
**Title 40 CFR Part 191
Compliance Certification
Application
for the
Waste Isolation Pilot Plant**

Appendix AIC



**United States Department of Energy
Waste Isolation Pilot Plant**

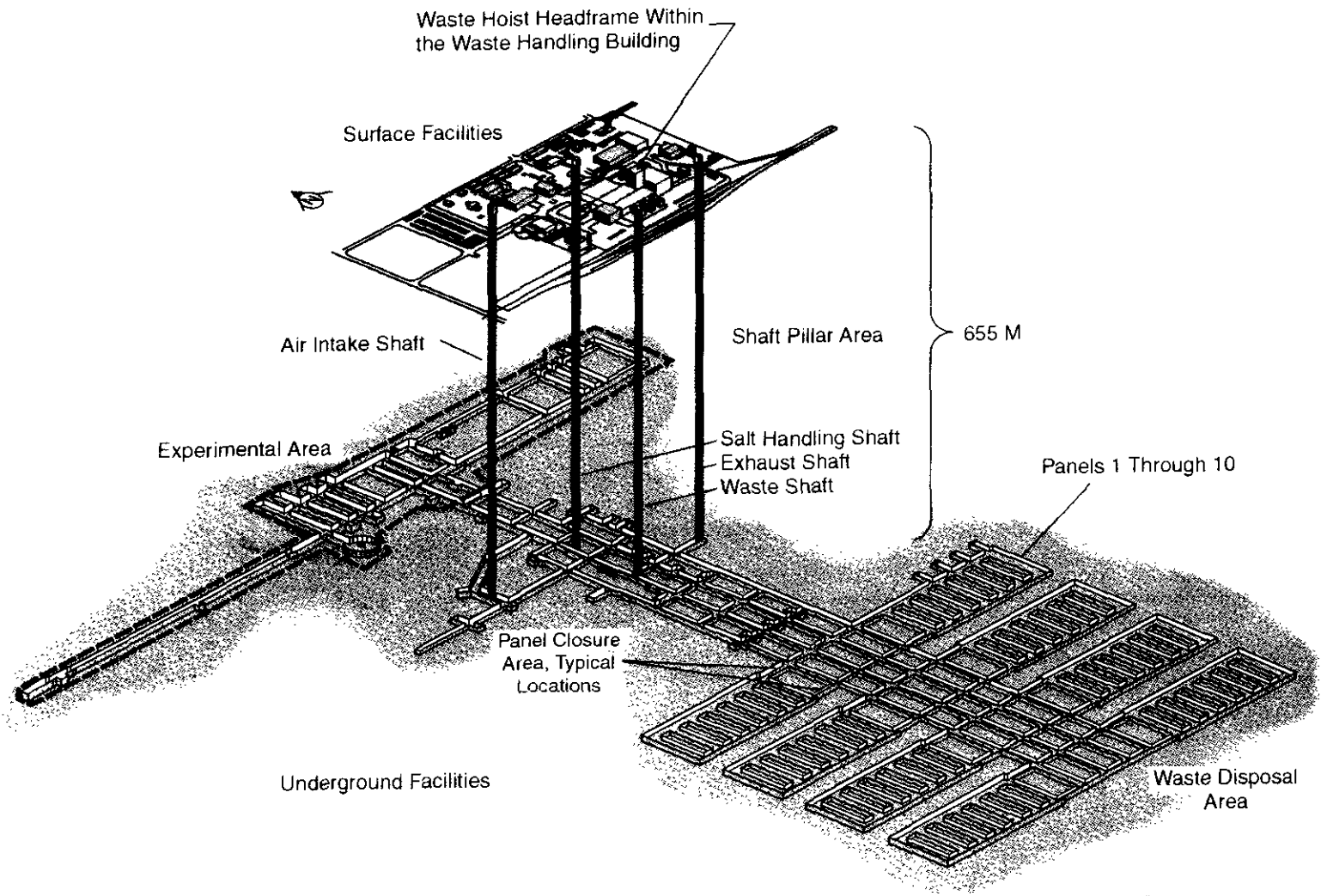
**Carlsbad Area Office
Carlsbad, New Mexico**



