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Long-Term Surveillance Plan for the Slick Rock, Colorado, Disposal Site

July 2024
Version 1.0

U.S. DEPARTMENT OF ENERGY | Legacy Management

This document has been designed for online viewing.

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Abbreviations

BLM	U.S. Bureau of Land Management
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EMS	Environmental Management System
ERO	Emergency Response Organization
ft	feet
IC	institutional control
LM	Office of Legacy Management
LMS	Legacy Management Support
LTS&M	long-term surveillance and maintenance
LTSP	Long-Term Surveillance Plan
m	meters
NRC	U.S. Nuclear Regulatory Commission
PLO	Public Land Order
^{226}Ra	radium-226
UMTRCA	Uranium Mill Tailings Radiation Control Act
USC	*United States Code*

1.0 Introduction

1.1 Purpose

This Long-Term Surveillance Plan (LTSP) details how the U.S. Department of Energy (DOE), as the long-term custodian, will comply with the general license requirements of Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27) for custody and long-term care of the Slick Rock, Colorado, UMTRCA Title I Disposal Site. An LTSP is a requirement under the general license held by the U.S. Nuclear Regulatory Commission (NRC) and states how DOE, as the long-term steward of the site, will comply with applicable federal, state, and local regulations. DOE coordinates the reporting of site and event information to all stakeholders.

The Slick Rock uranium mill tailings disposal site was initially licensed August 31, 1998, when NRC accepted the original *Long-Term Surveillance Plan for the Burro Canyon Disposal Cell, Slick Rock, Colorado* (DOE 1998).

This version includes the following revisions:

- Reflects site name change
- Eliminates text regarding monitoring of standpipes (DOE 2001; NRC 2002)
- Updates survey coordinates of existing and new site features
- Removes corrective action sections
- Adds aerial survey quality control monuments to the inspection checklist
- Adds a new emergency response section

1.2 Legal and Regulatory Requirements

Federal regulations set forth in 10 CFR 40.27 establish requirements for licensing, custody, and long-term care of uranium mill tailings disposal sites remediated under Title I of the Uranium UMTRCA of 1978 in Title 42 *United States Code* Section 7901 (42 USC 7901–7942, as amended). NRC is responsible for enforcing the general license requirements and for ensuring that DOE's long-term custody and care of these sites is satisfactory. Long-term stewardship includes institutional controls (ICs), inspection, monitoring, maintenance, and other measures to ensure that the sites continue to protect public health and the environment after remediation is completed. There is no provision for the termination of the general license or DOE's responsibility for the long-term custody at the site.

Table 1 presents how this LTSP demonstrates compliance with the requirements of the NRC general license for providing long-term custody and care of the licensed Slick Rock disposal site.

The procedures, plans, and specifications in this revised LTSP were developed using the *Guidance for Developing and Implementing Long-Term Surveillance Plans for UMTRCA Title I and Title II Disposal Sites* (DOE 2012).

Table 1. Requirements for LTSP and the Long-Term Surveillance and Maintenance of the Slick Rock, Colorado, Disposal Site

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1.3 Role of DOE and the Office of Legacy Management (LM)

DOE established LM in December 2003. The LM mission includes "implementing long-term surveillance and maintenance at sites to ensure sustainable protection of human health and the environment." As part of that mission, LM is responsible for DOE'S compliance with 10 CFR 40.27 and implementation of site-specific LTSPs.

During the course of long-term surveillance, changes in site conditions, management requirements, and technological advances may require changes to long-term surveillance and maintenance (LTS&M) activities for a particular site. Changes in site conditions or management requirements may require collecting new data, evaluating new reuse opportunities, utilizing new technology to aid in surveillance and monitoring, and documenting changes in physical site features. In such cases, LM revises the LTSP to document the changes and submits the revised LTSP to NRC for acceptance (10 CFR 40.27[c][3]).

LM implements an Environmental Management System (EMS) to incorporate life-cycle environmental considerations into LTS&M. LM's EMS process ensures that LM maximizes beneficial use of finite resources; minimizes waste and adverse environmental impacts; and meets or exceeds compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements.

2.0 Final Site Conditions

2.1 Site History

The Slick Rock disposal site consists of radioactive materials derived from the remediation of the former Slick Rock uranium and vanadium processing facility sites. Slick Rock East (formerly the North Continent site) and Slick Rock West (formerly the Union Carbide site) former processing sites are adjacent to the Dolores River about 22 miles north of the town of Dove Creek in San Miguel County (Figure 1).

Ore containing uranium and vanadium was mined in the Slick Rock area and trucked to the mill. The mills were designed to extract radium salts and vanadium from locally mined ores. In 1945, the federal government acquired control of the facility through the Union Mines Development Corporation to supply uranium for the Manhattan Project. After milling operations were discontinued in the early 1960s, the pile was covered with 6 inches of soil and vegetation (DOE 1994).

DOE's surface remediation of the Slick Rock processing sites began in January 1993 and concluded in September 1998 (MK-F 1997). Approximately 778,104 cubic yards of tailings and other contaminated materials were relocated to the Slick Rock disposal site, formerly named the Burro Canyon disposal cell, about 5 miles east of the processing sites (Figure 1). Both milling operations created a byproduct of radioactive tailings, which is a predominantly sandy material.

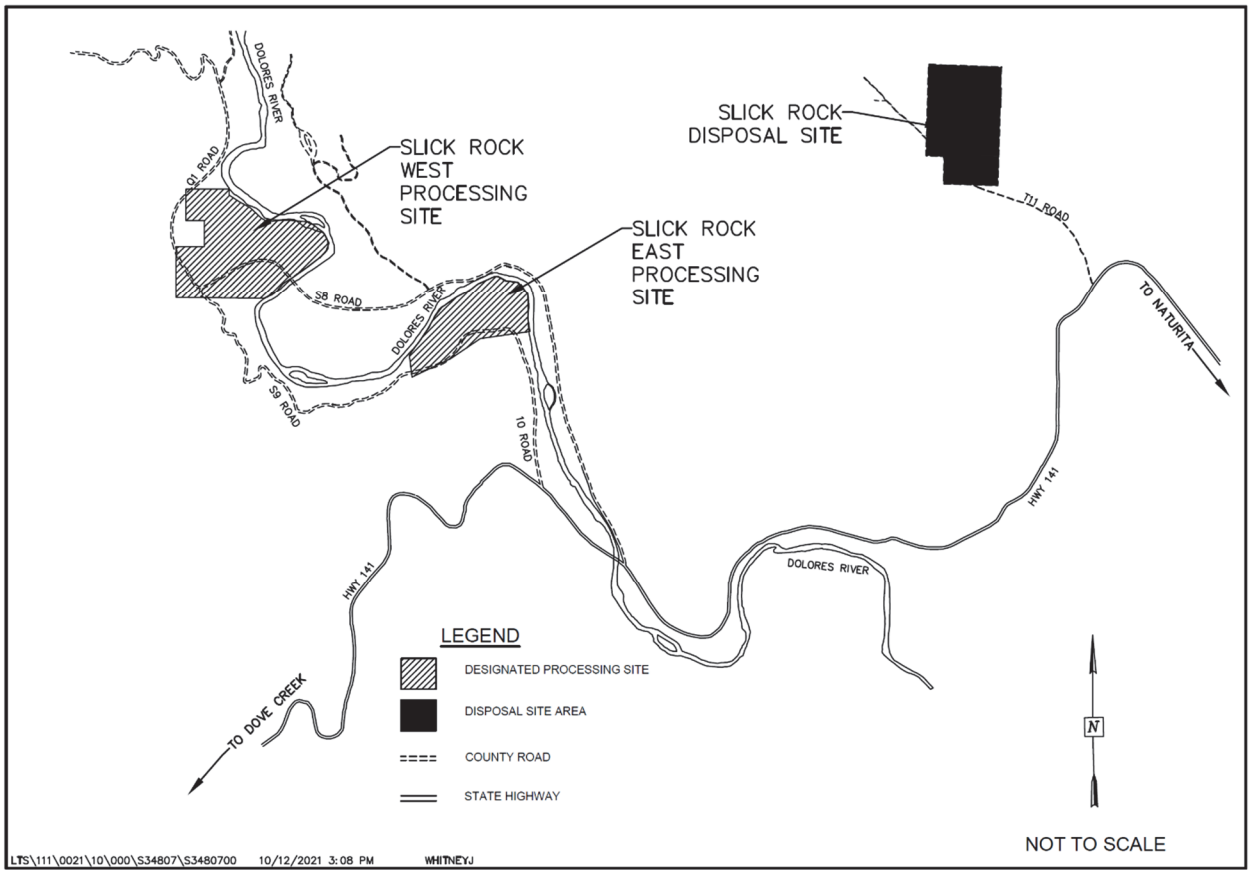

Figure 1. Location of the Slick Rock, Colorado, Disposal and Processing Sites

2.2 Disposal Site and Vicinity

2.2.1 Site Description

The Slick Rock disposal site is on approximately 62 acres, with the surrounding land owned and managed by the U.S. Bureau of Land Management (BLM). The Completion Report (MK-F 1997) contains a detailed description of final site conditions. The exclusion boundary is marked with warning signs, boundary markers, and survey monuments. The tailings and other

contaminated materials are contained in a rock-covered disposal cell in the center of the site. The site is enclosed by a four-strand wire fence that was placed during construction.

