

ATTACHMENT G

CLOSURE PLAN

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TABLE OF CONTENTS

Introduction	1
G-1 Closure Plan.....	2
G-1a Closure Performance Standard.....	3
G-1a(1) Container Storage Units	3
G-1a(2) Miscellaneous Unit	4
G-1a(3) Post-Closure Care	5
G-1b Requirements	5
G-1c Maximum Waste Inventory.....	5
G-1d Schedule for Closure	6
G-1d(1) Schedule for Panel Closure	6
G-1d(2) Schedule for Final Facility Closure.....	6
G-1d(3) Extension for Closure Time.....	7
G-1d(4) Amendment of the Closure Plan	8
G-1e Closure Activities	9
G-1e(1) Panel Closure.....	9
G-1e(2) Decontamination and Decommissioning.....	10
G-1e(2)(a) Determine the Extent of Contamination.....	12
G-1e(2)(b) Decontamination Activities	12
G-1e(2)(c) Dismantling.....	15
G-1e(2)(d) Closure of Open Underground HWDU	15
G-1e(2)(e) Final Facility Closure.....	16
G-1e(2)(f) Final Contouring and Revegetation.....	17
G-1e(2)(g) Closure, Monuments, and Records.....	17
G-1e(3) Performance of the Closed Facility	18
G-2 Notices Required for Disposal Facilities.....	18
G-2a Certification of Closure.....	18
G-2b Survey Plat	19
References	20

LIST OF TABLES

Table	Title
Table G-1	Anticipated Earliest Closure Dates for the Underground HWDUs
Table G-2	Anticipated Overall Schedule for Closure Activities
Table G-3	Governing Regulations for Borehole Abandonment

LIST OF FIGURES

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

1 **ATTACHMENT G**

2 **CLOSURE PLAN**

3 Introduction

4 This Permit Attachment contains the Closure Plan that describes the activities necessary to
5 close the Waste Isolation Pilot Plant (**WIPP**) individual units and facility. Since the current plans
6 for operations extend over several decades, the Permittees will periodically reapply for an
7 operating permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.10(h)).
8 Consequently, this Closure Plan describes several types of closures. The first type is panel
9 closure, which involves constructing closures in each of the underground hazardous waste
10 disposal units (**HWDUs**) after they are filled. The second type is partial closure, which can be
11 less than the entire facility and therefore less than an entire unit as described herein for the
12 Waste Handling Building (**WHB**) Unit, the Parking Area Unit (**PAU**), or Permit-related surface
13 equipment, structures and contaminated soils. The third type of closure is final facility closure at
14 the end of the Disposal Phase, which will entail “clean” closure of all remaining surface storage
15 units and construction of the four shaft seal systems. Finally, in the event a new permit is not
16 issued prior to expiration of an existing permit, a modification to this Closure Plan will be sought
17 to perform contingency closure. Contingency closure defers the final closure of waste
18 management facilities such as the Waste Handling Building Container Storage Unit (**WHB Unit**),
19 the conveyances, the shafts, and the haulage ways because these will be needed to continue
20 operations with non-mixed Transuranic (**TRU**) waste.

21 The hazardous waste management units (**HWMUs**) addressed in this Closure Plan include the
22 aboveground HWMU in the WHB, the parking area HWMU, and Panels 1 through 8, each
23 consisting of seven rooms.

24 This plan was submitted to the New Mexico Environment Department (**NMED**) and the U.S.
25 Environmental Protection Agency (**EPA**) in accordance with 20.4.1.900 NMAC (incorporating 40
26 CFR §270.14(b)(13)). Closure at the panel level will include the construction of barriers to limit
27 the emission of hazardous waste constituents from the panel into the mine ventilation air stream
28 below levels that meet environmental performance standards¹ and to mitigate the impacts of
29 methane buildup and deflagration that may be postulated for some closed panels. The Post-
30 Closure Plan (Permit Attachment H) includes the implementation of institutional controls to limit
31 access and groundwater monitoring to assess disposal system performance. Until final closure
32 is complete and has been certified in accordance with 20.4.1.500 NMAC (incorporating 40 CFR
33 §264.115), a copy of the approved Closure Plan and all approved revisions will be on file at the
34 WIPP facility and will be available to the Secretary of the NMED or the EPA Region VI
35 Administrator upon request.

¹ 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 G-1 Closure Plan

2 This Closure Plan is prepared in accordance with the requirements of 20.4.1.500 NMAC
3 (incorporating 40 CFR §264 Subparts G, I, and X), Closure and Post-Closure, Use and
4 Management of Containers, and Miscellaneous Units. The WIPP underground HWDUs,
5 including Panels 1 through 8 on Figure G-1, will be closed under this permit to meet the
6 performance standards in 20.4.1.500 NMAC (incorporating 40 CFR §264.601). The WIPP
7 surface facilities, including Waste Handling Building Container Storage Unit and the Parking
8 Area Container Storage Unit, will be closed in accordance with 20.4.1.500 NMAC (incorporating
9 40 CFR §264.178). The Permittees may perform partial closure of the WHB, PAU HWMUs, or
10 Permit-related surface equipment, structures and contaminated soils prior to final facility closure
11 and certification. For final facility closure, this plan also includes closure of future waste disposal
12 areas including Panels 9 and 10 and closure and sealing of the facility shafts in accordance with
13 20.4.1.500 NMAC (incorporating 40 CFR §264.601).

14 Following completion of waste emplacement in each underground HWDU, the HWDU will be
15 closed. The Permittees will notify the NMED of the closure of each underground HWDU as
16 specified in the schedule in Figure G-2. For the purpose of this Closure Plan, panel closure is
17 defined as the process of rendering underground HWDUs in the repository inactive and closed
18 according to the facility Closure Plan. The Post-Closure Plan (Permit Attachment H) addresses
19 requirements for future monitoring that are deemed necessary for the post-closure period,
20 including monitoring closed panels prior to final facility closure.

21 For the purposes of this Closure Plan, final facility closure is defined as closure that will occur
22 when all ~~waste disposal areas permitted HWDUs~~ are filled or have achieved their maximum
23 capacities as outlined in Permit Part 4, Table 4.1.1 or when ~~the~~ WIPP achieves its capacity of
24 6.2 million cubic feet (ft³) (175,564 cubic meters (m³)) of Land Withdrawal Act (LWA) TRU
25 waste volume. At final facility closure, the surface container storage areas will be closed, and
26 equipment that can be decontaminated and used at other facilities will be cleaned and sent off
27 site. Equipment that cannot be decontaminated plus any derived waste resulting from
28 decontamination will be placed in the last open underground HWDU. Stockpiled salt may be
29 placed in the underground; it may be used as the core material for the berm component of the
30 permanent marker system; or it must be otherwise disposed of in accordance with Sections 2
31 and 3 of the Minerals Act of 1947 (30 U.S.C. §§602 and 603). In addition, shafts and boreholes
32 which lie within the WIPP Site Boundary and penetrate the Salado will be plugged and sealed,
33 and surface and subsurface facilities and equipment will be decontaminated and removed. Final
34 facility closure will be completed to demonstrate compliance with the Closure Performance
35 Standards contained in 20.4.1.500 NMAC (incorporating 40 CFR §264.111, 178, and 601).