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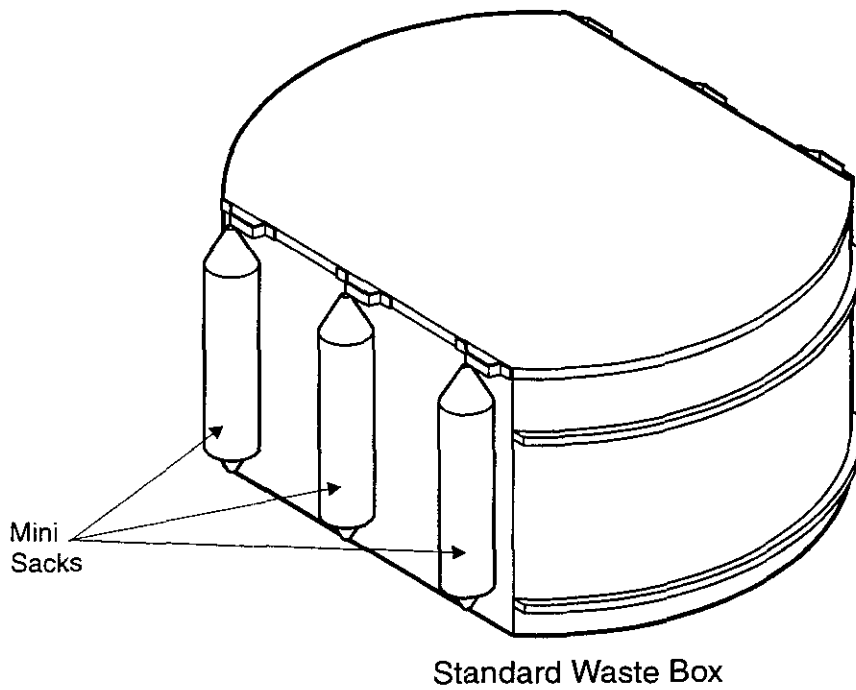
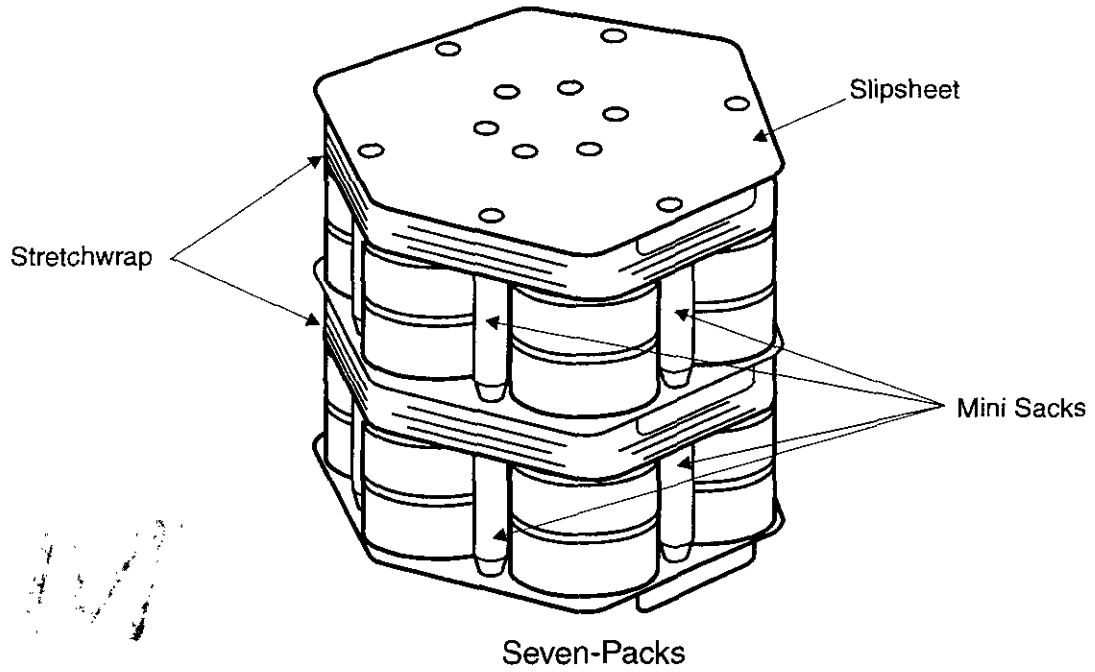
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Figure AIC-1. Spatial View of WIPP Surface and Underground Facilities

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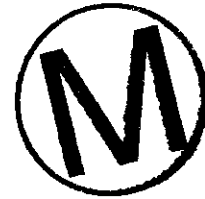