During final site grading, all areas were contoured to promote drainage away from the disposal cell. DOE used a mixture of grass species to revegetate disturbed areas of the disposal site that were not covered by riprap (DOE 1998).

At the completion of remedial action, DOE documented final disposal site conditions with site maps, as-built drawings, and ground and aerial photographs in the Final Completion Report (DOE 1997).

2.2.2 Legal Description

DOE acquired the disposal site land via a Public Land Order (PLO). The PLO permanently transferred 61.25 acres (24.8 hectares) from the public domain in San Miguel County, Colorado. Publication in Volume 60 *Federal Register* page 21984 (60 FR 21984) of PLO 7138 established the effective transfer date of May 4, 1995, to DOE. As a result, the land is no longer subject to the operation of the general land laws, including mining and mineral leasing laws. Transfer of the land to DOE vested in DOE the full management, jurisdiction, responsibility, and liability for the land and all activities conducted thereon, except that the U.S. Department of the Interior, through BLM, retained the authority to administer any claims, rights, and interests in the land established before the effective date of the transfer. There is a right-of-way agreement with the county for access to the disposal cell along San Miguel County Road T11.

The legal description in the public land office describes the disposal site area as follows (DOE 1998):

> Township 44 North, Range 18 West, New Mexico Principal Meridian. Section 21: S1/2 S1/2 SE1/4 SW1/4; Section 28: NE1/4 NW1/4, N1/2 NE1/4 SE1/4 NW1/4, N1/2 S1/2 NE1/4 SE1/4 NW1/4, NE1/4 NW1/4 SE1/4 NW1/4, and N1/2 SE1/4 NW1/4 SE1/4 NW1/4. The area described contains approximately 61.25 ac (24.79 ha) of public land in San Miguel County, Colorado.

2.2.3 Location and Access

The disposal site can be reached by the following driving directions and graphic directions as depicted in Figure 2.

1. From Grand Junction, Colorado, take U.S. Highway 50 (southeast) to Colorado Highway 141, which is approximately 9.3 miles.
2. Turn right (southwest) onto Highway 141. Travel for approximately 98 miles.
3. Turn right (south) to stay on Highway 141 for approximately 35 miles.
4. Turn right (north) onto the site access road, San Miguel County Road T11. Travel approximately 0.75 mile to the site. The site access point is marked by an entrance sign and a granite site marker just inside the site fence.

5. A four-strand wire fence surrounds the disposal cell, prohibiting access to the cell, and the site perimeter is bound by perimeter warning signs. The south access gate and pedestrian gates are kept locked.

2.2.4 Disposal Cell Description

The Slick Rock disposal cell measures 630 × 900 feet (ft) at the base and occupies an area of 12 acres on the 62-acre site. The disposal cell is on a small mesa isolated from upland drainage runoff, in an area that is not subject to significant hazard from slope failure processes such as landslides, debris flows, mudflows, and rockfalls. The geomorphic processes posing a potential hazard to the stabilized disposal cell are ephemeral drainage channel changes, low-gradient slope erosion, and wind erosion.

The cell was excavated up to 8 ft below ground surface so the bottom of the contaminated materials would be placed below a permeable sandstone layer of the Dakota Sandstone Formation that is exposed in the excavation wall. The disposal cell contains 1,109,265 million dry tons (about 778,104 cubic yards) of contaminated materials with a total activity of 149 curies of radium-226 (^{226}Ra) (MK-F 1997).

The top of the cell is at ground surface at the northwest corner and rises 50 ft above the surrounding land on the other sides. Material from the cell excavation was stockpiled west of the cell, contoured, and revegetated. A four-strand wire fence surrounds the cell, and the site perimeter is marked with warning signs and permanent boundary monuments (Figure 3).

Engineered structures at the site include the disposal cell, disposal cell cover, and erosion-protection features. The disposal cell is designed to isolate the materials in the cell from the surrounding environment while the disposal cell cover and erosion-protection features achieve the necessary surface water drainage control and erosion protection to satisfy the longevity design requirements. Construction details of the engineering structures may be found in the Completion Report (MK-F 1997), upon which this section is based.

The cover of the disposal cell is a multicomponent system designed to encapsulate and protect the contaminated materials. A 1.5 ft or 0.45 meter (m) thick radon or infiltration barrier is placed over the contaminated materials. This barrier is constructed of sandy clay soil. It is designed to reduce the radon-222 flux from the disposal cell to less than 20 picocuries per square meter per second and to minimize water infiltration into the tailings. A 2 ft (0.6 m) thick layer of compacted soil lies on top of the radon or infiltration barrier to prevent adverse freeze-thaw effects to the clay barrier. The top slopes and side slopes of the disposal cell are capped with rock to protect them from wind and water erosion and prevent damage to the underlying frost protection barrier. A cross section of the disposal cell and disposal cell cover are captured in Figure 4 and Figure 5.

