities are included as item 4 above and are shown on the schedules for contingency closure  
23 and final facility closure (Figures I-3 and I-4) as activities D, E, and F. These activities are  
24 anticipated to have a duration of twenty (20) months for both contingency closure and for final  
25 facility closure. The result of these activities is the clean closure of the surface container  
26 management units. Under contingency closure, the other areas that have been decontaminated  
27 will not be closed. Instead they will remain in use for continued waste management activities  
28 involving non-mixed waste. Under final facility closure, other areas that are decontaminated are  
29 eligible for closure.

30 The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will provide for  
31 minimum need for decontamination. However, the need for decontamination techniques may  
32 arise.

33 Decontamination activities will be coordinated with closure activities so that areas that have  
34 been decontaminated will not be recontaminated. All waste resulting from decontamination  
35 activities will be surveyed and analyzed for the presence of radioactive contamination and  
36 hazardous constituents specified in Permit Attachment O. The waste will be characterized as  
37 hazardous, mixed, or radioactive and will be packaged and handled appropriately. Mixed and  
38 radioactive waste will be classified as TRU mixed waste managed in accordance with the  
39 applicable Permit requirements. Derived mixed waste collected during decontamination  
40 activities that are generated before repository shafts have been sealed will be emplaced in the

1 facility, if appropriate, or will be managed together with decontamination derived waste collected  
2 after the underground is closed. This waste will be classified and shipped off site to an  
3 appropriate, permitted facility for treatment, if necessary, and for disposal.

#### 4 Removal of Hazardous Waste Residues

5 Because of the type of waste management activities that will occur at the WIPP facility, waste  
6 residues that may be encountered during the operation of the facility and at closure may include  
7 derived waste. Derived wastes result from the management of the waste containers or may be  
8 collected as part of the closure activities (such as those during which wipes were used to  
9 sample the containers and equipment for potential radioactive contamination or those involving  
10 solidified decontamination solutions, the handling of equipment designated for disposal, and the  
11 handling of residues collected as a result of spill cleanup). Derived wastes collected during the  
12 operation and closure of the WIPP facility will be identified and managed as TRU mixed wastes.  
13 These wastes will be disposed in the active underground HWDU. D&D derived wastes and  
14 equipment designated for disposal will be placed in the last underground HWDU panel before  
15 closure of that unit.

#### 16 Surface Container Storage Units

17 The procedures employed for waste receipt at the WIPP facility minimize the likelihood for any  
18 waste spillage to occur outside the WHB. TRU mixed waste is shipped to the WIPP facility in  
19 approved shipping containers (i.e., Contact-Handled or Remote-Handled Packages) that are not  
20 opened until they are inside the WHB. Therefore, it is unlikely that soil in the Parking Area Unit  
21 or elsewhere in the vicinity of the WHB will become contaminated with TRU mixed waste  
22 constituents as a result of TRU mixed waste management activities. An evaluation of the soils in  
23 the vicinity of the WHB will only be necessary if a documented event resulting in a release has  
24 occurred outside the WHB.

25 The "Start Clean—Stay Clean" operating philosophy of the WIPP Project will minimize the need  
26 for decontamination of the WHB during decommissioning and closure. Procedures for opening  
27 shipping containers in the WHB limit the opportunity for waste spillage.

28 Should the need for decontamination of the WHB arise, the following methods may be  
29 employed, as appropriate, for the hazardous constituent/contaminant type and extent:

- 30 ● Chemical cleaning (e.g., water, mild detergent cleanser, and polyvinyl alcohol)
- 31 ● Nonchemical cleaning (e.g., sandblasting, grinding, high-pressure water spray,  
32 scabber pistons and needle scalers, ice-blast technology, dry-ice blasting)
- 33 ● Removal of contaminated components such as pipe and ductwork

34 Waste generated as a result of WHB decontamination activities will be managed as derived  
35 waste in accordance with applicable permit requirements and will be emplaced in the last open  
36 underground HWDU for disposal.

1 Waste Handling Equipment and

2 The waste hoist conveyance and associated waste handling equipment will be decontaminated  
3 to background or be disposed as derived waste as part of both contingency and final facility  
4 closure. Procedures for detection and sampling will be as described above. Equipment cleanup  
5 will be as above using chemical or nonchemical techniques.