36 In the event the Permittees fail to obtain an extension of the hazardous waste permit in
37 accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.51) or fail to obtain a new
38 permit in accordance with 20.4.1.900 NMAC (incorporating 40 CFR §270.10(h)), the Permittees
39 will seek a modification to this Closure Plan in accordance with 20.4.1.900 NMAC (incorporating
40 40 CFR §270.42) to accommodate a contingency closure. Under contingency closure, storage
41 units will undergo clean closure in accordance with 20.4.1.500 NMAC (incorporating 40 CFR
42 §264.178); waste handling equipment, shafts, and haulage ways will be inspected for hazardous
43 waste residues (using, among other techniques, radiological surveys to indicate potential
44 hazardous waste releases as described in Permit Attachment G3) and decontaminated as
45 necessary; and underground HWDUs that contain radioactive mixed waste will be closed in
46 accordance with the panel closure design described in this Closure Plan. Final facility closure,

1 however, will be redefined and a request for a time extension for final closure will be requested.
2 A copy of this Closure Plan will be maintained by the Permittees at the WIPP facility and at the
3 U.S. Department of Energy (DOE) Carlsbad Field Office. The primary contact person at the
4 WIPP facility is:

5 Manager, Carlsbad Field Office
6 U.S. Department of Energy
7 Waste Isolation Pilot Plant
8 P. O. Box 3090
9 Carlsbad, New Mexico 88221-3090
10 (575) 234-7300

11 G-1a Closure Performance Standard

12 The closure performance standard specified in 20.4.1.500 NMAC (incorporating 40 CFR
13 §264.111), states that the closure shall be performed in a manner that minimizes the need for
14 further maintenance; that minimizes, controls, or eliminates the escape of hazardous waste; and
15 that conforms to the closure requirements of §264.178 and §264.601. These standards are
16 discussed in the following paragraphs.

17 G-1a(1) Container Storage Units

18 Final or partial closure of the permitted container storage units (the Waste Handling Building
19 Unit and Parking Area Unit) will be accomplished by removing all waste and waste residues.
20 Indication of waste contamination will be based, among other techniques, on the use of
21 radiological surveys as described in Permit Attachment G3. Radiological surveys use very
22 sensitive radiation detection equipment to indicate if there has been a potential release of TRU
23 mixed waste, including hazardous waste components, from a container. This allows the
24 Permittees to indicate potential releases that are not detectable from visible evidence such as
25 stains or discoloration. Visual inspection and operating records will also be used to identify
26 areas where decontamination is necessary. Contaminated surfaces will be decontaminated until
27 radioactivity is below free release limits². Once surfaces are determined to be free of radioactive
28 waste constituents, they will be tested for hazardous waste contamination. These surface
29 decontamination activities will ensure the removal of waste residues to levels protective of
30 human health and the environment. The facility is expected to require no decontamination at
31 closure because any waste spilled or released during operations will be contained and removed
32 immediately. Solid waste management units listed in Attachment K, Table K-4 will be subject to
33 closure. In the event portions of these units which require decontamination cannot be
34 decontaminated, these portions will be removed and the resultant wastes will be managed as
35 appropriately.

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

² 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.

1 G-1a(2) Miscellaneous Unit

2 Post-closure migration of hazardous waste or hazardous waste constituents to ground or
3 surface waters or to the atmosphere, above levels that will harm human health or the
4 environment, will not occur due to facility engineering and the geological isolation of the unit.
5 The engineering aspects of closure are centered on the use of panel closures on each of the
6 underground HWDUs and final facility seals placed in the shafts. The design of the panel
7 closure system is based on the criteria that the closure system for closed underground HWDUs
8 will prevent migration of hazardous waste constituents in the air pathway in concentrations
9 above health-based levels beyond the WIPP land withdrawal boundary during the 35 year
10 operational and facility closure period and to withstand any flammable gas deflagration that may
11 occur prior to final facility closure.

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

18 Shaft seals are designed to provide effective barriers to the inward migration of ground water
19 and the outward migration of gas and contaminated brine over two discrete time periods.
20 Several components become effective immediately and are expected to function for 100 years.
21 Other components become effective more slowly, but provide permanent isolation of the waste.
22 The final shaft seal design is specified in Permit Attachment G2.

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

26 Prevention of any releases that may have adverse effects on human health or the
27 environment due to the migration of waste constituents in the groundwater or in the
28 subsurface environment [20.4.1.500 NMAC, incorporating 40 CFR §264.601(a)].

29 Prevention of any releases that may have adverse effects on human health or the
30 environment due to migration of waste constituents in surface water, in wetlands, or on
31 the soil surface [20.4.1.500 NMAC, incorporating 40 CFR §264.601(b)].

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

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

1 If, during panel or final facility closure activities, unexpected events require modification of this
2 Closure Plan to demonstrate compliance with closure performance standards, a Closure Plan
3 amendment will be submitted in accordance with 20.4.1.900 NMAC (incorporating 40 CFR
4 §270.42).

5 G-1a(3) Post-Closure Care

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

13 G-1b Requirements

14 The Permit specifies a sequential process for the closure of individual HWMUs at the WIPP.
15 Each underground HWDU will undergo panel closure when waste emplacement in that panel is
16 complete. Following waste emplacement in each underground HWDU, construction-side
17 ventilation will be terminated and waste-disposal-side ventilation will be established in the next
18 underground HWDU to be used, and the underground HWDU containing the waste will be
19 closed. The Permittees will notify the NMED of the closure of each of the underground HWDUs
20 as they are sequentially filled on a HWDU-by-HWDU basis. The HWMUs in the WHB and in the
21 parking area will be closed as part of final facility closure of the WIPP facility.

22 The Permittees will notify the Secretary of the NMED in writing at least 60 days prior to the date
23 on which closure activities are scheduled to begin.

24 G-1c Maximum Waste Inventory

25 The maximum waste inventory (maximum capacity) for the permitted HWDUs is established in
26 Permit Part 4, Table 4.1.1. In accordance with the LWA, The WIPP will receive no more than 6.2
27 million ft³ (175,564 m³) of LWA TRU mixed-waste volume, which may include up to 250,000 ft³
28 (7,079 m³) of remote-handled (RH) TRU mixed waste. Excavations are mined as permitted
29 when needed during operations to maintain a reserve of disposal areas. The amount of waste
30 placed in each room is limited by structural and physical considerations of equipment and
31 design. Transuranic mixed waste Waste volumes include waste received from off-site generator
32 locations as well as derived waste from disposal and decontamination operations. The
33 maximum volume of TRU mixed waste in a disposal panel is established in Permit Part 4, Table
34 4.1.1. For closure planning purposes, a maximum achievable volume of 685,100 ft³ (19,400 m³)
35 of TRU mixed waste per panel is used. This equates to 662,150 ft³ (18,750 m³) of contact-
36 handled (CH) TRU mixed waste and 22,950 ft³ (650 m³) of RH TRU mixed waste per panel.

37 The maximum extent of operations during the term of this permit is expected to be Panels 1
38 through 8 as shown on Figure G-1, the WHB Container Storage Unit, and the Parking Area
39 Container Storage Unit. Note that panels 9 and 10 are scheduled for excavation only under this
40 permit. If other waste management units are permitted during the Disposal Phase, this Closure
41 Plan will be revised to include the additional waste management units. At any given time during
42 disposal operations, it is possible that multiple rooms may be receiving TRU mixed waste for

1 disposal at the same time. Underground HWDUs in which disposal has been completed (i.e., in
2 which CH and RH TRU mixed waste emplacement activities have ceased) will undergo panel
3 closure.

4 G-1d Schedule for Closure

5 For the purpose of establishing a schedule for closure, an operating and closure period of no
6 more than 35 years (25 years for disposal operations and 10 years for closure) is assumed. This
7 operating period may be extended or shortened depending on a number of factors, including the
8 rate of waste approved for shipment to the WIPP facility and the schedules of TRU mixed waste
9 generator sites, and future decommissioning activities.

10 G-1d(1) Schedule for Panel Closure

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

16 In the schedule in Figure G-2, notification of intent to close occurs 30 days before placing the
17 final waste in a panel. Once a panel is full, the Permittees will initially block ventilation through
18 the panel as described in Permit Attachment A2 and then will assess the closure area for
19 ground conditions and contamination so that a definitive schedule and closure design can be
20 determined. If as the result of this assessment the Permittees determine that a panel closure
21 cannot be emplaced in accordance with the schedule in this Closure Plan, a modification will be
22 submitted requesting an extension to the time for closure.