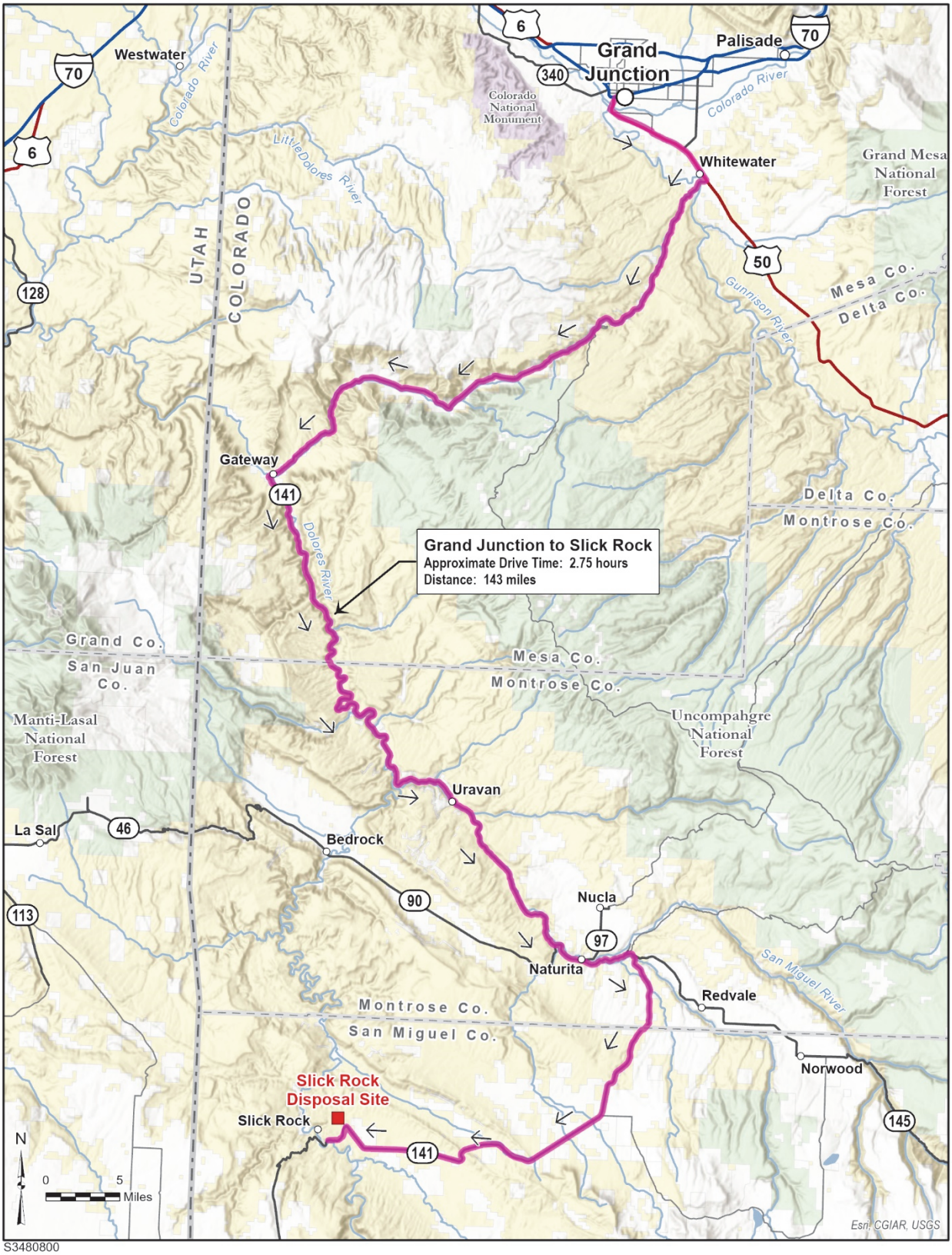

Figure 2. Driving Directions to the Slick Rock Processing and Disposal Sites

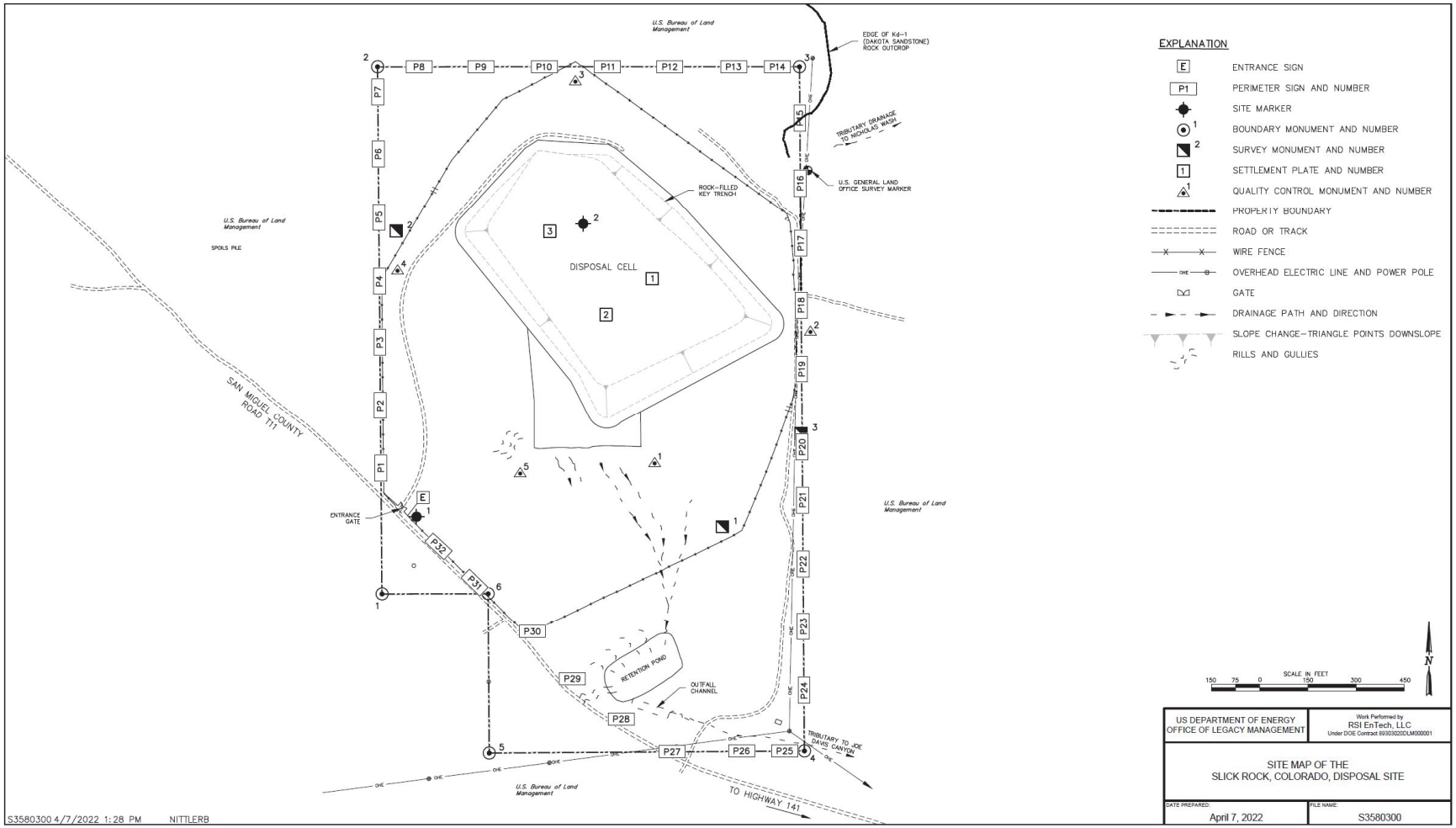

Figure 3. Site Map of Slick Rock Disposal Cell

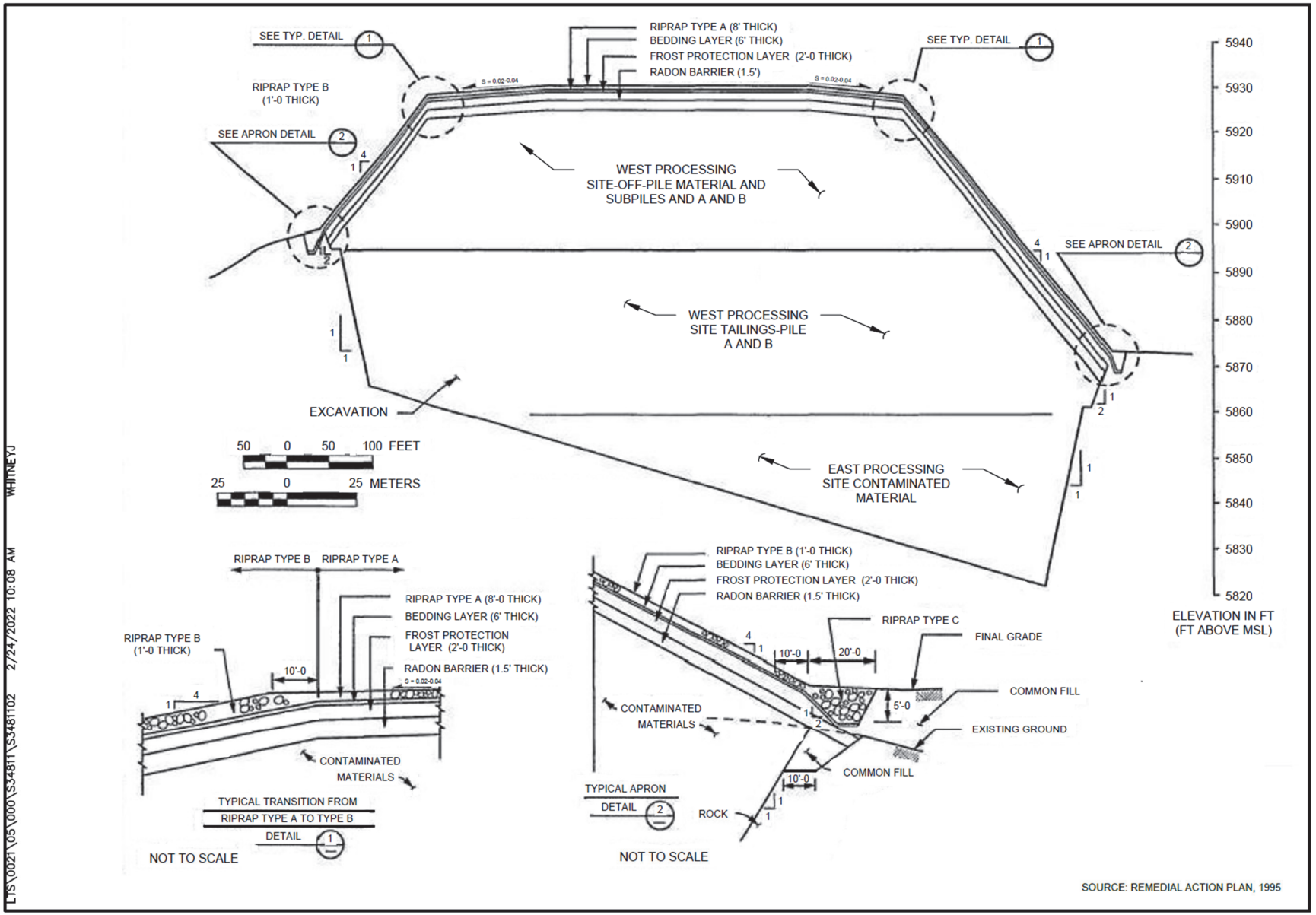

Figure 4. Cross Section of the Slick Rock Disposal Cell

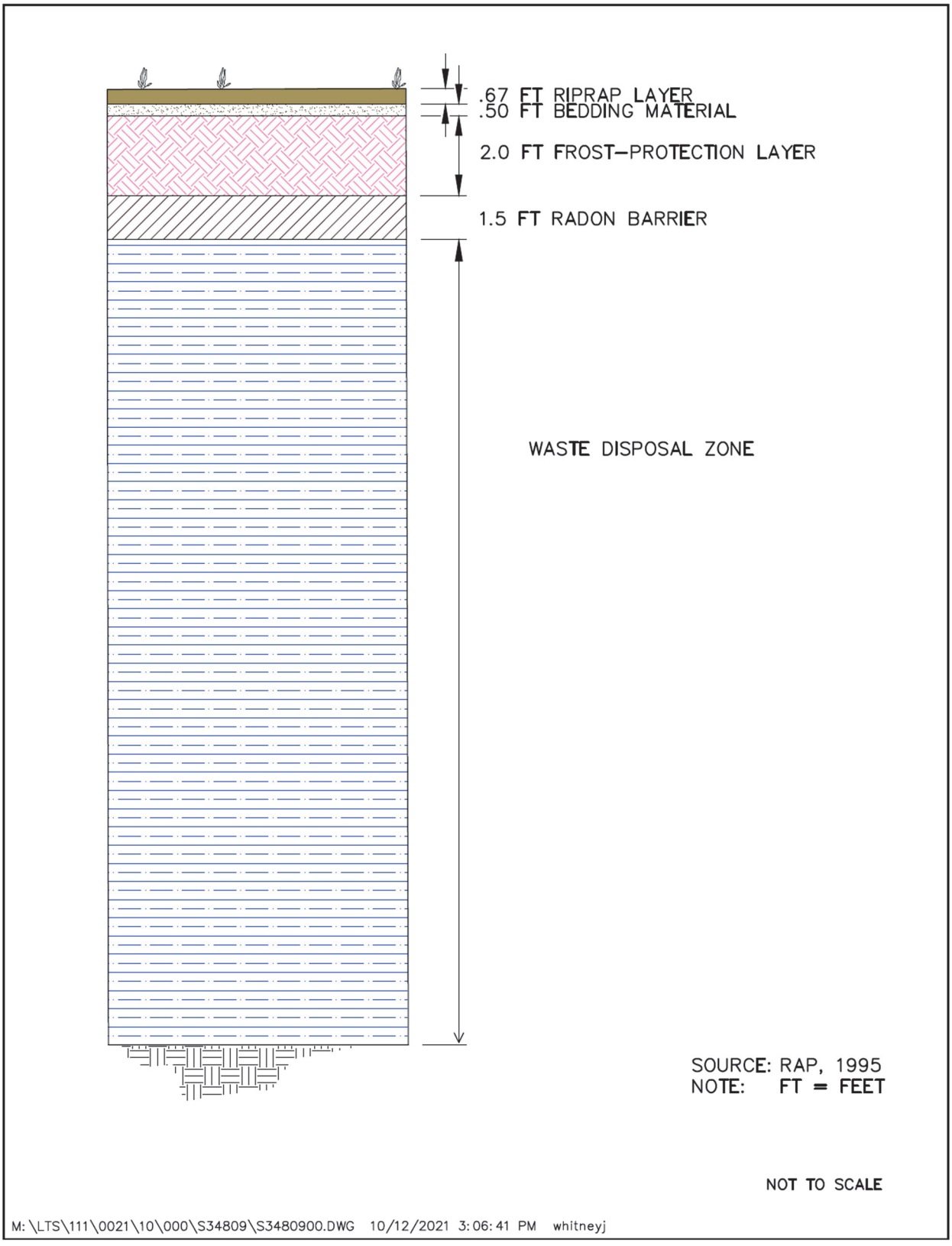

Figure 5. Cross Section of the Slick Rock Disposal Cell Cover

Because of the disposal cell's location, permanent drainage and interceptor ditches were not required at the disposal site. The erosion protection layer is 0.67 ft or 0.20 m thick riprap on the top slopes and 1.0 ft (0.3 m) thick riprap on the side slopes. The erosion protection layer is placed over a 0.5 ft (0.15 m) thick layer of bedding sand to prevent penetration of the riprap rock into the underlying clay layers. The maximum top slope grade is 4% with 25% grade on the side slopes.

These grades, in conjunction with the bedding layer, allow excess surface water to run off the disposal cell and be conveyed to adjacent site grades, minimizing the risk of significant erosion. The components of both the top slope and side slope covers are designed to minimize the potential for deep percolation of precipitation into the residual radioactive material. The riprap apron at the disposal cell toe is up to 5 ft (1.5 m) thick.

A riprap apron surrounding the perimeter of the disposal cell provides erosion protection at the toe of the cell and channels runoff away from the cell. Disturbed areas surrounding the site were regraded and seeded with native grasses.

2.2.5 Disposal Cell Drainage

A concern for the potential lateral migration of transient water during disposal cell completion, led to the installation of four PVC standpipes to monitor water levels in the disposal cell. In 1996, two standpipes showed water levels had stabilized and were abandoned before the licensing of the disposal cell occurred. The remaining two standpipes were abandoned and decommissioned in 2001 after water levels remained below the lower sandstone formation. NRC concurred on the termination of monitoring in 2001 (DOE 2001; NRC 2002).

2.2.6 Institutional Controls

ICs are established at disposal sites to protect human health and the environment; maintain the physical safety and security of the site; and to appropriately limit access to or use of land, facilities, and other real and personal properties. In accordance with DOE Policy 454.1 Chg 1 (Admin Chg), ICs may include administrative or legal controls, physical barriers or markers, and methods to preserve information and data and inform the public of hazards and risks. ICs at the Slick Rock disposal site consist of proprietary control in the form of federal ownership of the property and physical ICs that include warning or no-trespassing signs (entrance and perimeter signs) along the property boundary, a perimeter fence around the cell, and a locked gate at the entrance to the site. DOE inspects physical ICs annually to confirm their integrity.