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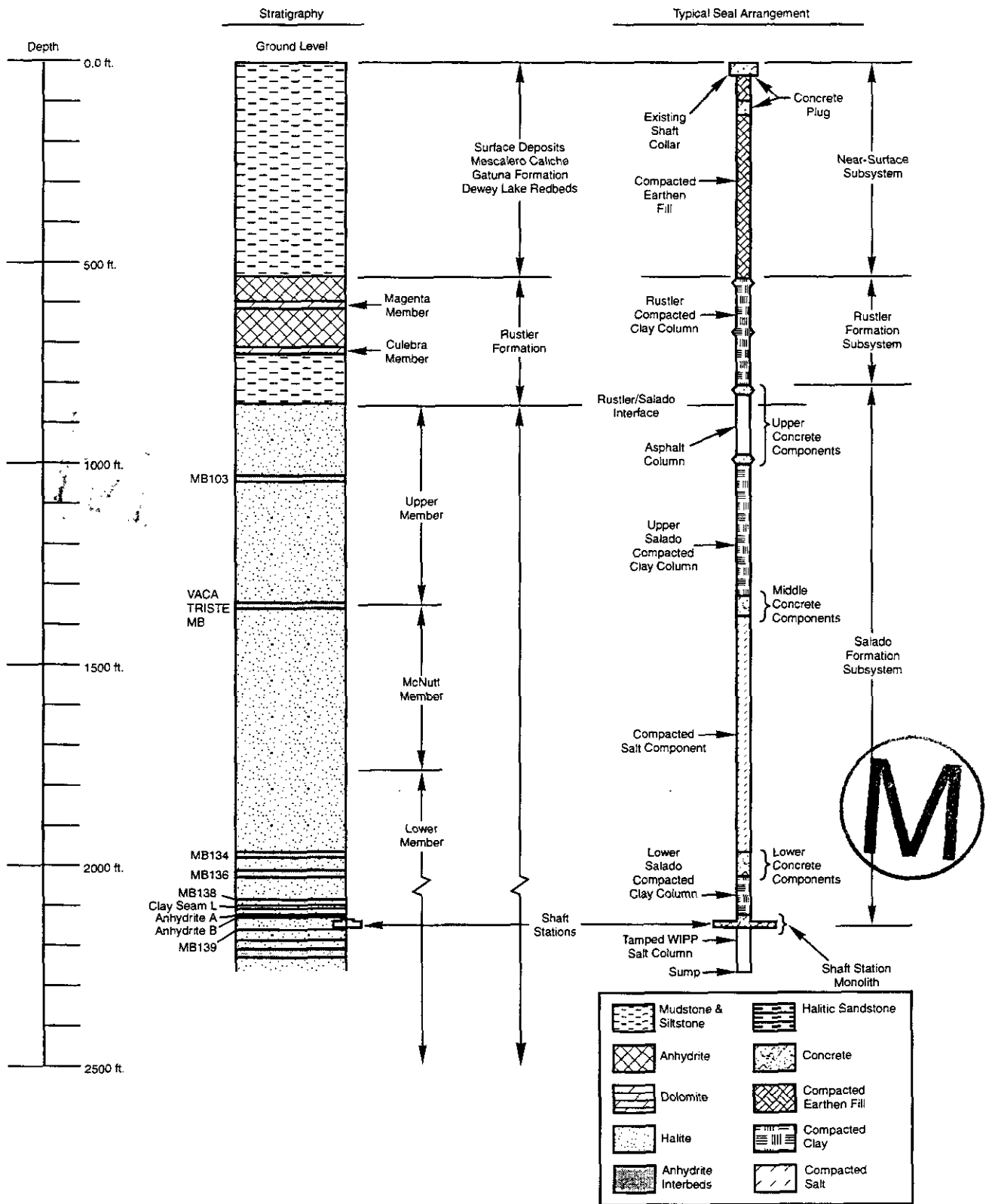
Figure AIC-2. Standard Waste Box and Seven-Pack Configuration

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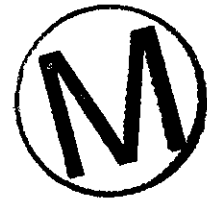


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Figure AIC-3. Typical Shaft Sealing System

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- 1 • The test program supporting the permanent marker system will require the
2 construction of a berm section, the erection of test monuments, and the emplacement
3 of test markers, all of which impact the ability to return the land disturbed by the
4 WIPP activities to a stable ecological state that will assimilate with the surrounding
5 undisturbed ecosystem.
- 6
- 7 • A posted access barrier will be erected around the repository footprint, also affecting
8 the return of the land disturbed by the WIPP activities to a stable ecological state.
- 9
- 10 • Elevation benchmarks to support the long-term monitoring program will be located
11 within a grid network on the surface of the withdrawal area.
- 12
- 13 • A portion of the mined salt sufficient to support future construction of the berm
14 component of the permanent marker system (see Appendix PIC) will remain on the
15 surface.
- 16
- 17 • The water supply line to the site will be disconnected. At a future time, a water supply
18 may have to be reestablished to support construction of the permanent marker system.
19 This supply will also be disconnected when construction of the marker system is
20 complete.
- 21
- 22 • The electrical supply to the site will be removed and isolated at the utility company's
23 substation. Electricity will be required for the future construction of the permanent
24 marker system.
- 25

26 Over the several decades following site restoration, activities supporting the long-term
27 monitoring program and evaluation of the performance of the permanent marker system test
28 program will require occasional access to the site surface area. Construction of the permanent
29 marker system will be a significant effort that will again require the development of water,
30 electrical, and transportation facilities at the site. Both railroad and trucking will be used to
31 transport required materials to the site. This effort is scheduled to last several years.

32
33 Upon completion of the permanent marker system, the access control program for the site will
34 be reevaluated and modified as required to address any changes necessitated by the effects of
35 the permanent marker system. At the time that the permanent marker system construction
36 effort is completed, the utilities and railroad spur supporting the site will be removed and the
37 affected terrain returned to a stable ecological state that will assimilate with the surrounding
38 undisturbed ecosystem.