6 Personnel Decontamination

7 PPE worn by personnel performing closure activities in areas determined to be contaminated  
8 will be disposed of appropriately. Disposable PPE used in such areas will be placed into  
9 containers and managed as TRU mixed waste. Non-disposable PPE will be decontaminated, if  
10 possible. Non-disposable PPE that cannot be decontaminated will be managed as TRU mixed  
11 waste.

12 In accordance with DOE policy, TRU mixed waste PPE will be considered to be contaminated  
13 with all of the hazardous waste constituents contained in the containers that have been  
14 managed within the unit being closed. Wastes collected as a result of closure activities and that  
15 may be contaminated with radioactive and hazardous constituents will be considered TRU  
16 mixed wastes. These wastes will be managed as derived wastes, as described in Permit  
17 Attachment M2. Such waste, collected as the result of closure of the WIPP facility, will be  
18 disposed of in the final open underground HWDU.

19 Cleanup Criteria

20 Radiation decontamination will be less than or equal to the following levels, or to whatever  
21 lesser levels that may be established by DOE Order at the time of cleanup:

22 <u>Contamination Type</u>	<u>Loose<sup>4</sup></u>
	<u>Fixed plus removable</u>
25 alpha contamination (" )	20 dpm/100 cm <sup>2</sup>
26	500 dpm/100 cm <sup>2</sup>
27 beta-gamma contamination (\$ )	200 dpm/100 cm <sup>2</sup>
28	1000 dpm/100 cm <sup>2</sup>

29 Hazardous waste decontamination will be conducted in accordance with standards in  
30 20.4.1.500 NMAC (incorporating 40 CFR §264) or as incorporated into the Permit.

31 Final Contamination Sampling and Quality Assurance

32 Verification samples will be analyzed by an approved laboratory that has been qualified by the  
33 DOE according to a written program with strict criteria. The QA requirements of EPA/SW-846,

---

<sup>4</sup> The unit "dpm" stands for "disintegration per minute" and is the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

1 "Test Methods for Evaluating Solid Waste" (EPA, 1986), will be met for hazardous constituent  
2 sampling and analyses.

3 Quality Assurance/Quality Control

4 Because decisions about closure activities may be based, in part, on analyses of samples of  
5 potentially contaminated surfaces and media, a program to ensure reliability of analytical data is  
6 essential. Data reliability will be ensured by following a QA/QC program that mandates  
7 adequate precision and accuracy of laboratory analyses. Field documentation will be used to  
8 document the conditions under which each sample is collected. The documented QA/QC  
9 program in place at the WIPP facility will meet applicable RCRA QA requirements.

10 Field blanks and duplicate samples will be collected in the field to determine potential errors  
11 introduced in the data from sample collection and handling activities. To determine the potential  
12 for cross-contamination, rinsate blanks (consisting of rinsate from decontaminated sampling  
13 equipment) will be collected and analyzed. At least one rinsate blank will be collected for every  
14 20 field samples. Duplicate samples will be collected at a frequency of one duplicate sample for  
15 every ten field samples. In no case will less than one rinsate blank or duplicate sample be  
16 collected for a field-sampling effort. These blank and duplicate samples will be identified and  
17 treated as separate samples. Acceptance criteria for QA/QC hazardous constituent sample  
18 analyses will adhere to the most recent version of EPA SW-846 or other applicable EPA  
19 guidance.

20 I-1e(2)(c) Dismantling

21 Final facility closure will include dismantling of structures on the surface and in the underground.  
22 These are items 6 and 7 above and are represented as Activity G in the final facility closure  
23 schedule in Figure I-4. During dismantling, priority will be given to contaminated structures and  
24 equipment that cannot be decontaminated to assure these are properly disposed of in the  
25 remaining open underground HWDU in a timely manner. All such facilities and equipment are  
26 expected to be removed and disposed of sixteen (16) months after the initiation of closure.  
27 Dismantling of the balance of the facility, including those structures and equipment that are not  
28 included in the application and are not used for TRU mixed waste management, is anticipated to  
29 take an additional sixty-six (66) months. It should be noted that the placement of D&D waste  
30 into the final underground HWDU may, by necessity, involve the placement of uncontainerized  
31 bulk materials such as concrete components, building framing, structural members,  
32 disassembled or partially disassembled equipment, or containerized materials in non-standard  
33 waste boxes. Such placement will only occur if it can be shown that it is protective of human  
34 health and the environment and all items are described in an amendment to the Closure Plan.  
35 Identification of bulk items is not possible at this time since their size and quantity will depend  
36 on the extent of non-removable contamination.