2.2.7 Permanent Site Surveillance Features

DOE establishes permanent site surveillance features as part of the ICs to maintain control of the site and notify the public about any hazards. Permanent site surveillance features at the site include the following: site markers, survey monuments, aerial survey quality control monuments, boundary monuments, and entrance and perimeter signs. The permanent site surveillance features are discussed below and listed in Table 2. Locations of the permanent site surveillance features are shown on Figure 3.

Site Markers: Two unpolished granite markers with an incised message identify the Slick Rock disposal cell. The marker includes a drawing showing the general location of the stabilized disposal cell within the site boundaries, the date of closure, the weight of tailings (1,112,260 dry tons, which was estimated at the time of the site marker installation), and the amount of radioactivity (149 curies of ^{226}Ra). Site marker SMK-1, near the south site access gate, is set in reinforced concrete that extends 3 ft (0.9 m) below the ground surface (Figure 6). Site marker SMK-2, at the crest of the disposal cell, is set in reinforced concrete that extends to the top of the frost protection barrier. A small "+" symbol on the upper right corner of the marker indicates that spot is an elevation control point.

Survey Monuments: Survey monuments establish permanent horizontal control, or base control. The original LTSP described three permanent survey monuments (SM-1, SM-2, and SM-3) at the site, however, only two (SM-1 and SM-3) could be verified in the field. Survey monument SM-2 is thought to have been destroyed during cell construction. The two remaining survey monuments SM-1 and SM-3 are Berntsen RT-1 markers set in concrete with the monument approximately 4 inches above ground level. Magnets in the survey monuments permit easier detection if they become buried over time.

Boundary Monuments: Six boundary monuments define the corners of the site boundary. These monuments are Berntsen Model A-1 survey monuments set in concrete with the monument approximately 1 inch above ground level. Berntsen Model A-1 federal aluminum survey monuments were used for the boundary monuments (BM-1 through BM-6). Magnets in the boundary monuments allow easier detection if they become buried. The boundary monument identification number is stamped on the top of the metal cap. Boundary monuments are offset 5 ft inside the site boundary.