39 40 **AIC.1 Design Criteria**

41
42 The access control design criteria applicable to the WIPP active institutional controls after
43 disposal have been developed to meet the definition in 40 CFR § 191.12 for controlling access
44 to the disposal site. In addition to active access controls, the criteria also address scheduling



1 processes to be implemented upon completion of shaft sealing activities. The
2 decontamination, decommissioning, and restoration of the land is addressed in Appendix
3 D&D of this application and will be described in detail in the *Plan for WIPP*
4 *Decommissioning*. The *Passive Institutional Controls Conceptual Design Report* (Appendix
5 PIC) addresses postdecommissioning testing activities conducted at the WIPP site. To a
6 limited extent, the restoration of the land to its original condition will be impacted by the
7 testing activities related to the permanent marker system and by the hot cell structure, which
8 will not be removed but will remain as an artifact of the WIPP operating surface activity. The
9 monitoring plan for the detection of substantial and detrimental deviations from expected
10 performance of the disposal system is described in Appendix MON.

11
12 Although the LWA establishes a 10,240-acre (4,144-hectare) area for administrative control
13 by the Secretary of Energy in conducting activities associated with the WIPP, the actual
14 disposal area is only approximately 120 acres (48.5 hectares). Access is controlled to ensure
15 that inadvertent intrusion into the disposal area does not occur. Deep or shallow drilling and
16 mining activities are the scenarios requiring consideration as human intrusion events in
17 performance assessment. Drilling techniques in the local area do not normally include slant
18 drilling (see Appendix DEL). In those cases where slant drilling is used, deviation from
19 vertical does not begin until a depth of approximately 4,000 feet (1,200 meters) is attained.
20 This depth is well below the Salado Formation, which extends to approximately 2,800 feet
21 (854 meters) below the surface in the vicinity of the repository. Salt formations do not
22 typically support slant drilling because of the solubility and insufficient consolidation of the
23 salt material (that is, its softness) (Rodriguez and Hughes 1994 and Rodriguez 1996, both in
24 the Bibliography). These technical facts reasonably preclude slant drilling into the repository
25 from outside the area immediately above the repository. In addition, as described in Appendix
26 PIC, the withdrawal boundary is marked with warnings not to drill or conduct mining
27 operations within the 16-square-mile (41-square-kilometer) controlled area. Therefore, it is
28 reasonable not to extend a restrictive access control program to the entire 10,240 acres (4,144
29 hectares) with the accompanying cost increase and unnecessary resulting prohibition of such
30 uses as grazing, hunting, and other public recreational activities.

31
32 The design features developed for the active access controls after disposal are the following:

- 33
34 1. A fence line will be established to control access to the repository footprint area on the
35 surface. A standard four-strand (three barbed and one unbarbed, in accordance with
36 the Bureau of Land Management specifications) wire fence will be erected along the
37 perimeter of the repository surface footprint. To provide access to the repository
38 footprint during construction of the berm (which may be built in multiple sections
39 simultaneously), the fence will have gates placed approximately midway along each of
40 the four sides. The western gate will be 20 feet (6 meters) wide. The remaining three
41 gates will each be 16 feet (4.9 meters) wide. Additional fencing may be needed for
42 remote locations that are used for disposal system monitoring. Such fences will meet
43 the same construction specifications as the repository footprint perimeter fence.
44



- 1 2. Unpaved roadways 16 feet (4.9 meters) wide will be established along the perimeter of
2 the barbed wire fence as well as along the WIPP site boundary. These roadways will
3 be constructed so as to provide ready vehicle access to any point around the fenced
4 perimeter and the site boundary. These roadways will facilitate inspection and
5 maintenance of the fenceline and will allow visual observation of the repository
6 footprint and the site boundary to the extent permitted by the lay of the land. These
7 roadways will connect to the paved south access road. Roads to remote sites will also
8 be constructed and maintained as needed.
- 9
- 10 3. The fence line will be posted with signs having, as a minimum a legend reading
11 "Danger—Unauthorized Personnel Keep Out" (40 CFR § 264.14[c]) and warning
12 against entering the area without specific permission of the federal government. The
13 signs must be legible from a distance of at least 25 feet (7.6 meters). The size of the
14 visual warning and the spacing of the warning signs will be sufficiently large and close
15 to ensure that one or more of the signs can be seen from any approach prior to an
16 individual actually making contact with the fence line. In no case will the spacing be
17 greater than 300 feet (91.5 meters).
- 18
- 19 4. The federal government will ensure that periodic inspection and expedited corrective
20 maintenance are conducted on the fence line, its associated warning signs, and the
21 roadway.
- 22
- 23 5. The federal government will provide for routine periodic patrols and surveillance of
24 the protected area by personnel trained in security surveillance and investigation.
- 25
- 26 6. A process will be implemented for monitoring and controlling the long-term testing
27 requirements of the permanent marker system and implementing the periodic
28 monitoring requirements of the long-term monitoring system.
- 29
- 30 7. The federal government will ensure that any necessary modifications to the active
31 controls appropriate for access control and surveillance upon installation of the
32 permanent marker system are provided.
- 33
- 34 8. The federal government will provide for actions to be taken to address abnormal
35 conditions identified during periodic surveillance and inspections.
- 36
- 37 9. Reports addressing activities associated with the performance of the active access
38 controls after disposal will be prepared periodically by the federal government for
39 submittal to the appropriate regulatory and legislative authority.
- 40

41 The primary active attribute of access control consists of the routine surveillance patrols of the
42 fence barrier and the repository footprint within that barrier. Periodic monitoring of the
43 parameters associated with repository performance is a secondary active control feature. The

1 development of a schedule for these activities and implementation of that schedule serves as a
2 tertiary active control. The details of the monitoring program are described in Appendix
3 MON.