37 I-1e(2)(d) Closure of Open Underground HWDU

38 The closure of the final underground HWDU is shown by Activity H in Figure I-3. This closure  
39 will be consistent with the description in Section I-1e(1) and the design in Permit Attachment I1.  
40 Detailed closure schedules for underground HWDUs are given in Figure I-2 and Table I-1.

1 I-1e(2)(e) Final Facility Closure

2 Final facility closure includes several activities designed to assure both the short-term isolation  
3 of the waste and the long-term integrity of the disposal system. These include the placement of  
4 plugs in boreholes that penetrate the salt and the placement of the repository sealing system. In  
5 addition, the surface will be returned to as near its original condition as practicable, and will be  
6 readied for the construction of markers and monuments that will provide permanent marking of  
7 the repository location and contents.

8 Figure I-6 identifies where ten existing boreholes overlie the proximate area of the repository  
9 footprint. Of these identified boreholes in Figure I-6, all but ERDA-9 are terminated hundreds of  
10 feet above the repository horizon. Only ERDA-9, which is accounted for in long-term  
11 performance modeling, is drilled through the repository horizon, near the WIPP excavations.

12 To mitigate the potential for migration beyond the repository horizon, the DOE has specified that  
13 borehole seals be designed to limit the volume of water that could be introduced to the  
14 repository from the overlying water-bearing zones and to limit the volume of contaminated brine  
15 released from the repository to the surface or water-bearing zones.

16 Borehole plugging activities have been underway since the 1970s, from the early days of the  
17 development of the WIPP facility. Early in the exploratory phase of the project, a number of  
18 boreholes were sunk in Lea and Eddy counties. After the WIPP site was situated in its current  
19 location, an evaluation of all vertical penetrations was made by Christensen and Peterson  
20 (1981).

21 As an initial criterion, any borehole that connects a fluid-producing zone with the repository  
22 horizon becomes a plugging candidate.

23 Grout plugging procedures are routinely performed in standard oil-field operations; however,  
24 quantitative measurements of plug performance are rarely obtained. The Bell Canyon Test  
25 reported by Christensen and Peterson (1981) was a field test demonstration of the use of  
26 cementitious plugging materials and modification of existing industrial emplacement techniques  
27 to suit repository plugging requirements. Cement emplacement technology was found to be  
28 "generally adequate to satisfy repository plugging requirements." Christensen and Peterson  
29 (1981) also report "that grouts can be effective in sealing boreholes, if proper care is exercised  
30 in matching physical properties of the local rock with grout mixtures. Further, the reduction in  
31 fluid flow provided by even limited length plugs is far in excess of that required by bounding  
32 safety assessments for the WIPP." The governing regulations for plugging and/or abandonment  
33 of boreholes are summarized in Table I-3.

34 The proposed repository sealing system design will prevent water from entering the repository  
35 and will prevent gases or brines from migrating out of the repository. The proposed design  
36 includes the following subsystems and associated principal functions:

- 37 ● Near-surface: to prevent subsidence at and around the shafts

- 1           ●       Rustler Formation: to prevent subsidence at and around the shafts and to ensure  
2                    compliance with Federal and State of New Mexico groundwater protection  
3                    requirements
  
- 4           ●       Salado Formation: to prevent transporting hazardous waste constituents beyond  
5                    the point of compliance specified in Permit Module V

6       The repository sealing system will consist of natural and engineered barriers within the WIPP  
7       repository that will withstand forces expected to be present because of rock creep, hydraulic  
8       pressure, and probable collapses in the repository and will meet the closure requirements of  
9       20.4.1.500 NMAC (incorporating 40 CFR §264.601 and §264.111). Permit Attachment I2  
10       presents the final repository sealing system design.

11       Once shaft sealing is completed, the Permittees will consider closure complete and will provide  
12       the NMED with a certification of such within sixty (60) days.