Aerial Survey Control Quality Control Monuments: Five aerial survey topographic quality control monuments were installed in 2021 and function as reliable geospatial reference points for future aerial surveys. The quality control monuments are set in concrete with the top approximately 4 inches above ground with a magnet in the top for ease of location in case they are obscured by vegetation or windblown sediment.

Table 2. Permanent Site Surveillance Feature Location Coordinates

Feature	Coordinates are in NAD83(2011) Colorado State Plane CO South Zone (0503)	
Granite Site Markers		
SMK-1	1521902.585	2030967.157
SMK-2	1522791.995	2031519.73
Survey Monuments		
SM-1 (BC-s)	1522118.096	2032171.431
SM-3 (BC-m)	1521837.435	2031915.126
Boundary Monuments		
BM-1	1521665.603	2030848.021
BM-2	1523310.149	2030900.184
BM-3	1523268.273	2032212.475
BM-4	1521132.105	2032145.365
BM-5	1521162.381	2031160.669
BM-6	1521659.974	2031181.652
Aerial Survey Quality Control Monuments		
QC-1	1522056.662	2031708.222
QC-2	1522440.627	2032144.812
QC-3	1523155.073	2031425.255
QC-4	1522671.532	2030933.355
QC-5	1522124.174	2031335.767

Note:
Survey monuments SM-1 and SM-3 are labeled BC-s and BC-m, respectively. Before installation in 1993, the location for site marker SM-2 could not be verified and is considered nonexistent.

Abbreviation:
NAD83 = North American Datum of 1983

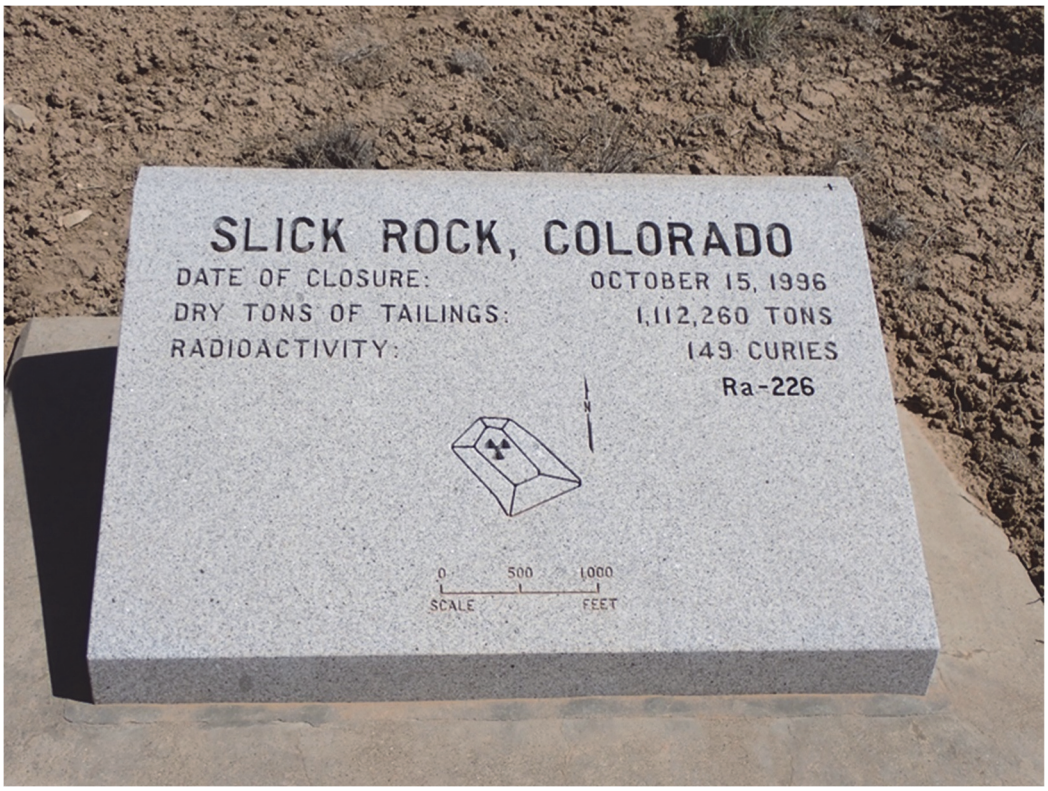

Figure 6. Site Marker SMK-1

Entrance and Perimeter Signs: An LM-posted entrance warning sign is installed at the property entrance gate and at site marker SMK-1. In addition to the entrance signs, 32 perimeter signs (P1–P32) are at approximately 200 ft intervals along the site boundary outside or adjacent to the site fence (Figure 3). The warning signs are mounted on 2⅜ inch steel posts with the top of the signs approximately 6 ft (2.0 m) above the ground surface. These signs display the international trefoil symbol indicating the presence of radioactive materials and state that trespassing is forbidden (Figure 7). The entrance sign (Figure 8) has the same information as the perimeter signs with the addition of the site name "Slick Rock, CO, Uranium Mill Tailings Repository," the 24-hour telephone number for the LM Field Support Center at Grand Junction, Colorado (970) 248-6070, and the LM website address. All signposts are embedded in concrete to a depth of approximately 3 ft below ground surface.