4
5 **AIC.2 Access Controls**

6
7 40 CFR § 191.12 defines active institutional controls to consist of four elements:

- 8
- 9 • controlling access to a disposal site by any means other than passive institutional
- 10 controls,
- 11
- 12 • performing maintenance operations or remedial actions at a site,
- 13
- 14 • controlling or cleaning up releases from a site, and
- 15
- 16 • monitoring parameters related to disposal system performance.
- 17



18 The LWA has removed the WIPP site from public use as a site for mining and other types of
19 mineral resource extraction. Since any type of exploration activity would require
20 authorization, the issuance of approval to intrude upon the repository is precluded by the
21 LWA. The existence of the LWA as law permits meeting the requirements of the first
22 element above by implementing low technology barriers. These barriers include a posted
23 fence and active surveillance at a frequency that denies sufficient time for an individual or
24 organization to intrude into the repository undetected using today's drilling technology. As
25 identified in the design criteria, maintenance and remedial actions at the WIPP site will be
26 conducted by the federal government at the time of implementing the access controls for the
27 site. Those maintenance operations and remedial actions associated with decommissioning
28 and site restoration following final facility closure are discussed in Appendix D&D. The
29 control or cleanup of releases from the site will be conducted as part of the operational
30 program prior to sealing of the shafts. This is necessary to ensure that all radioactive derived
31 waste is disposed of within the repository prior to shaft sealing. There is no credible scenario
32 for the release of radioactive material during the active institutional controls period. Both
33 preclosure and postclosure monitoring of disposal system performance are addressed in
34 Appendix MON.

35
36 The federal government has the responsibility to maintain the access controls. Such
37 responsibility includes the maintenance and corrective actions necessary to ensure that the
38 fence and patrol requirements (surveillance) are met for as long as the federal government
39 remains a viable controlling entity. Justification that such control will endure for at least
40 100 years is supported by the fact that the U.S. government has existed for over 200 years, and
41 in that 200 years, its degree of control over activities affecting the common good has steadily
42 increased. In addition, historical evidence supports that as the human population increases



1 and technology advances, the need to control the resulting complexities gives rise to society's
2 acceptance of a governing system of laws, regulations, and oversight of activities affecting the
3 common good.

4 5 ***AIC.2.1 Repository Footprint Fencing***

6
7 Access to an area approximately 2,780 feet by 2,360 feet (875 meters by 720 meters) will be
8 controlled by a four-strand barbed wire fence. A single gate will be included along each side
9 of the fence for access. Around the perimeter of the fence, an unpaved roadway 16 feet
10 (4.9 meters) wide will be cut to allow for patrolling of the perimeter. Figure AIC-4 is an
11 illustration of the fence line in relation to the repository footprint. Patrolling of the perimeter
12 is based upon the need to ensure that no mining or well drilling activity is inadvertently
13 initiated that could threaten the integrity of the repository.

14
15 Fencing off an area larger than the disposal area footprint would not significantly reduce the
16 risk of inadvertent intrusion but would interfere with cattle grazing established prior to the
17 LWA. The LWA states that the Secretary of Energy can allow grazing to continue where it
18 was established prior to enactment of the LWA. Based upon current drilling technologies,
19 discussions with local well drilling organizations, and observation of well drilling activities in
20 the WIPP vicinity, it typically requires at least two to three days for a driller to set up a deep
21 drilling rig and commence actual drilling operations. Attaining the 2,150-foot (655-meter)
22 depth that would approach the repository horizon takes at least another week to 10 days.
23 Based upon current drilling practices (see Appendix DEL), patrolling the fenced area two to
24 three times weekly would identify any potential drilling activity well before any breach of the
25 repository could occur.

26
27 A scenario involving drilling at a location outside the disposal area surface footprint and
28 inadvertently intruding into the disposal area is extremely unlikely. The most economical
29 drilling practice is to drill vertically into the targeted formation. Local slant drilling is
30 conducted only when the desired drill location is not available because of circumstances that
31 the operator cannot overcome. When slant drilling practices are employed, the deviation from
32 a vertical position directly below the drill rig does not commence until approximately 4,000
33 feet (1,200 meters) below the surface in the local area. Slant drilling within a salt formation is
34 not practical because the salt is water soluble and insufficiently consolidated to support the
35 technique for accurate control of the drill bit (Rodriguez 1996 in the Bibliography).

36 According to the local office of the Bureau of Land Management, local operators and drillers,
37 and oil field consultants, slant drilling in the local area does not begin until the drilling
38 operator has reached a level below the evaporite formations. The lowest evaporite formation
39 in the WIPP vicinity is the Castile Formation, which lies immediately below the Salado,
40 which contains the WIPP repository.