23 The Permittees will initially block ventilation through Panel 5 as described in Permit Attachment
24 A2, Section A2-2a(3), "Subsurface Structures," once Panel 5 is full. The Permittees will then
25 install the explosion-isolation wall portion of the panel closure system that is described in Permit
26 Attachment G1, Section 3.3.2, "Explosion- and Construction-Isolation Walls." Construction of the
27 explosion-isolation wall shall be completed within 180 days after the last receipt of waste in
28 Panel 5. Final closure of Panels 1 through 6 will be completed as specified in this Permit no
29 later than June 30, 2018.

30 To ensure continued protection of human health and the environment, the Permittees will
31 initially block ventilation through Panels 3 through 7 as described in Permit Attachment A2,
32 Section A2-2a(3), after waste disposal in each panel has been completed. The Permittees shall
33 continue VOC monitoring in such panels until final panel closure. If the measured concentration,
34 as confirmed by a second sample, of any VOC in a panel exceeds the 95% action level given in
35 Permit Part 4, Table 4.6.3.2, the Permittees will initiate remedial actions as required by Permit
36 Part 4, Section 4.6.3.3. Regardless of the outcome of disposal room VOC monitoring, final
37 closure of Panels 3 and 4 will be completed as specified in this Permit no later than June 30,
38 2018.

39 G-1d(2) Schedule for Final Facility Closure

40 The Disposal Phase for the WIPP facility is expected to require a period of 25 years beginning
41 with the first receipt of TRU waste at the WIPP facility and followed by a period ranging from 7
42 to 10 years for decontamination, decommissioning, and final closure. The Disposal Phase may

1 therefore extend until 2024, and the latest expected year of final closure of the WIPP facility
2 (i.e., date of final closure certification) would be 2034. If, as is currently projected, the WIPP
3 facility is dismantled at closure, all surface and subsurface facilities (except the hot cell portion
4 of the WHB, which will remain as an artifact of the Permanent Marker System [PMS]) will be
5 disassembled and either salvaged or disposed in accordance with applicable standards. In
6 addition, asphalt and crushed caliche that was used for paving will be removed, and the area
7 will be recontoured and revegetated in accordance with a land management plan. A detailed
8 closure schedule will be submitted in writing to the Secretary of the NMED, along with the
9 notification of closure. Throughout the closure period, all necessary steps will be taken to
10 prevent threats to human health and the environment in compliance with all applicable
11 Resource Conservation and Recovery Act (RCRA) permit requirements. Figure G-3 presents an
12 estimate of a final facility closure schedule based on 84 months to implement final closure.

13 The schedule for final facility closure is considered to be a best estimate because closure of the
14 facility is driven by policies and practices established for the decontamination, if necessary, and
15 decommissioning of radioactively contaminated facilities. These required activities include
16 extensive radiological contamination surveys and hazardous constituent surveys using, among
17 other techniques, radiological surveys to indicate potential hazardous waste releases. Both
18 types of surveys will be performed at all areas of the WIPP site where hazardous waste were
19 managed. These surveys, along with historical radiological survey records, will provide the basis
20 for release of structures, equipment, and components for disposal or decontamination for
21 release off site. Specifications will be developed for each structure to be removed. A cost benefit
22 analysis will be needed to evaluate decontamination options if extensive decontamination is
23 necessary. Individual equipment surveys, structure surveys, and debris surveys will be required
24 prior to disposition. Size-reduction techniques may be required to dispose of mixed or
25 radioactive waste at the WIPP site. Current DOE policy, as reflected in the WIPP facility Safety
26 Analysis Report (SAR) (DOE 1997), requires the preparation of a final decommissioning and
27 decontamination (D&D) plan immediately prior to final facility closure. In this way, the specific
28 conditions of the facility at the time D&D is initiated will be addressed. Section G-1e(2) provides
29 a more detailed discussion of final facility closure activities.

30 Figure G-3 shows the schedule for the final facility closure consisting of decontamination, as
31 needed, of the TRU waste-handling equipment, and of the aboveground equipment and
32 facilities, including closure of surface HWMUs; decontamination of the shaft and haulage ways;
33 disposal of decontamination derived wastes in the last open underground HWDU; and
34 subsequent closure of this underground HWDU. Subsequent activities will include installation of
35 repository shaft seals.

36 An overall schedule for final facility closure, showing currently scheduled dates for the start and
37 end of final facility closure activities is shown in Table G-2. The dates assume a start up date of
38 March 1999 and continued permitting of the WIPP facility until it is filled. Details for panel
39 closures are shown on Table G-1.

40 G-1d(3) Extension for Closure Time

41 As indicated by the closure schedule presented in Figure G-3, the activities necessary to
42 perform facility closure of the WIPP facility will require more than 180 days to complete because
43 of additional stringent requirements for managing radioactive materials. Therefore, the Permit
44 provides an extension of the 180-day final closure requirement in accordance with 20.4.1.500
45 NMAC (incorporating 40 CFR §264.113). During the extended closure period, the Permittees

1 will continue to demonstrate compliance with applicable permit requirements and will take all
2 steps necessary to prevent threats to human health and the environment as a result of TRU
3 mixed waste management at the WIPP facility including all of the applicable measures in Part
4 2.10 (Preparedness and Prevention).

5 In addition, according to the schedules in Figure G-3, the final derived wastes that are
6 generated as the result of decontamination activities will not be disposed of for 16 months after
7 the initiation of final facility closure. In accordance with 20.4.1.500 NMAC (incorporating 40 CFR
8 §264.113(a)), the Permit provides an extension of the 90-day limit to dispose of final derived
9 waste resulting from the closure process. This provision is necessitated by the fact that the
10 radioactive nature of the derived waste makes placement in the WIPP the best disposition, and
11 the removal of these wastes will, by necessity, take longer than 90 days in accordance with the
12 closure schedules. During this extended period of time, the Permittees will take all steps
13 necessary to prevent threats to human health and the environment, including compliance with
14 all applicable permit requirements. These steps include all of the applicable preparedness and
15 prevention measures in Permit Attachment A.

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

21 G-1d(4) Amendment of the Closure Plan

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

28 There are changes in operating plans or in the waste management unit facility design that
29 affect the Closure Plan

30 There is a change in the expected year of closure

31 Unexpected events occur during panel or final facility closure that require modification of
32 the approved Closure Plan

33 Changes in State or Federal laws affect the Closure Plan

34 Permittees fail to obtain permits for continued operations as discussed above

35 The Permittees will submit a written request for a permit modification with a copy of the
36 amended Closure Plan at least 60 days prior to the proposed change in facility design or
37 operation or within 60 days of the occurrence of an unexpected event that affects the Closure
38 Plan. If the unexpected event occurs during final closure, the permit modification will be
39 requested within 30 days of the occurrence. If the Secretary of the NMED requests a
40 modification of the Closure Plan, a plan modified in accordance with the request will be

1 submitted within 60 days of notification or within 30 days, if the change in facility condition
2 occurs during final closure.

3 G-1e Closure Activities

4 Closure activities include those instituted for panel closure (i.e., closure of filled underground
5 HWDUs), contingency closure (i.e., closure of surface HWMUs and decontamination of other
6 waste handling areas), and final facility closure (i.e., closure of surface HWMUs, D&D of surface
7 facilities and the areas surrounding the WHB, and placement of repository shaft seals). Panel
8 closure systems will be emplaced to separate areas of the facility and to isolate panels. Permit
9 Attachments G1 and G2 provide panel closure system and shaft seal designs. All closure
10 activities will meet the applicable quality assurance (QA)/quality control (QC) program standards
11 in place at the WIPP facility. Facility monitoring procedures in place during operations will
12 remain in place through final closure, as applicable.