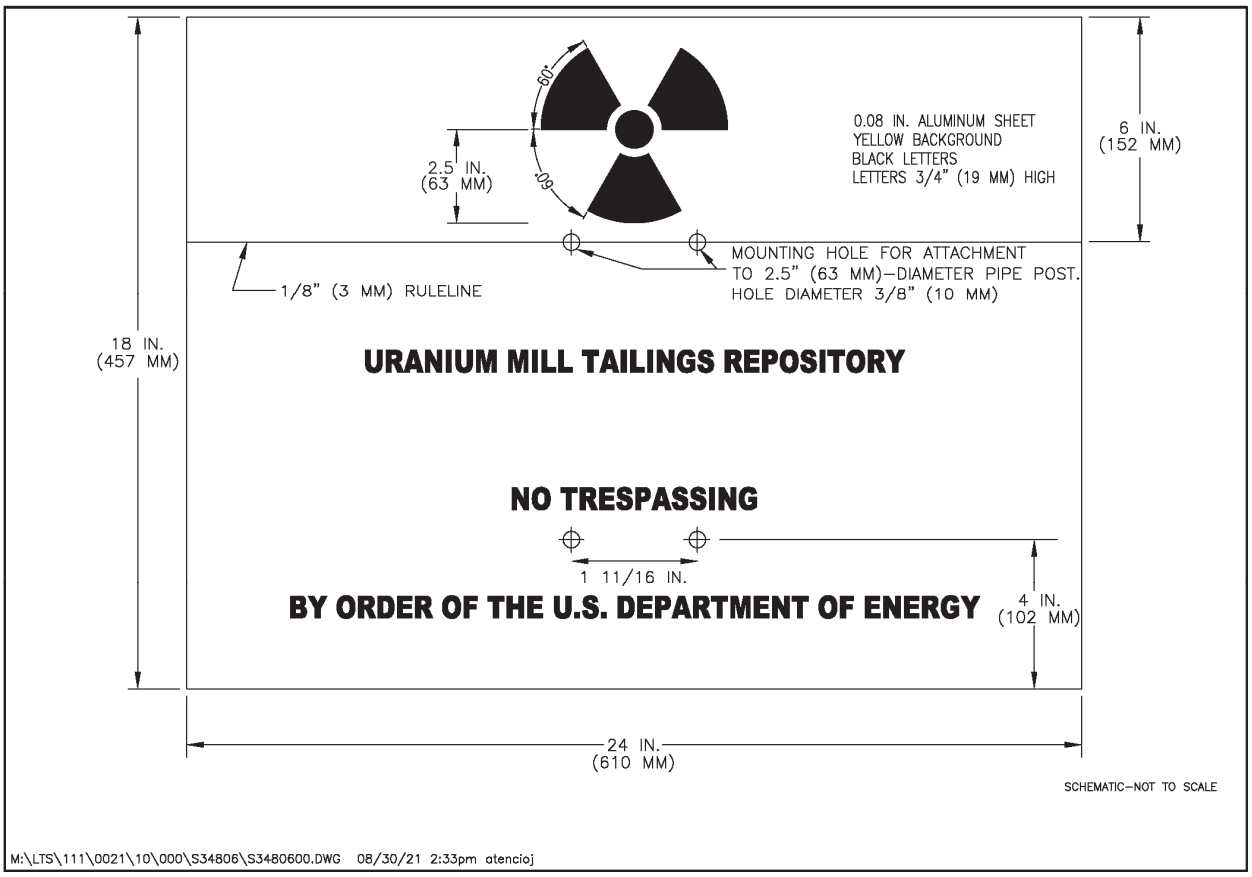

Figure 7. Perimeter Sign Design Proof

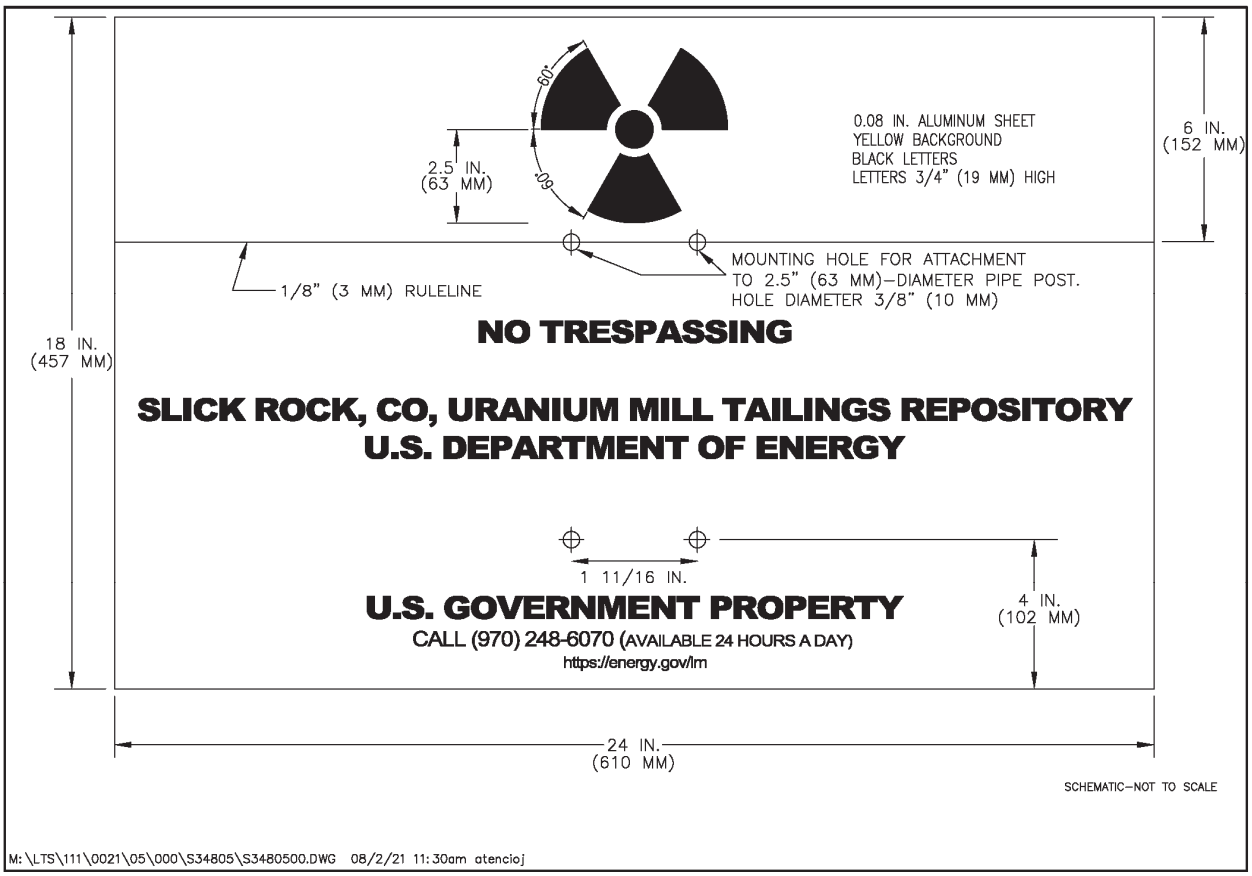

Figure 8. Entrance Sign Design Proof

2.2.8 Site Drawings and Photographs

Following completion of construction at the site, as-built conditions were documented with drawings and photographs in the Completion Report (MK-F 1997). The as-built drawings are filed and maintained in the permanent site file. The as-built drawings are used to document changes in physical site conditions over time and to develop corrective action plans, if required.

The as-built drawings were used to prepare the site map (Figure 3). The site map identifies the following site features:

- Topographic features
- Permanent site surveillance features
- Entrance road and gate
- Site boundary
- Disposal cell
- Apron
- Retention pond

A photographic record of the final site conditions at the site is maintained in the site permanent file. This record consists of a series of aerial and ground photographs that provide a baseline visual record of site construction and final site conditions to complement the as-built drawings. These photographs provide a record of site conditions to monitor changes (e.g., erosion patterns, vegetation changes, and land use) over time.

2.3 Geology, Hydrology, and Groundwater Quality

This section describes the geology, hydrology, and groundwater quality at the site as required under the general license.

2.3.1 Geology and Hydrology

Bedrock geological conditions at the site were characterized primarily to provide the basic information required for site geotechnical stability evaluations and groundwater performance assessments. Surficial geologic conditions were characterized to establish the geomorphic history and processes at the site, and therefore determine that long-term stability standards are met.

The site lies on a small mesa protected by the bedrock consisting of late Cretaceous shales and thin sandstones of the lower unit of the Dakota Sandstone, underlain by early Cretaceous mudstone and claystone of the Burro Canyon Formation. The most significant strata in terms of hydrogeology are an upper sandstone at a depth of about 100 ft (30 m), a middle sandstone at a depth of about 200 ft (60 m), and a lower sandstone at a depth of about 300 ft (90 m). The cell was constructed in the mudstone, siltstone, and claystone strata of the lower Dakota Sandstone and the top of the Burro Canyon Formation (DOE 1995).

Surficial deposits on the approximately 18-acre (7.3-hectare) mesa surface consist of thin soil covering the interior drainage basin of the site. The thickness of surficial soil ranges from less than 1 ft (0.3 m) at the perimeter to 4 ft (1 m) along the interior drainage swale. Because most of the surface area was utilized in the cell design, the soil was stripped to bedrock and stockpiled for other use. DOE concluded that the surficial deposits will not detrimentally affect the long-term stability of the disposal cell (DOE 1995).

The rim of the mesa forms the drainage divide so that no offsite overland flow can occur. Drainage on the mesa is interior with only a single outlet on sandstone that occurs at the south rim. The principle geomorphic processes at the site are scarp retreat and headcutting. All tributary drainage around the site terminates on the exposed rock rim of the surrounding mesa. Natural armoring of the mesa slopes has developed from the detritus of the sandstone ledges. Conditions potentially affecting long-term stability of the site have been identified and either avoided by design layout or mitigated during remediation.

2.3.2 Groundwater Protection Strategy

To achieve compliance with the U.S. Environmental Protection Agency groundwater protection standards (40 CFR 192, Subpart A), DOE applied supplemental standards for limited use groundwater (40 CFR 192.2[g]). The disposal cell foundation is separated from the uppermost aquifer by low permeability mudstone (50 to 65 ft thick). The groundwater in the underlying

lithologic units is protected from potential site-related contamination by the low-permeability mudstone units and upward hydraulic gradients that inhibit downward migration of water.

Groundwater in this aquifer is not a current or potential source of drinking water because of the low yield. Supplemental standards are appropriate due to the low yield of groundwater (less than 150 gallons per day) in the uppermost aquifer (upper sandstone unit of the Burro Canyon Formation). Pursuant to 40 CFR 192.03, DOE has determined that concentration limits and groundwater monitoring in the uppermost aquifer at point of compliance wells at the Slick Rock disposal site would not further protect human health and the environment (DOE 1995), therefore, groundwater monitoring was not proposed.

3.0 Long-Term Surveillance Program

3.1 General License for Long-Term Custody

With NRC acceptance of the original LTSP (DOE 1998) the Slick Rock disposal site was included under the general license for long-term custody established at 10 CFR 40.27(b). Although engineered disposal cells constructed under UMTRCA are designed to "be effective for up to one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years," as stated in 40 CFR 192.02(a), there is no provision for the termination of the general license or DOE's responsibility for the long-term custody of these sites (10 CFR 40.27[b]). When DOE determines that revision of the LTSP is necessary, DOE will notify NRC. Changes to the LTSP may not conflict with the requirements of the general license. In addition, DOE must guarantee that NRC has permanent right-of-entry to the site so NRC can conduct site inspections (Table 3).