41
42 Construction of access control systems using higher technology than described is not required
43 or cost-effective. Likewise, continuous surveillance whether human or electronic is not
44 required or practicable. The staffing levels required to achieve continuous human surveillance

1 become significant when weighed against the potential threat and alternatives for controlling
2 access. Continuous electronic surveillance also has significant costs of procurement,
3 installation, testing, and maintenance. Electronic systems would require significant
4 maintenance, both operational and corrective, and probably would not relieve the need to
5 make routine patrols to the site. This is especially true of alarmed electronic surveillance in a
6 location populated by a variety of wild and domestic animals that might trigger numerous
7 false alarms. Televised electronic surveillance that combines both human and electronic
8 technology could be incorporated to deter inadvertent human intrusion; however, this method
9 is extremely costly.

10
11 **AIC.2.2 Surveillance Monitoring**

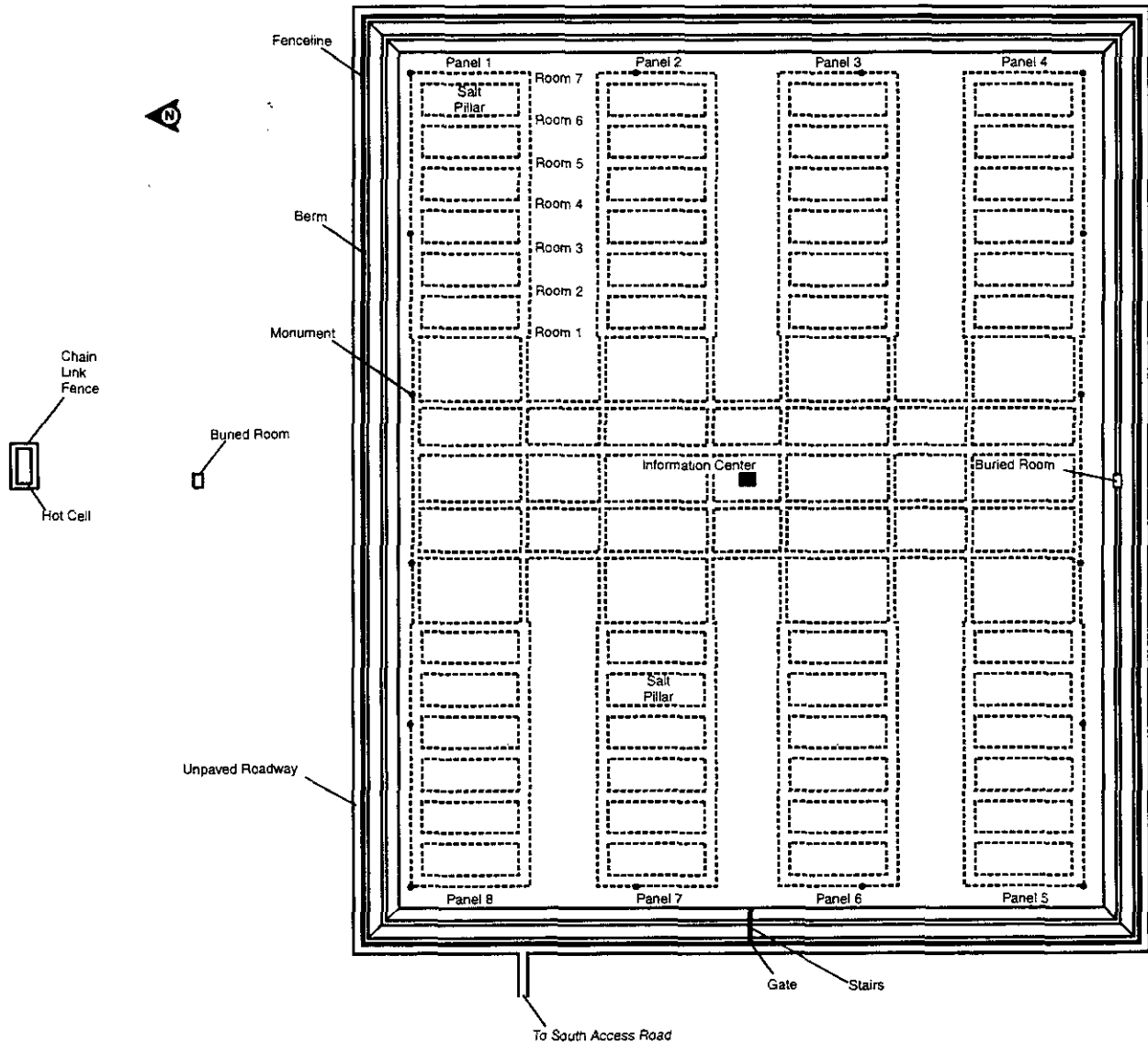
12
13 The federal government (initially DOE and/or the Bureau of Land Management) will conduct
14 periodic surveillance of the site and the repository footprint. Unpaved roadways around the
15 WIPP site boundary and around the repository footprint will facilitate such surveillance.
16 Contractual arrangements with a local organization such as the Eddy County Sheriff's
17 Department would provide some distinct advantages. Among the advantages are the
18 following:

- 19 • deputies are trained in patrol and surveillance activities,
- 20 • deputies are authorized to arrest members of the general public who are found to be
21 violating trespassing laws,
- 22 • the liability associated with apprehension, attempted apprehension, or circumstances
23 arising from attempts would remain with the Sheriff's Department, and
- 24 • the liability associated with apprehension, attempted apprehension, or circumstances
25 arising from attempts would remain with the Sheriff's Department, and
- 26 • the general area to be patrolled is already a part of the Sheriff's area of responsibility.
- 27
- 28
- 29

30 Surveillance will consist of drive-by patrolling around the fenced perimeter a minimum of two
31 times per week. In the course of the patrol, particular note will be taken of the fence integrity.
32 In addition, the locked condition of each gate will be checked to ensure that gate integrity is
33 maintained and there is no evidence of tampering. Surveillance will also include visual
34 observation of the entire enclosed area for any signs of human activity. Additionally,
35 surveillance patrols will be conducted around the site boundary's perimeter for signs of
36 unauthorized human activities. A routine summary of each month's surveillance activity will
37 be prepared documenting the date and time of each patrol and any unusual circumstances that
38 may have been observed. This surveillance routine will continue throughout the active
39 controls period and for at least 100 years following the sealing of shafts.

40
41 Upon beginning construction of the permanent marker system, a routine presence at the site
42 will once again be established and periodic surveillance will not be necessary. Once the
43 permanent marker system is completed, the active controls program and access control
44 measures will be reevaluated, and changes necessitated by construction of the permanent





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Figure AIC-4. Perimeter Fenceline and Roadway

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1 marker system will be made and implemented for the remainder of the active controls period.
2 With construction of the permanent marker system, easy visual inspection will not be possible
3 from the perimeter fence because the berm and monuments will restrict vision. However, this
4 will not affect the ability of patrols to properly survey the repository footprint integrity. The
5 berm profile and configuration would require an extensive dismantling effort to create an
6 opening sufficient to permit entrance of drilling equipment. The routine patrols would detect
7 this effort well before intrusion into the repository could occur.
8

9 ***AIC.2.3 Maintenance and Remedial Actions***

10
11 Anticipated maintenance and remedial action issues during the active controls period are
12 minimal and should encompass such issues as

- 13
- 14 • fence and road maintenance,
- 15
- 16 • correction of any damage that occurs due to vandalism,
- 17
- 18 • response to evidence of potential erection of drilling equipment, and
- 19
- 20 • response to unauthorized entry into prohibited areas.
- 21



22 The federal government (initially the DOE) will provide maintenance services when the need
23 is identified during routine patrolling activity. Any observed vandalism or unauthorized entry
24 will be investigated and action will be taken as the circumstances warrant.
25

26 ***AIC.2.4 Control and Clean-up of Releases***

27
28 The *Plan for WIPP Decommissioning* (as required by the LWA) will describe how the DOE
29 intends to decontaminate and dismantle the surface structures. The decontamination process
30 and disposal of the derived radioactive waste will be completed prior to sealing the shafts and
31 final facility closure. With the location of the WIPP repository at 2,150 feet (655 meters)
32 below the surface and with panels closed and shafts sealed, the potential for releases of
33 radioactive material following the sealing of the shafts is precluded. There will be no credible
34 pathway for releases from the repository other than human intrusion. Routine patrols in
35 accordance with access control requirements will preclude human intrusion into the
36 repository.
37

38 ***AIC.2.5 Monitoring Disposal System Performance***

39
40 Subsidence monitoring is one of three monitoring programs that are expected to be conducted
41 throughout the active institutional controls period (see Appendix SMP). The other programs
42 are groundwater surveillance and drilling practice observation (Appendices GWMP and
43 DMP). If, upon analysis of monitoring data, disposal system performance deviates from what



1 is expected, other techniques also described in the long-term monitoring plan may be used to
2 assist in acquiring more information regarding performance.

3
4 Performance assessment sensitivity analyses have identified important repository performance
5 parameters (see Appendix MON). Those important parameters that lend themselves to current
6 monitoring technologies without compromising the integrity of the disposal system were
7 considered as candidates for preclosure and postclosure monitoring.

8 9 **AIC.3 Periodic Activity Controls**

10
11 With the advent of decommissioning the WIPP and returning the land disturbed by the WIPP
12 activities to a stable ecological state that will assimilate with the surrounding undisturbed
13 ecosystem, continuous occupancy of the site for operational and security purposes will cease.
14 However, during the active controls period after disposal (at least 100 years) there will be an
15 ongoing need to carry out periodic activities associated with the long-term monitoring
16 program and evaluations of the performance of permanent marker system features under long-
17 term testing. To ensure that these periodic activities are implemented and that their results are
18 included in periodic reports to the appropriate regulatory and legislative authorities, the
19 essential elements of the process for controlling these activities have been identified. The
20 process will be managed from the appropriate DOE office. The essential elements of the
21 process include the following:

- 22
23 • development of detailed individual activities supporting the long-term monitoring
24 plan;
- 25
26 • development of detailed individual activities supporting the evaluation of performance
27 of permanent marker system features;
- 28
29 • development of the individual steps and identification of responsible personnel
30 required for the drafting, review, commenting, and approval of reports to the
31 appropriate regulatory authority;
- 32
33 • development of the individual steps and identification of responsible organizations or
34 personnel required for the drafting, review, commenting, and approval of reports to the
35 appropriate legislative authority;
- 36
37 • identification of the requirements defined from the above actions in a detailed
38 schedule covering a period of at least 10 years;
- 39
40 • review of the approved schedule at least quarterly during the first two years following
41 completion of land restoration and implementation of active institutional controls; and
42

- semiannual reviews of the schedule including updating and progress reporting to the DOE to be documented until such time as the federal government ceases active control of the site.