13 G-1e(1) Panel Closure

14 Following completion of waste emplacement in each underground HWDU, disposal-side
15 ventilation will be established in the next panel to be used, and the panel containing the waste
16 will be closed. A panel closure system will be emplaced in the panel access drifts, in
17 accordance with the design in Permit Attachment G1 and the schedule in Figure G-2 and Table
18 G-1. The panel closure system is designed to meet the following requirements that were
19 established by the DOE for the design to comply with 20.4.1.500 NMAC (incorporating 40 CFR
20 §264.601(a)):

21 the panel closure system shall limit the migration of VOCs to the compliance point so that
22 compliance is achieved by at least one order of magnitude

23 the panel closure system shall consider potential flow of VOCs through the disturbed rock
24 zone (DRZ) in addition to flow through closure components

25 the panel closure system shall perform its intended functions under loads generated by
26 creep closure of the tunnels

27 the panel closure system shall perform its intended function under the conditions of a
28 postulated methane explosion

29 the nominal operational life of the closure system is 35 years

30 the panel closure system for each individual panel shall not require routine maintenance
31 during its operational life

32 the panel closure system shall address the most severe ground conditions expected in the
33 waste disposal area

34 the design class of the panel closure system shall be IIIb (which means that it is to be built
35 to generally accepted national design and construction standards)

36 the design and construction shall follow conventional mining practices

1 structural analysis shall use data acquired from the WIPP underground

2 materials shall be compatible with their emplacement environment and function

3 treatment of surfaces in the closure areas shall be considered in the design

4 thermal cracking of concrete shall be addressed

5 during construction, a QA/QC program shall be established to verify material properties
6 and construction practices

7 construction of the panel closure system shall consider shaft and underground access and
8 services for materials handling

9 The performance standard for air emissions from the WIPP facility is established in Permit Part
10 4 and Permit Attachment A2. Releases shall be below these limits for the facility to remain in
11 compliance with standards to protect human health and the environment. The following panel
12 closure design has been shown, through analysis, to meet these standards, if emplaced in
13 accordance with the specifications in Permit Attachment G1.

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

24 Figures G-4 and G-5 show a diagram of the panel closure design and installation envelopes.
25 Permit Attachment G1 provides the detailed design and the design analysis for the panel
26 closure system. Although the permit application proposed several panel closure design options,
27 depending on the gas generated by wastes and the age of the mined openings, the NMED and
28 EPA determined that only the most robust design option (D) would be approved. This decision
29 does not prevent the Permittees from continuing to collect data on the behavior of the wastes
30 and mined openings, or proposing a modification to the Closure Plan in the future, using the
31 available data to support a request for reconsideration of one or more of the original design
32 options. If a design different from Option D as defined in Permit Attachment G1 is proposed, the
33 appropriate permit modification will be sought.

34 G-1e(2) Decontamination and Decommissioning

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

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

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

- 9 1. Review of operational records for historical information on releases
- 10 2. Visual examination of surface structures for evidence of spills or releases
- 11 3. Performance of site contamination surveys
- 12 4. Decontamination, if necessary, of usable equipment, materials, and structures
13 including surface facilities and areas surrounding the WHB.
- 14 5. Disposal of equipment/materials that cannot be decontaminated but that meet the
15 treatment, storage, and disposal facility waste acceptance criteria (**TSDF-WAC**) in an
16 underground HWDU
- 17 6. Emplacement of final panel closure system
- 18 7. Emplacement of shaft seals³
- 19 8. Regrading the surface to approximately original contours
- 20 9. Initiation of active controls

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

23 Health and Safety

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

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

1 G-1e(2)(a) Determine the Extent of Contamination

2 The first activities performed as part of decontamination include those needed to determine the
3 extent of any contamination that needs to be removed prior to decommissioning a facility. This
4 includes activities 1 to 3 above and, as can be seen by the schedules in Figures G-3 and G-4
5 (Items B and C), these surveys are anticipated to take 10 months to perform, including obtaining
6 the results of any sample analyses. The process of identifying areas that require
7 decontamination include three sources of information. First, operating records will be reviewed
8 to determine where contamination has previously been found as the result of historical releases
9 and spills. Even though releases and spills will have been cleaned up at the time of occurrence,
10 newer equipment and technology may allow further cleaning. Second, surfaces of facilities and
11 structures will be examined visually for evidence of spills or releases. Finally, extensive detailed
12 contamination surveys will be performed to document the level of cleanliness for all surface
13 structures and equipment. If equipment or areas are identified as contaminated, the Permittees
14 will notify NMED as specified in Permit Part 1, and a plan and procedure(s) will be developed
15 and implemented to address decontamination-related questions, including:

- 16 Should the component be decontaminated or disposed of as waste?
17 What is the most cost-effective method of decontaminating the component?
18 Will the decontamination procedures adequately contain the contamination?

19 Radiological and hazardous constituent surveys will be used in determining the presence of
20 hazardous waste and hazardous waste residues in areas where spills or releases have
21 occurred. Radiological surveys are described in Permit Attachment G3. Once cleanup of the
22 radioactivity has been completed, the surface will be sampled for hazardous constituents
23 specified in Permit Attachment B to determine that they, too, have been cleaned up. Sampling
24 and analysis protocols will be consistent with EPA's document SW-846 (EPA, 1996).

25 G-1e(2)(b) Decontamination Activities

26 Once the extent of contamination is known, decontamination activities will be planned and
27 performed. Radiological control and the control of hazardous waste residues are the primary
28 criteria used in the design of decontamination activities. Radiation control procedures require
29 that careful planning and execution be used in decontamination activities to prevent the
30 exposure of workers beyond applicable standards and to prevent the further spread of
31 contamination. Careful control of entry, cleanup, and ventilation are vital components of
32 radiation decontamination. The level of care mandated by DOE orders and occupational
33 protection requirements results in closure activities that will exceed the 180 days allowed in
34 20.4.1.500 NMAC (incorporating 40 CFR §264.113(b)). Decontamination activities are included
35 as item 4 above and are shown on the schedules for contingency closure and final facility
36 closure (Figures G-3 and G-4) as activities D, E, and F. These activities are anticipated to have
37 a duration of 20 months for both contingency closure and for final facility closure. The result of
38 these activities is the clean closure of the surface container management units. Under
39 contingency closure, the other areas that have been decontaminated will not be closed. Instead
40 they will remain in use for continued waste management activities involving non-mixed waste.
41 Under final facility closure, other areas that are decontaminated are eligible for closure.

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

1 Decontamination activities will be coordinated with closure activities so that areas that have
2 been decontaminated will not be recontaminated. All waste resulting from decontamination
3 activities will be surveyed and analyzed for the presence of radioactive contamination and
4 hazardous constituents specified in Permit Attachment B. The waste will be characterized as
5 hazardous, mixed, or radioactive and will be packaged and handled appropriately. Mixed and
6 radioactive waste will be classified as TRU mixed waste managed in accordance with the
7 applicable Permit requirements. Derived mixed waste collected during decontamination
8 activities that are generated before repository shafts have been sealed will be emplaced in the
9 facility, if appropriate, or will be managed together with decontamination derived waste collected
10 after the underground is closed. This waste will be classified and shipped off site to an
11 appropriate, permitted facility for treatment, if necessary, and for disposal.

12 Removal of Hazardous Waste Residues

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

24 Surface Container Storage Units

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

33 The “Start Clean—Stay Clean” operating philosophy of the WIPP Project will minimize the need
34 for decontamination of the WHB during decommissioning and closure. Procedures for opening
35 shipping containers in the WHB limit the opportunity for waste spillage.

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

38 Chemical cleaning (e.g., water, mild detergent cleanser, and polyvinyl alcohol)

39 Nonchemical cleaning (e.g., sandblasting, grinding, high-pressure water spray, scabblers
40 pistons and needle scalers, ice-blast technology, dry-ice blasting)

41 Removal of contaminated components such as pipe and ductwork

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

4 Waste Handling Equipment and

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

9 Personnel Decontamination

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

15 In accordance with DOE policy, TRU mixed waste PPE will be considered to be contaminated
16 with all of the hazardous waste constituents contained in the containers that have been
17 managed within the unit being closed. Wastes collected as a result of closure activities and that
18 may be contaminated with radioactive and hazardous constituents will be considered TRU
19 mixed wastes. These wastes will be managed as derived wastes, as described in Permit
20 Attachment A2. Such waste, collected as the result of closure of the WIPP facility, will be
21 disposed of in the final open underground HWDU.