This revision of the LTSP for the Slick Rock site is necessary to remove the requirement for disposal cell monitoring and to incorporate site updates such as the new site name.

3.2 Requirements of the General License

Requirements of the general license are at 10 CFR 40.27 and at 10 CFR 40, Appendix A, Criterion 12. Table 3 lists the requirements of the general license and the sections in this LTSP where each is addressed.

Table 3. Requirements of the General License and Corresponding LTSP Section

Requirement	LTSP Section
Annual site inspection	3.3
Annual inspection report	3.4
Follow-up inspections and follow-up inspection reports, as necessary	3.5
Routine site maintenance and emergency measures	3.6
Environmental monitoring	3.7

3.3 Annual Site Inspection

3.3.1 Inspection Frequency

At a minimum, sites must be inspected annually to confirm the integrity of visible features at the site and to determine the need for maintenance, additional inspections, or monitoring (10 CFR 40, Appendix A, Criterion 12).

To meet the inspection requirement, DOE will inspect the Slick Rock disposal site once each calendar year. The date of the inspection may vary from year to year, but DOE strives to inspect the site once every 12 months unless circumstances warrant a variance. The variance would be explained in the inspection report. DOE will notify NRC of the annual inspection at least 30 days in advance.

3.3.2 Personnel

Typically, two inspectors will perform the annual inspections. Inspectors will be trained to inspect integrity of site markers, fences, settlement plates, and to recognize and document subsidence and cracking; erosion by surface water; and degradation of erosion protection.

It is preferred that the lead inspector will have participated in previous site inspections at the site. Engineers, scientists, or other subject matter experts may need to participate in the inspection if the previous inspection identified potential concerns with the integrity of the disposal cell and diversion structures. If conditions warrant, more than two inspectors specialized in specific fields may be assigned to the inspection to evaluate serious or unusual problems to make appropriate recommendations.

3.3.3 Inspection Procedure

To ensure a thorough and uniform inspection, the site is divided into three areas: (1) the disposal cell, including side slopes, key trench, and apron; (2) the area between the disposal cell and the site boundary; and (3) the outlying area for a distance of approximately 0.25 mile.

The permanent site surveillance features within each area are examined for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

Before inspections, inspectors conduct a preinspection briefing to discuss the site inspection checklist and other site features to be evaluated. The LTSP guidance (DOE 2012) contains information useful to prepare for inspections as outlined in Section 3.3.4.

Site inspections must be thorough enough to identify any significant changes or active modifying processes that potentially could adversely impact the disposal cell. Surveillance will be performed to identify the unanticipated effects of modifying processes such as gully formation, slope erosion, changes to the rock cover, ephemeral drainage channel changes, and significant modifications by humans, animals, or plants.

Inspectors will evaluate the integrity of the disposal cell by walking a series of transects or routes around the perimeter and over the rock cover. Sufficient transects will be walked to ensure that the disposal cell is thoroughly covered and inspected.

Diagonal transects of the top slopes will be made and the crest line will be walked. Additional transects will be walked along the side slopes and rock apron. Inspectors should vary the transect paths from one inspection to the next to ensure small anomalies are not overlooked.

The sample inspection checklist in Appendix A is revised from the original checklist from the 1998 LTSP (DOE 1998). The inspection checklist aligns with the recommendations in the LTSP guidance document (DOE 2012) listing items that should be examined during inspections. The Slick Rock disposal cell has a rock cover with no planned vegetation on the cell. However, remedial action of the areas surrounding the disposal cell includes revegetated areas. Inspectors will examine this area for evidence of erosion caused by wind or water, or changes in drainage patterns. Site inspections also will monitor damage to or disturbance of permanent site surveillance features, fencing, gates, and locks.

Inspectors will examine each inspection area for surficial changes that might compromise or threaten the safety, security, or integrity of the site. Such changes include the success of previous maintenance, signs of erosion, settling, slumping, plant or animal encroachment, human intrusion, or vandalism. Photographs and measurements are used as necessary to support or supplement written observations. Inspectors note changes within 0.25 mile (0.40 kilometer) of the site that might represent changes in land use or other significant items.

A new site inspection map will be prepared after each annual inspection using the site map (Figure 3) as a base. The site inspection maps used during the inspection will become a part of the permanent site file. Site inspection maps will include, at a minimum, the following:

- Locations from which photographs were taken
- Locations and descriptions of new, anomalous, or unexpected features
- Features identified during previous inspections for observation or monitoring
- Date of inspection and signature of inspector

3.3.4 Inspection Checklist

Inspectors are briefed and the inspection checklist is reviewed before each annual inspection. A sample checklist is provided in Appendix A. The checklist includes the following:

- Specific site surveillance features to be inspected
- Routine observations to be made
- Special issues or problems to be observed and evaluated

The checklist is reviewed annually and revised as necessary to reflect changes or new conditions at the site that should be monitored or investigated.

3.4 Annual Inspection Report

DOE will report the results to NRC in an annual site inspection and monitoring report that will include the results from all UMTRCA Title I sites' annual inspections. The annual report will be sent to NRC within 90 days of the last Title I site inspection in the calendar year (10 CFR 40 Appendix A Criterion 12). If the annual site inspection and monitoring report cannot be submitted in accordance with 10 CFR 40, DOE will notify NRC. Annual site inspection and monitoring reports are made available to the public and other agencies.

3.5 Follow-Up Inspections

Follow-up inspections are unscheduled and conducted in response to observations from annual inspections, other site visits, or unusual occurrences.

3.5.1 Criteria for Follow-Up Inspections

Criteria for follow-up inspections are found at 10 CFR 40.27(b)(4). DOE will conduct a follow-up inspection when:

- A condition is identified during the annual inspection (or other site visit) that requires personnel, perhaps with specific expertise, to return to the site to evaluate the condition.
- DOE is notified by a citizen or outside agency that conditions at the site are substantially changed. A 24-hour DOE contact telephone number is posted on the entrance sign and is intended for public use to request information or to report a problem at the site (Figure 7 and Figure 8).

Events such as a heavy storm or an earthquake are examples of events that would warrant a follow-up inspection. NRC is notified prior to the follow-up inspection if the reported problem indicates that the disposal cell has been compromised or that extensive repair or emergency measures could be needed.

Once a new or changed condition is identified, DOE will evaluate the information and determine whether a follow-up inspection is warranted. Conditions that threaten the safety of the site or the integrity of the disposal cell may require a more urgent follow-up inspection or emergency response. Slope failure, a severe storm, a major seismic event, and deliberate human intrusion are among these conditions. DOE may request the assistance of local agencies to confirm the seriousness of a condition before conducting a follow-up inspection or emergency response.

DOE will use a graded approach for follow-up inspections; the priority level will be proportional to the potential seriousness of the condition.

In the event of "unusual damage or disruption" (10 CFR 40 Appendix A Criterion 12) or damage that may compromise or threaten the safety, security, or integrity of the site, DOE will:

- Notify NRC the follow-up inspection if the reported problem indicates that the disposal cell has been compromised or that extensive repair or emergency measures could be needed.
- Begin the DOE internal occurrence notification process (DOE Order 231.1B Admin Chg 1, *Environment, Safety, and Health Reporting*).

- Respond with an immediate follow-up inspection or emergency response team.
- Implement emergency measures, as necessary, to prevent or contain exposure or release of radioactive materials (Section 3.6.2).

DOE monitors severe weather and other disaster notifications issued by the federal government for those areas where disposal sites are located.

3.5.2 Follow-Up Inspection Personnel

DOE will assign inspectors to follow-up inspections on the same basis as the annual site inspection (see Section 3.3.2).

3.5.3 Follow-Up Inspection Reports

For conditions that warrant a follow-up inspection, DOE will submit a preliminary status report to NRC within 60 days of the follow-up inspection. The report will evaluate the problem and recommend the next step (e.g., immediate action or continued evaluation). If the problem requires immediate repair, DOE will develop a corrective action plan for NRC approval. Once NRC approves the corrective action, DOE will implement the plan. In some cases, corrective action could include temporary emergency measures instituted before completion of the normal approval process. If the problem does not require immediate repair, the problem will be documented in the annual report and assessed at the next annual inspection. In addition to the preliminary assessment report, the DOE may (as appropriate) prepare a progress report on each corrective action while it is under way or under evaluation.