#### 13       I-1e(2)(f) Final Contouring and Revegetation

14       In the preparation of its Final Environmental Impact Statement (DOE, 1980), the DOE  
15       committed to restore the site to as near to its original condition as is practicable. This involves  
16       removal of access roads, unneeded utilities, fences, and any other structures built by the DOE  
17       to support WIPP operations. Provisions would be left for active post-closure controls of the site  
18       and for the installation of long-term markers and monuments for the purpose of permanently  
19       marking the location of the repository and waste. Permit Attachment J-1a(1) discusses the  
20       active and long-term controls proposed for the WIPP. Installation of borehole seals are  
21       anticipated to take twelve (12) months, shaft seals fifty-two (52) months, and final surface  
22       contouring eight (8) months.

#### 23       I-1e(2)(g) Closure, Monuments, and Records

24       A record of the WIPP Project shall be listed in the public domain in accordance with the  
25       requirements of 20.4.1.500 NMAC (incorporating 40 CFR §264.116). Active access controls will  
26       be employed for at least the first one hundred (100) years after final facility closure. In addition,  
27       a passive control system consisting of monuments or markers will be erected at the site to  
28       inform future generations of the location of the WIPP repository (see "Permanent Marker  
29       Conceptual Design Report" [DOE, 1995b]).

30       This Permit requires only a thirty (30) year post-closure period. This is the maximum post-  
31       closure time frame allowed in an initial Permit for any facility, as specified in 20.4.1.500 NMAC  
32       (incorporating 40 CFR §264.117(a)). The Secretary of the NMED may shorten or extend the  
33       post-closure care period at any time in the future prior to completion of the original post-closure  
34       period (30 years after the completion of construction of the shaft seals). The Permanent Marker  
35       Conceptual Design Report and other provisions during the first 100 years after closure are  
36       addressed under another Federal regulatory program.

37       Closure of the WIPP facility will contribute to the following:

- 38           ●       Prevention of the intrusion of fluids into the repository by sealing the shafts

- 1           ●       Prevention of human intrusion after closure
- 2           ●       Minimization of future physical and environmental surveillance

3 Detailed records shall be filed with local, State, and Federal government agencies to ensure  
4 that the location of the WIPP facility is easily determined and that appropriate notifications and  
5 restrictions are given to anyone who applies to drill in the area. This information, together with  
6 land survey data, will be on record with the U.S. Geological Survey and other agencies. The  
7 Federal government will maintain permanent administrative authority over those aspects of land  
8 management assigned by law. Details of post-closure activities are in Permit Attachment J.

9 I-1e(3) Performance of the Closed Facility

10 20.4.1.500 NMAC (incorporating 40 CFR §264.601) requires that a miscellaneous unit be  
11 closed in a manner that protects human health and the environment. The RCRA Part B permit  
12 application addressed the expected performance of the closed facility during the thirty (30) year  
13 post closure period. Groundwater monitoring will provide information on the performance of the  
14 closed facility during the post-closure care period, as specified in Section J-1a(2) (Monitoring) of  
15 Permit Attachment J.

16 The principal barriers to the movement of hazardous constituents from the facility or the  
17 movement of waters into the facility are the halite of the Salado Formation (natural barrier) and  
18 the repository seals (engineered barrier). Data and calculations that support this discussion  
19 were presented in the permit application. The majority of the calculations performed for the  
20 repository are focused on long-term performance and making predictions of performance over  
21 10,000 years. In the short term, the repository is reaching a steady state configuration where the  
22 hypothetical brine inflow rate is affected by the increasing pressure in the repository due to gas  
23 generation and creep closure. These three phenomena are related in the numerical modeling  
24 performed to support the permit application. The modeling parameters, assumptions and  
25 methodology were described in detail in the permit application.

26 I-2 Notices Required for Disposal Facilities

27 I-2a Certification of Closure

28 Within sixty (60) days after completion of closure activities for a HWMU (i.e., for each storage  
29 unit and each disposal unit), the Permittees will submit to the Secretary of the NMED a  
30 certification that the unit (and, after completion of final closure, the facility) has been closed in  
31 accordance with the specifications of this Closure Plan. The certification will be signed by the  
32 Permittees and by an independent New Mexico registered professional engineer.  
33 Documentation supporting the independent registered engineer's certification will be furnished  
34 to the Secretary of the NMED with the certification.