22 Cleanup Criteria

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

25 <u>Contamination Type</u>	<u>Loose</u> ⁴	<u>Fixed plus removable</u>
26 alpha contamination (α)	20 dpm/100 cm ²	500 dpm/100 cm ²
27 beta-gamma contamination (β - γ)	200 dpm/100 cm ²	1000 dpm/100 cm ²

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

30 Final Contamination Sampling and Quality Assurance

31 Verification samples will be analyzed by an approved laboratory that has been qualified by the
32 DOE according to a written program with strict criteria. The QA requirements of EPA/SW-846,
33 "Test Methods for Evaluating Solid Waste" (EPA, 1986), will be met for hazardous constituent
34 sampling and analyses.

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

1 Quality Assurance/Quality Control

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

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

18 G-1e(2)(c) Dismantling

19 G-1e(2)(c)(1) Dismantling During Final Closure

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

36 G-1e(2)(c)(2) Dismantling of Permit-Related Surface Equipment, Structures, and
37 Contaminated Soils During Partial Closure

38 Partial closure includes dismantling of Permit-related structures and/or equipment and removal
39 of contaminated soils on the surface prior to final closure. During dismantling, priority will be
40 given to structures and equipment contaminated with hazardous waste or hazardous waste
41 constituents that cannot be decontaminated due to the presence of radioactivity to ensure these
42 are properly disposed of at the WIPP facility or at another designated disposal facility in a timely
43 manner. It should be noted that the placement of D&D waste into a WIPP HWDU may, by

1 necessity, involve the placement of uncontainerized bulk materials such as concrete
2 components, building framing, structural members, disassembled or partially disassembled
3 equipment, or containerized materials in non-standard waste boxes. Such placement will only
4 occur if it can be shown that it is protective of human health and the environment and items are
5 described in the operating record. Identification of bulk items is not possible at this time since
6 their size and quantity will depend on the extent of non-removable contamination.

7 G-1e(2)(d) Closure of Open Underground HWDU

8 The closure of the final underground HWDU is shown by Activity H in Figure G-3. This closure
9 will be consistent with the description in Section G-1e(1) and the design in Permit Attachment
10 G1. Detailed closure schedules for underground HWDUs are given in Figure G-2 and Table G-
11 1.

12 G-1e(2)(e) Final Facility Closure

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

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

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

27 Borehole plugging activities have been underway since the 1970s, from the early days of the
28 development of the WIPP facility. Early in the exploratory phase of the project, a number of
29 boreholes were sunk in Lea and Eddy counties. After the WIPP site was situated in its current
30 location, an evaluation of all vertical penetrations was made by Christensen and Peterson
31 (1981).

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

34 Grout plugging procedures are routinely performed in standard oil-field operations; however,
35 quantitative measurements of plug performance are rarely obtained. The Bell Canyon Test
36 reported by Christensen and Peterson (1981) was a field test demonstration of the use of
37 cementitious plugging materials and modification of existing industrial emplacement techniques
38 to suit repository plugging requirements. Cement emplacement technology was found to be
39 "generally adequate to satisfy repository plugging requirements." Christensen and Peterson
40 (1981) also report "that grouts can be effective in sealing boreholes, if proper care is exercised
41 in matching physical properties of the local rock with grout mixtures. Further, the reduction in
42 fluid flow provided by even limited length plugs is far in excess of that required by bounding

1 safety assessments for the WIPP.” The governing regulations for plugging and/or abandonment
2 of boreholes are summarized in Table G-3.

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

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

7 Rustler Formation: to prevent subsidence at and around the shafts and to ensure
8 compliance with Federal and State of New Mexico groundwater protection
9 requirements

10 Salado Formation: to prevent transporting hazardous waste constituents beyond the point
11 of compliance specified in Permit Part 5

12 The repository sealing system will consist of natural and engineered barriers within the WIPP
13 repository that will withstand forces expected to be present because of rock creep, hydraulic
14 pressure, and probable collapses in the repository and will meet the closure requirements of
15 20.4.1.500 NMAC (incorporating 40 CFR §264.601 and §264.111). Permit Attachment G2
16 presents the final repository sealing system design.

17 Once shaft sealing is completed, the Permittees will consider closure complete and will provide
18 the NMED with a certification of such within 60 days.

19 G-1e(2)(f) Final Contouring and Revegetation

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

28 G-1e(2)(g) Closure, Monuments, and Records

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

35 This Permit requires only a 30 year post-closure period. This is the maximum post-closure time
36 frame allowed in an initial Permit for any facility, as specified in 20.4.1.500 NMAC (incorporating
37 40 CFR §264.117(a)). The Secretary of the NMED may shorten or extend the post-closure care
38 period at any time in the future prior to completion of the original post-closure period (30 years
39 after the completion of construction of the shaft seals). The Permanent Marker Conceptual

1 Design Report and other provisions during the first 100 years after closure are addressed under
2 another Federal regulatory program.

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

- 4 Prevention of the intrusion of fluids into the repository by sealing the shafts
- 5 Prevention of human intrusion after closure
- 6 Minimization of future physical and environmental surveillance

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

13 G-1e(3) Performance of the Closed Facility

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

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

30 G-2 Notices Required for Disposal Facilities

31 G-2a Certification of Closure

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

1 G-2b Survey Plat

2 Within 60 days of completion of closure activities for each underground HWDU, and no later
3 than the submission of the certification of closure of each underground HWDU, the Permittees
4 will submit to the Secretary of the NMED a survey plat indicating the location and dimensions of
5 hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat will
6 be prepared and certified by a professional land surveyor and will contain a prominently
7 displayed note that states the Permittees' obligation to restrict disturbance of the hazardous
8 waste disposal unit. In addition, the land records in the Eddy County Courthouse, Carlsbad,
9 New Mexico, will be updated through filing of the final survey plats.

10

1 References

2 Christensen, C. L., and Peterson, E. W. 1981. "Field-Test Programs of Borehole Plugs in
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5 L. Hofman and J. J. Breslin, eds., SAND79-1634C, DOE/TIC-4621, Vol. 1, pp. 354–369.
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9 U.S. Department of Energy, 1980, "Final Environmental Impact Statement, Waste Isolation Pilot
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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.

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TABLES

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Table G-1
Anticipated Earliest Closure Dates for the Underground HWDUs

HWDU	OPERATIONS START	OPERATIONS END	CLOSURE START	CLOSURE END
PANEL 1	3/99*	3/03*	3/03*	7/03* SEE NOTE 5
PANEL 2	3/03*	10/05*	10/05*	3/06* SEE NOTE 5
PANEL 3	4/05*	2/07*	2/07*	2/07* SEE NOTE 5
PANEL 4	1/07*	5/09*	5/09*	8/09* SEE NOTE 5
PANEL 5	3/09*	7/11*	7/11*	11/11* SEE NOTE 5
PANEL 6	3/11*	1/14*	1/14*	6/18* SEE NOTE 5
PANEL 7	9/13*	6/18	7/18	3/19
PANEL 8	6/18	6/20	7/20	3/21
PANEL 9	6/20	1/28	2/28	SEE NOTE 4
PANEL 10	1/28	9/30	10/30	SEE NOTE 4

* Actual month and year

NOTE 1: Only Panels 1 to 4 will be closed under the initial term of this permit. Closure schedules for Panels 5 through 10 are projected assuming new permits will be issued in 2009 and 2019.

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

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

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

NOTE 5: Installation of the 12-foot explosion-isolation wall for Panels 1, 2, and 5 has been completed. Final closure of Panels 1 through 6 will be completed as specified in this Permit no later than June 30, 2018.