For long-term repository performance monitoring, a detailed subsidence survey will be conducted upon completion of land restoration. That survey will include, at a minimum, the 54 elevation benchmarks currently monitored. Once every 10 years, an additional detailed subsidence survey will be taken and analyzed for indications of unexpected repository performance. The long-term monitoring plan describes in detail additional technologies to be used to further evaluate repository performance should any unanticipated subsidence data be developed. These additional technologies may include

- seismic reflection and refraction surveys,
- gravitational surveys,
- electromagnetic conductivity surveys,
- resistivity surveys, and
- ground-penetrating radar surveys.



Currently, none of these technologies is developed to the degree of providing irrefutable evidence of the condition of the sealed repository. However, over the next few decades while waste is being emplaced in the repository, the technologies will likely advance significantly. It is also possible that images available using today's technologies will improve to a point where resolution of images of the repository acquired from grade level will be of sufficient quality to make some assessments of repository performance. Updating the 10-year schedule every six months to one year will ensure that this infrequent requirement is not lost.

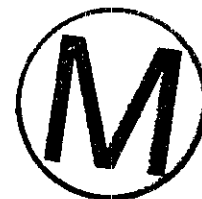
To optimize the final design of the permanent marker system, testing of various materials and berm configurations over a long period of time is a prudent and logical course of action. The detailed activities supporting the testing required to evaluate various aspects of the planned permanent marker system design will be included in the schedule managed during the active institutional controls period. Periodic reports will also be managed by the scheduling activity during the active controls period.

Because of the relatively simple technology utilized in providing access control to the repository footprint and the hot cell, the range of potential abnormal occurrences is quite limited. Primarily, the abnormal occurrences will involve damage to the fencelines or roadway through vandalism, weather effects, and aging of the materials. The federal government is responsible for corrective action to repair these effects. Considering the properties for which access control is being provided, there is no need to provide continuous

1 surveillance. However, arrangements will be made to increase vehicular patrols of the site to
2 daily patrols until repairs are made, if the damage is of a suspicious nature. If not, no increase
3 in patrol activity will be required.

4
5 Abnormal occurrences associated with the environmental monitoring activities will be
6 investigated. As described above, the postdecommissioning environmental monitoring
7 program will include both radiological and nonradiological monitoring for the first two years
8 following land restoration and then only radiological monitoring thereafter. Because of the
9 reduced activity to support the WIPP after disposal, it is probably more cost effective for the
10 DOE to contract for the periodic sampling and analyses than to maintain a Carlsbad staff for
11 that purpose. Within the contractual arrangements, immediate notification by the contractor to
12 the DOE Albuquerque Operations Office in the event of an abnormal occurrence will be a
13 requirement. Appropriate guidelines for action to mitigate the effects of abnormal
14 occurrences related to environmental monitoring will include

- 15 • verification of analytical results,
- 16 • increased frequency of sampling and analyses,
- 17 • determination of cause,
- 18 • investigation of additional geographical and/or parameter monitoring areas that might
19 be affected, and
- 20 • timely communication to the press regarding any potential adverse impacts and
21 mitigating actions to be taken.



22 The action guidelines for abnormal occurrences associated with subsidence are the same as
23 those proposed for the environmental monitoring program.

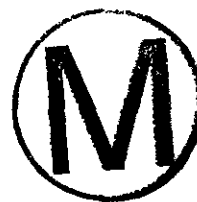
31 **AIC.4 Quality Assurance**

32
33 The quality assurance and quality control discipline will be applied to the procurement of
34 materials for and the erection of the fencelines enclosing the repository footprint and the hot
35 cell. *In particular, quality control inspection of the placement and tensioning of the barbed*
36 *wire and chain link fabric should be applied and utilized to provide reasonable assurance that*
37 *the fencing structures will function over an extended period of years without significant*
38 *maintenance.*

39
40 Quality assurance and quality control will also be applied to the sampling and analyses
41 supporting the environmental monitoring program and the long-term monitoring plan. DOE
42 contractors collecting samples and laboratories conducting analyses should be qualified in

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- 1 accordance with guidelines prescribed in the most current edition of the *Quality Assurance*
- 2 *Program Document* (see Appendix QAPD of this application) at the time that the contracts are
- 3 awarded.

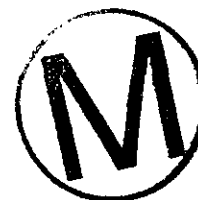


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