35 I-2b Survey Plat

36 Within sixty (60) days of completion of closure activities for each underground HWDU, and no  
37 later than the submission of the certification of closure of each underground HWDU, the  
38 Permittees will submit to the Secretary of the NMED a survey plat indicating the location and

1 dimensions of hazardous waste disposal units with respect to permanently surveyed  
2 benchmarks. The plat will be prepared and certified by a professional land surveyor and will  
3 contain a prominently displayed note that states the Permittees' obligation to restrict disturbance  
4 of the hazardous waste disposal unit. In addition, the land records in the Eddy County  
5 Courthouse, Carlsbad, New Mexico, will be updated through filing of the final survey plats.



## References

1

2 Christensen, C. L., and Peterson, E. W. 1981. "Field-Test Programs of Borehole Plugs in  
3 Southeastern New Mexico." In *The Technology of High-Level Nuclear Waste Disposal*  
4 *Advances in the Science and Engineering of the Management of High-Level Nuclear Wastes*, P.  
5 L. Hofman and J. J. Breslin, eds., SAND79-1634C, DOE/TIC-4621, Vol. 1, pp. 354–369.  
6 Technical Information Center of the U.S. Department of Energy, Oak Ridge, TN.

7 DOE, see U.S. Department of Energy

8 EPA, see U.S. Environmental Protection Agency

9 U.S. Department of Energy, 1980, "Final Environmental Impact Statement, Waste Isolation Pilot  
10 Plant," DOE/EIS 0026, U.S. Department of Energy, Washington, D.C.

11 U.S. Department of Energy, 1995b, "Permanent Marker Conceptual Design Report," from  
12 Appendix PMR of the *Draft Compliance Certification Application*, Draft-DOE/CAO-2056, U.S.  
13 Department of Energy, Carlsbad, NM.

14 U.S. Department of Energy, 1997, "WIPP Safety Analysis Report," DOE/WIPP-95-2065,  
15 Revision 1, U.S. Department of Energy, Carlsbad, NM.

16 U.S. Environmental Protection Agency, 1996, "Test Methods for Evaluating Solid Waste," SW-  
17 846, U.S. Environmental Protection Agency, Washington, D.C.

(This page intentionally blank)

1

## **TABLES**

(This page intentionally blank)

**TABLE I-1  
 ANTICIPATED EARLIEST CLOSURE DATES FOR  
 THE UNDERGROUND HWDUs**

<b>HWDU</b>	<b>OPERATIONS START</b>	<b>OPERATIONS END</b>	<b>CLOSURE START</b>	<b>CLOSURE END</b>
<b>PANEL 1</b>	3/99	2/03	3/03	9/03 SEE NOTE 5
<b>PANEL 2</b>	3/03	6/05	7/05	1/06 SEE NOTE 5
<b>PANEL 3</b>	7/05	11/06	12/06	6/07
<b>PANEL 4</b>	11/06	6/08	7/08	1/09
<b>PANEL 5</b>	6/08	11/09	12/09	6/10
<b>PANEL 6</b>	11/09	2/11	3/11	9/11
<b>PANEL 7</b>	2/11	6/12	7/12	1/13
<b>PANEL 8</b>	6/12	1/14	2/14	8/14
<b>PANEL 9</b>	1/14	1/28	2/28	SEE NOTE 4
<b>PANEL 10</b>	1/28	9/30	10/30	SEE NOTE 4

NOTE 1: Only Panels 1 to 5 will be closed under the initial term of this permit. Closure schedules for Panels 6 through 10 are projected assuming new permits will be issued in 2009 and 2019.

NOTE 2: The point of closure start is defined as sixty (60) days following notification to the NMED of closure.

NOTE 3: The point of closure end is defined as one hundred eighty (180) days following placement of final waste in the panel.

NOTE 4: The time to close these areas may be extended depending on the nature and extent of the disturbed rock zone. The excavations that constitute these panels will have been opened for as many as forty (40) years so that the preparation for closure may take longer than the time allotted in Figure I-2. If this extension is needed, it will be requested as an amendment to the Closure Plan.

NOTE 5: The anticipated closure end date for Panels 1 and 2 is for installation of the 12-foot explosion isolation wall. Final closure of Panels 1 and 2 will be completed as specified in this Permit no later than five years after completion of their respective explosion isolation wall.