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**Table G-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 [*]	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 G-3 and G-4 for precise activity titles.

*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.

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Table G-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>

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FIGURES

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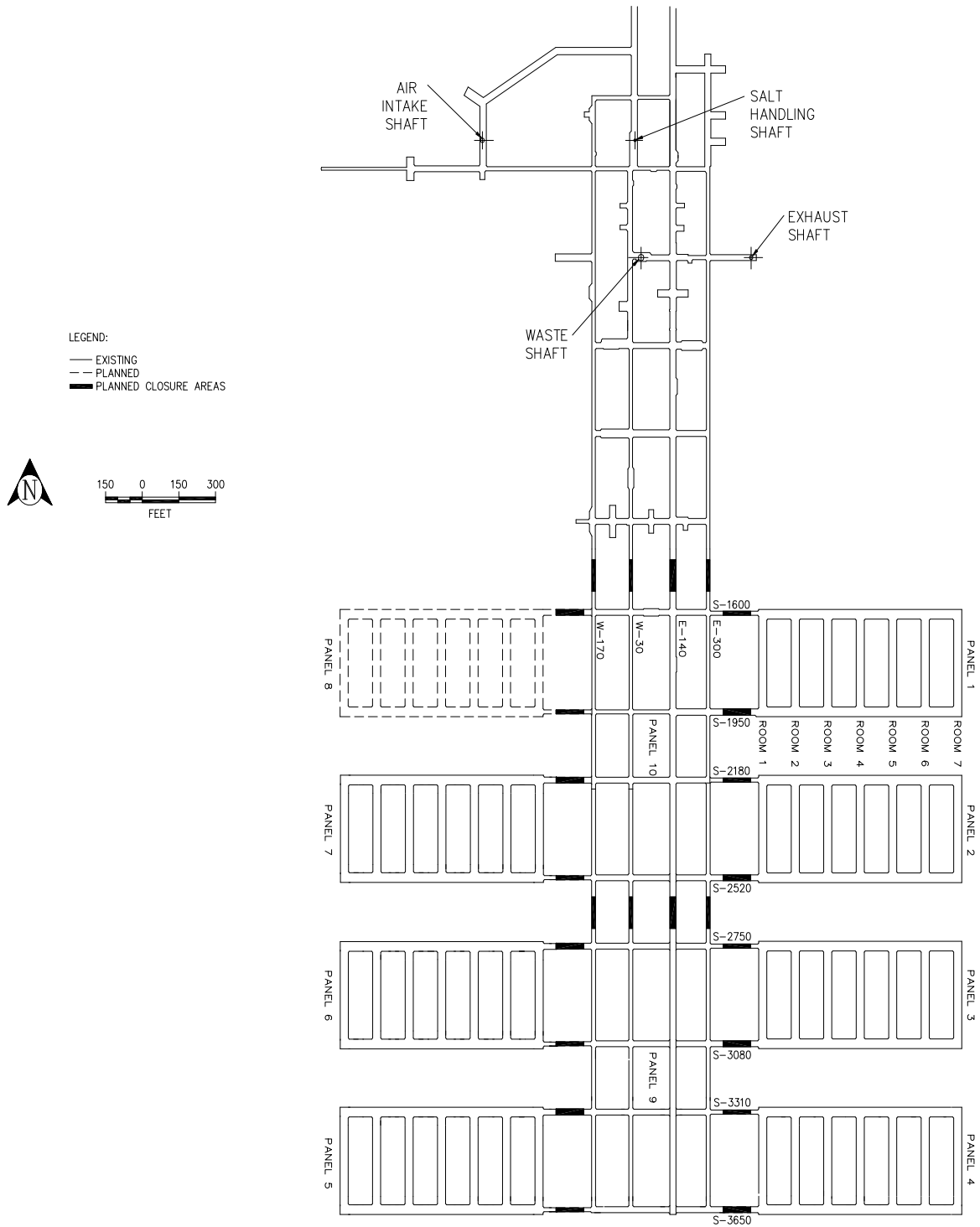


Figure G-1
 Location of Underground HWDUs and Anticipated Closure Locations

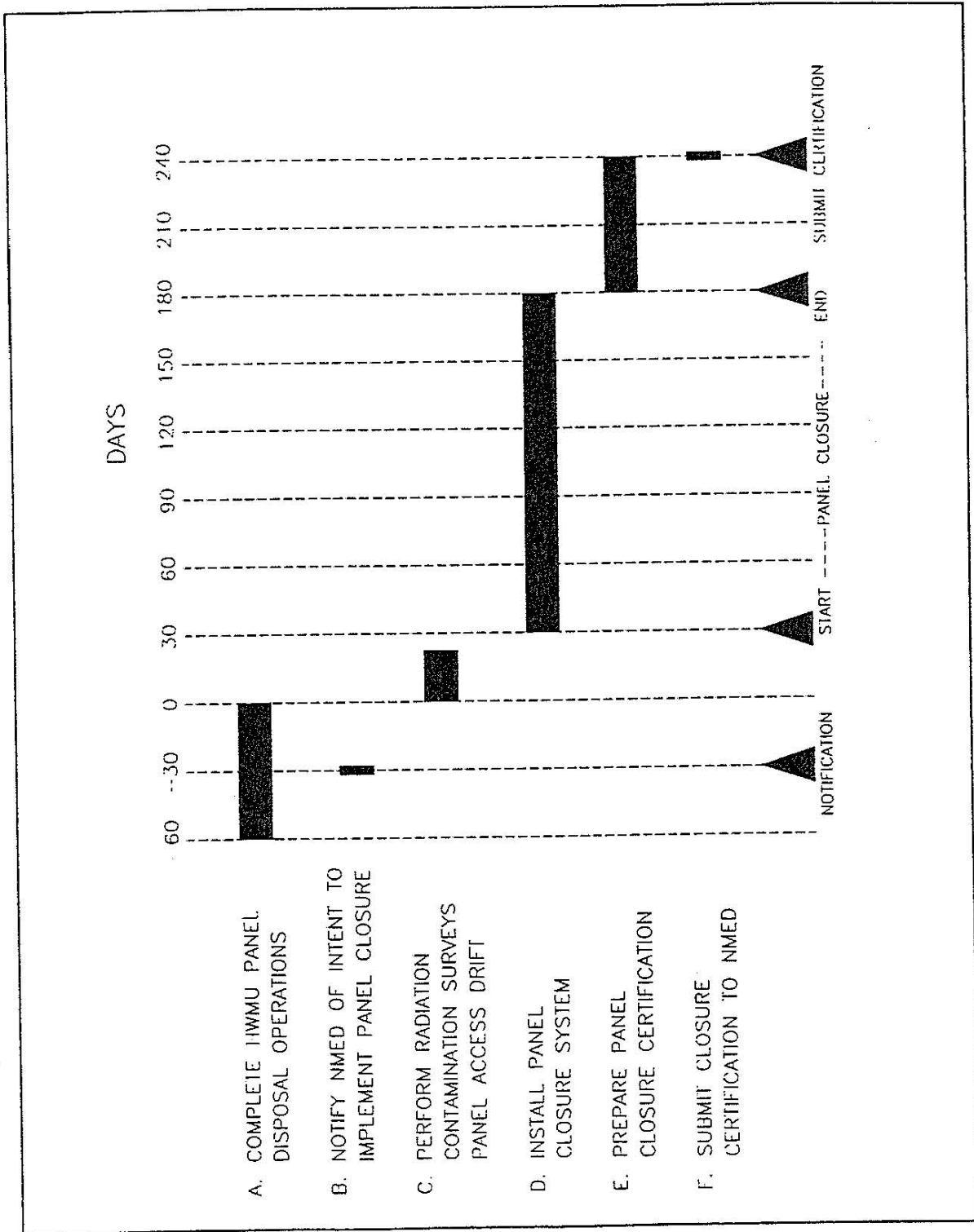


Figure G-2
 WIPP Panel Closure Schedule

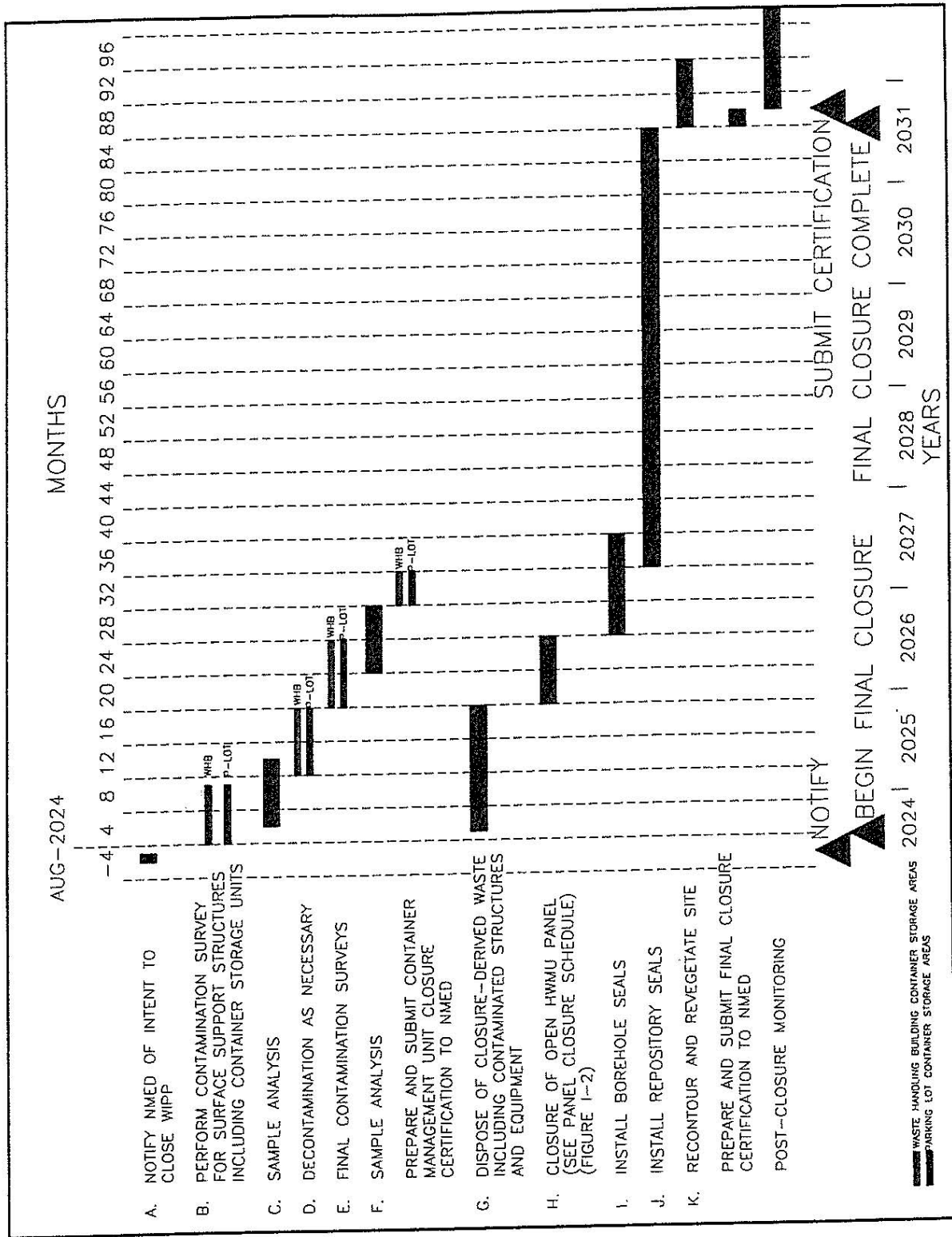


Figure G-3
WIPP Facility Final Closure 84-Month Schedule

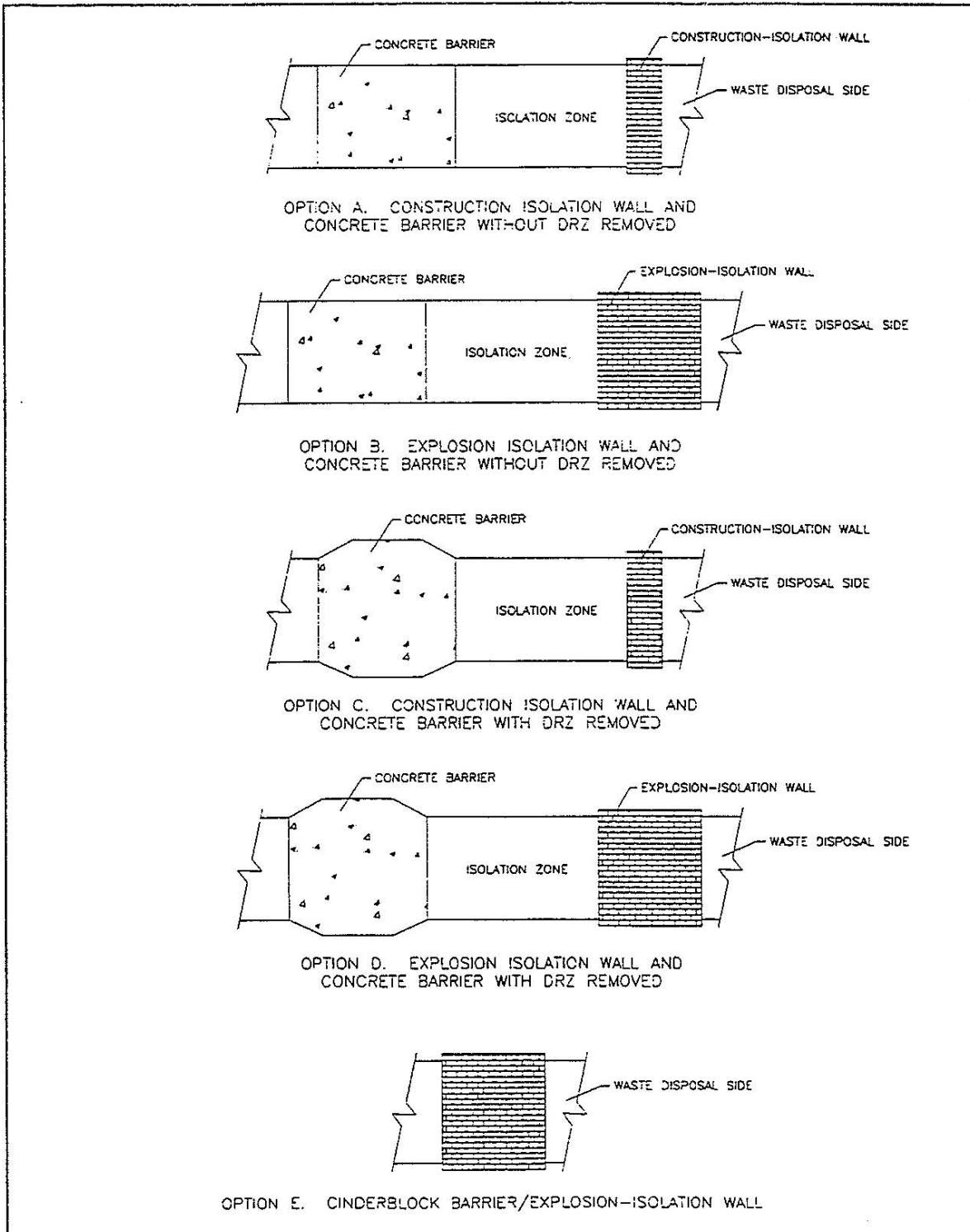
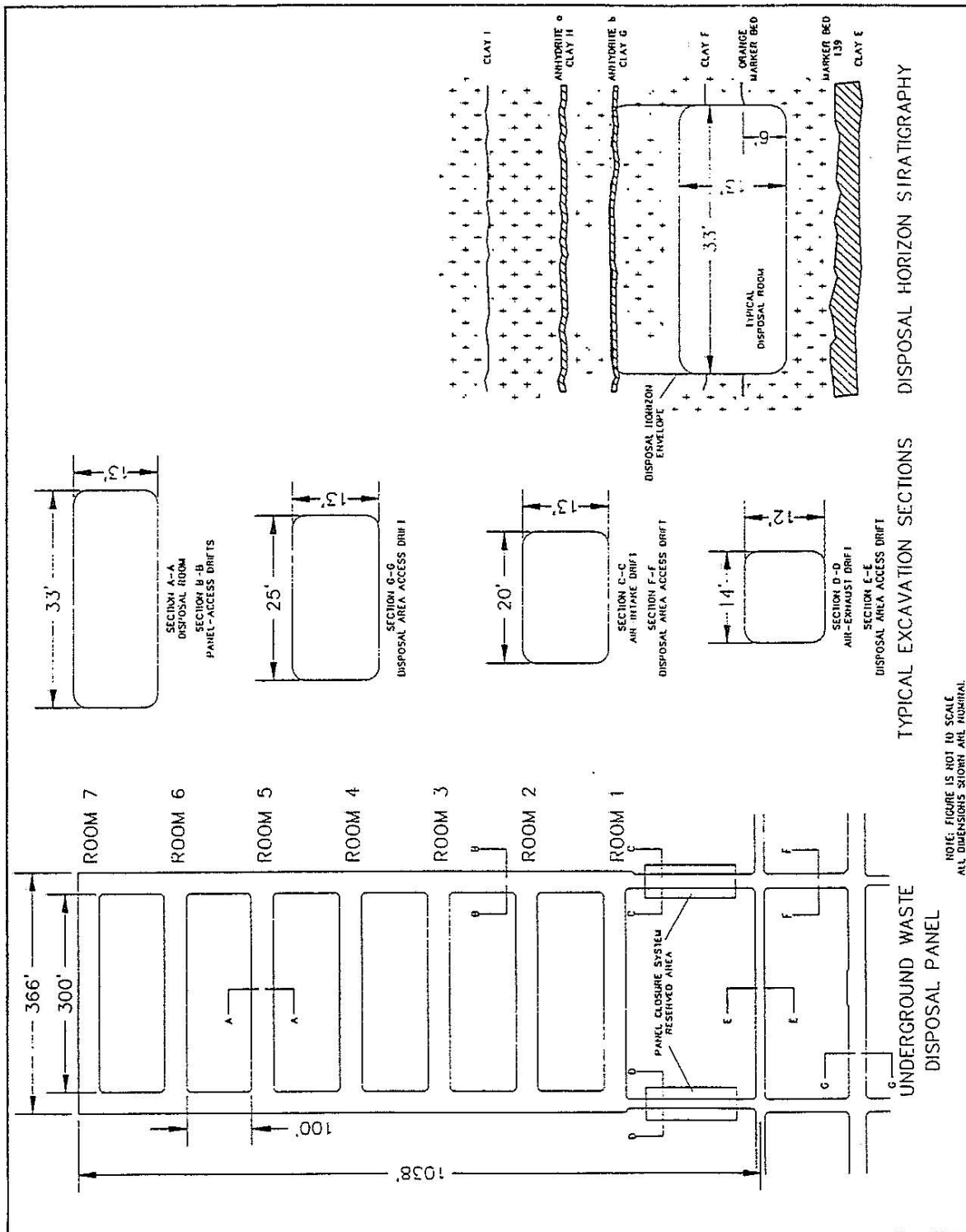