**TABLE I-2  
 ANTICIPATED OVERALL SCHEDULE FOR CLOSURE ACTIVITIES**

ACTIVITY	FINAL FACILITY CLOSURE	
	START	STOP
Notify NMED of Intent to Close WIPP (or to Implement Contingency Closure)	October 2030	N/A
Perform Contamination Surveys in both Surface Storage Areas	October 2030	April 2031
Sample Analysis	December 2030	July 2031
Decontamination as Necessary of both Surface Storage Areas	June 2031	January 2032
Final Contamination Surveys of both Surface Storage Areas	February 2032	September 2032
Sample Analysis	June 2032	January 2033
Prepare and Submit Container Management Unit Closure Certification	February 2033	May 2033
Dispose of Closure-Derived Waste	November 2030	January 2032
Closure of Open Underground HWDU panel	February 2032 <sup>*</sup>	September 2032
Install Borehole Seals	October 2032	September 2033
Install Repository Seals	June 2033	September 2037
Recontour and Revegetate	October 2037	May 2038
Prepare and Submit Final (Contingency) Closure Certification	October 2037	May 2038
Post-closure Monitoring	July 2038	N/A

N/A--Not Applicable  
 Refer to Figures I-3 and I-4 for precise activity titles.

<sup>\*</sup>This assumes the final waste is placed in this unit in January 2032 and notification of closure for this HWDU is submitted to the NMED in December 2031.

**TABLE I-3  
 GOVERNING REGULATIONS FOR BOREHOLE ABANDONMENT**

Federal or State Land	Type of Well or Borehole	Governing Regulation	Summary of Requirements
Both	Groundwater Surveillance	State and Federal regulation in effect at time of abandonment	Monitor wells no longer in use shall be plugged in such a manner as to preclude migration of surface runoff or groundwater along the length of the well. Where possible, this shall be accomplished by removing the well casing and pumping expanding cement from the bottom to the top of the well. If the casing cannot be removed, the casing shall be ripped or perforated along its entire length if possible, and grouted. Filling with bentonite pellets from the bottom to the top is an acceptable alternative to pressure grouting.
Federal	Oil and Gas Wells	43 CFR Part 3160, §§ 3162.3-4	The operator shall promptly plug and abandon, in accordance with a plan first approved in writing or prescribed by the authorized officer.
Federal	Potash	43 CFR Part 3590, § 3593.1	(b) Surface boreholes for development or holes for prospecting shall be abandoned to the satisfaction of the authorizing officer by cementing and/or casing or by other methods approved in advance by the authorized officer. The holes shall also be abandoned in a manner to protect the surface and not endanger any present or future underground operation, any deposit of oil, gas, or other mineral substances, or any aquifer.
State	Oil and Gas Well Outside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Rule 202 (eff. 3-1-91)	<p>B. Plugging</p> <p>(1) Prior to abandonment, the well shall be plugged in a manner to permanently confine all oil, gas, and water in the separate strata where they were originally found. This can be accomplished by using mud-laden fluid, cement, and plugs singly or in combination as approved by the Division on the notice of intention to plug.</p> <p>(2) The exact location of plugged and abandoned wells shall be marked by the operator with a steel marker not less than four inches (4") in diameter, set in cement, and extending at least four feet (4') above mean ground level. The metal of the marker shall be permanently engraved, welded, or stamped with the operator name, lease name, and well number and location, including unit letter, section, township, and range.</p>
State	Oil and Gas Wells Inside the Oil-Potash Area	State of New Mexico, Oil Conservation Division, Order No. R-111-P (eff. 4-21-88)	<p>F. Plugging and Abandonment of Wells</p> <p>(1) All existing and future wells that are drilled within the potash area, shall be plugged in accordance with the general rules established by the Division. A solid cement plug shall be provided through the salt section and any water-bearing horizon to prevent liquids or gases from entering the hole above or below the salt selection.</p> <p>It shall have suitable proportions—but no greater than three (3) percent of calcium chloride by weight—of cement considered to be the desired mixture when possible.</p>

(This page intentionally blank)



1

## FIGURES

1

(This page intentionally blank)

Figure I-1  
Location of Underground HWDUs and Anticipated Closure Locations

Figure I-2  
WIPP Panel Closure Schedule

Figure I-3  
WIPP Facility Final Closure Schedule

Figure I-4  
Design of a Panel Closure System

Figure I-5  
Typical Disposal Panel

Figure I-6  
Approximate Location of Boreholes in Relation to the WIPP Underground