Figure G-4
Design of a Panel Closure System



NOTE: FIGURE IS NOT TO SCALE
 ALL DIMENSIONS SHOWN ARE NOMINAL

Figure G-5
 Typical Disposal Panel

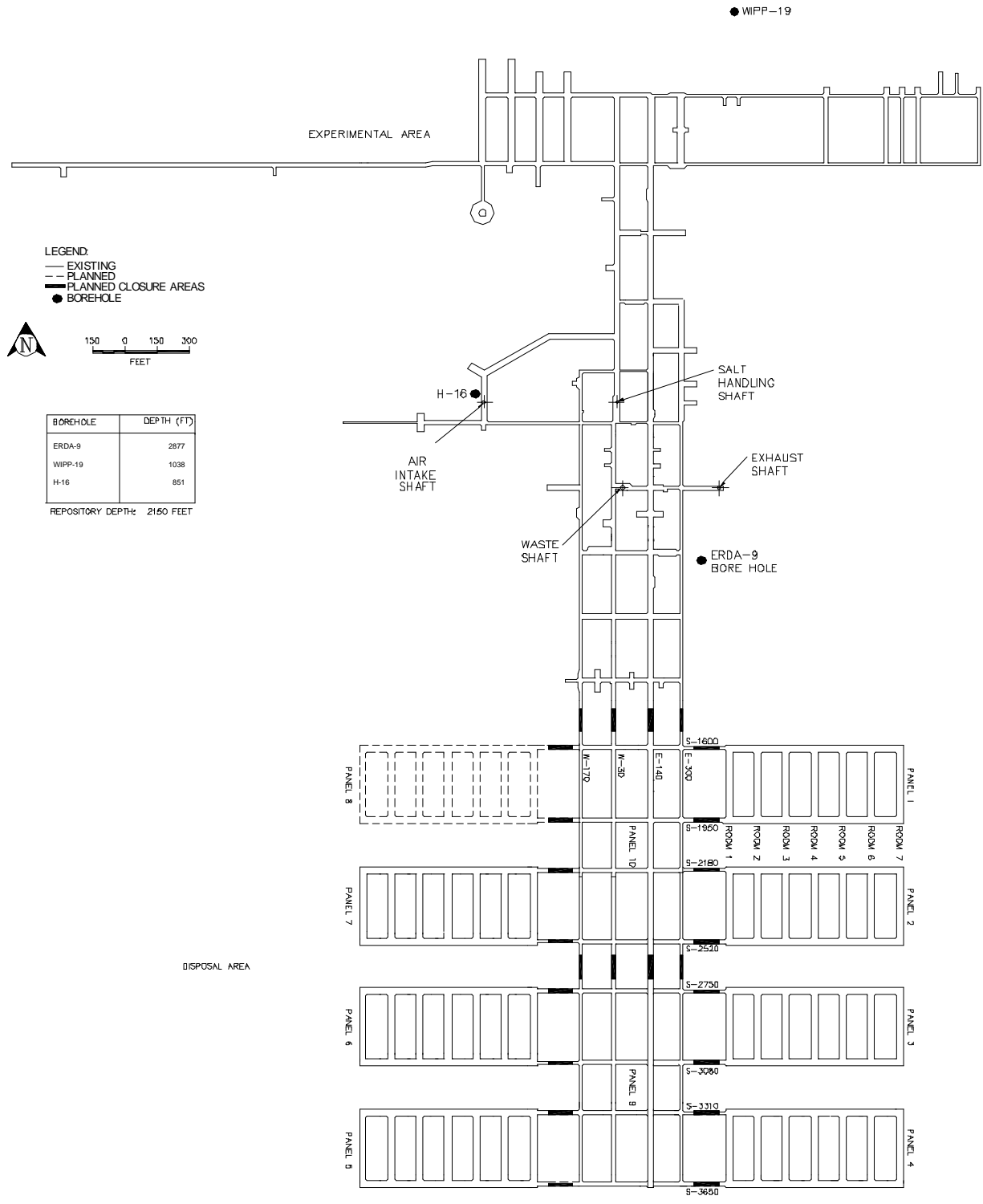


Figure G-6
 Approximate Locations of Boreholes in Relation to the WIPP Underground