Follow-up inspection reports should reflect the urgency of the need for the follow-up inspection. DOE will submit a report if site structures are degraded or there is a threat of release of regulated materials or another threat to human health and the environment. If the follow-up inspection is for a routine matter, results will be reported in the next annual compliance report.
Follow-up inspection reports should include:

- A description of the problem that triggered the follow-up inspection.
- A preliminary assessment of the maintenance, repair, or emergency measures required.
- Conclusions and recommendations.
- Assessment data, including field inspection data and photographs.
- Inspectors' names, qualifications, and signatures.

Separate preliminary reports will not be issued unless DOE determines that a potentially serious problem has occurred at the site and notifies the NRC and other agencies. If applicable, DOE will submit the preliminary report of the follow-up inspection to NRC within the 60-day period required by 10 CFR 40 Appendix A Criterion 12.

3.6 Routine Site Maintenance and Emergency Measures

3.6.1 Routine Maintenance

UMTRCA disposal sites are designed and constructed so that "ongoing active maintenance is not necessary to preserve isolation" of radioactive material (10 CFR 40 Appendix A Criterion 12). The disposal cell has been designed and constructed to minimize the need for routine maintenance. If an inspection reveals damaged or missing site surveillance features (e.g., signs, site markers, and boundary monuments), the features will be repaired or replaced as necessary.

If a structure has failed or has been degraded in a way that might compromise site protectiveness (but is not considered to be an emergency), repairs will be conducted to reestablish integrity of the disposal system.

3.6.2 Emergency Measures

Emergency measures are actions DOE will take in response to "unusual damage or disruption" that threatens or compromises site safety, security, or integrity (10 CFR 40 Appendix A Criterion 12). DOE will contain or prevent the dispersal of radioactive materials in the unlikely event of a breach in the disposal cell cover.

3.6.3 Criteria for Routine Site Maintenance and Emergency Measures

DOE uses a graded approach for site intervention, from minor routine maintenance to large-scale reconstruction following disasters. Although 10 CFR 40.27 (b)(5) requires that increasingly serious levels of intervention trigger particular DOE responses, the criteria for those responses are not easily defined because the nature and scale of all potential problems cannot be foreseen. The information in Table 4 serves only as a guide for appropriate DOE responses. The table shows that the primary differences between routine maintenance and an emergency response is the urgency of the activity and the degree of threat or risk. DOE's priority levels, in the first column of Table 4, bear an inverse relationship to DOE's estimate of probability; the highest priority response is believed to be the least likely to occur.

Table 4. DOE Criteria for Maintenance and Emergency Measures

Priority	Description	Example	Response
1	Breach of disposal cell with dispersal of radioactive material.	Seismic event that exceeds design basis and causes massive discontinuity in cover.	Notify NRC. Immediate follow-up inspection by DOE emergency response team. Emergency measures to prevent further dispersal, recover radioactive materials, and repair breach.
2	Breach without dispersal of radioactive material.	Partial or threatened exposure of radioactive materials.	Notify NRC. Immediate follow-up inspection by DOE emergency response team. Emergency Measures to repair the breach.
3	Maintenance of specific site surveillance features.	Deterioration/vandalism of signs, markers.	Repair at first opportunity.
4	Minor erosion or undesirable changes in vegetation.	Erosion not immediately affecting disposal cell, invasion of undesirable plant species.	Evaluate, assess impact, respond as appropriate to address problem.

Note:
Other changes or conditions will be evaluated and treated similarly on the basis of potential risks posed.

3.6.4 Earthquakes

The disposal cell was designed to resist seismic forces. The onsite peak horizontal acceleration used in the disposal cell design was 0.28*g* (where *g* = acceleration due to gravity). This would allow the disposal cell to withstand a magnitude 6.2 event occurring at a distance of 9.3 miles from the site (DOE 1995). As discussed in the LTSP guidance (DOE 2012), DOE subscribes to the U.S. Geological Survey's early warning service for notification when an earthquake has sufficient magnitude to threaten a disposal site. This service provides data on the magnitude of the event and the location of the epicenter. DOE will receive email notifications from the agency when earthquakes of magnitude 3.0 or greater occur within about 70 miles (or 0.3 degrees) of the site. DOE will evaluate the peak ground acceleration produced by reported earthquakes to determine if further action, such as a follow-up inspection, is required.

3.6.5 Reporting Maintenance and Emergency Measures

Routine maintenance completed during the previous 12 months will be summarized in the annual inspection report.

In accordance with 10 CFR 40.60, within 4 hours of discovery of any Priority 1 or Priority 2 event, such as those listed in Table 4, DOE will contact the NRC 24-Hour Operations Center for Emergencies at (301) 816-5100 and will notify the appropriate NRC offices.

3.6.6 Procedures for Emergency Response

If there is a Priority 1 or 2 incident, the LM Emergency Management Watch Office will be notified at (303) 404-6100 as soon as the incident is discovered to coordinate any needed immediate actions to contain radioactive materials and establish any needed protective actions to prevent harm to workers or the public.

In the event of a Priority 1 or 2 event, LM will implement the *LM/LMS All Hazards Emergency Management Plan* (LM-Procedure-3-20-17.0, LMS/POL/S37643) to protect life, property, and resources and to prevent or contain exposure or excursion of radioactive materials (Section 3.6.3) by performing the following:

- Activate the LM Emergency Response Organization (ERO) and Emergency Operations Center, if needed
- Establish and maintain an overall responsibility for supporting and coordinating the response to an emergency
- Perform emergency categorization and offsite emergency notifications in accordance with DOE Order 151.1D
- Implement protective actions or provide offsite stakeholders with protective action recommendations, as applicable
- Coordinate emergency public information during an incident involving response by the offsite responder(s) for incidents that may affect or be of interest to the media and public

- Deploy technical specialists (e.g., engineers, scientists, or [Legacy Management Support] LMS Radiological Control staff) or members of the ERO for damage assessment or reentry activities
  - As part of the damage assessment, LM will assess and evaluate the following:
    - Adequacy of the design specification(s) for the damaged feature to control or accommodate the observed problem(s)
    - Extent of the damage, degradation, or departure from the design (or as-built condition) of the damaged feature
    - Ability of the feature, in its damaged condition, to withstand a design-basis event
    - LM will provide NRC with a clear, technical explanation for its decision to study and evaluate or intervene with additional remedial action (DOE 2012)
  - Provide centralized collection, validation, analysis and coordination of information related to an emergency
  - Establish a preliminary recovery plan and organization

3.7 Environmental Monitoring

Only vegetation monitoring is required at the site. A plant specialist or other qualified person will periodically participate in site inspections to conduct vegetation monitoring. If the inspection does not coincide with the general growing season, the plant specialist can conduct a separate inspection at a more favorable time.

Volunteer plant growth is anticipated at the site and is not of concern unless it threatens the performance of engineered structures. Volunteer plant growth includes plants growing where none were planned, such as in rock-lined toe drains, or unwanted plant species growing on the top slope of the disposal cell. Unwanted plant species may be eliminated from the cover by selective spraying or mechanical removal.

Over the life of the disposal cell, it is expected that windblown soil or water flows may cause sediment loading over erosion-protection rock areas. These areas will be monitored, but as long as erosion protection is not diminished, removal of the sediments or plants will not be necessary. If volunteer plant growth or sedimentation occurs where the function of engineered structures might be degraded, DOE will evaluate the potential impact and select appropriate responses in consultation with NRC.

3.8 IC Monitoring

DOE will monitor ICs as part of the annual inspection. This includes monitoring land use at the site and the ICs identified in Section 2.2.6. Damaged or missing ICs will be repaired or replaced as soon as possible.

3.9 Records

DOE receives and maintains selected records to support postclosure site maintenance. Inactive records are preserved in DOE collections or at a Federal Records Center. Site records contain critical information required to protect human health and the environment, manage land and assets, protect the legal interests of DOE and the public, and mitigate community impacts resulting from the cleanup of legacy waste.

The records are managed in accordance with the following requirements:

- 44 USC 29, "Records Management by the Archivist of the United States and by the Administrator of General Services"; 44 USC 31, "Records Management by Federal Agencies"; and 44 USC 33, "Disposal of Records"
- 36 CFR 1220–1238, Subchapter B, "Records Management"
- DOE Order 243.1C, *Records Management Program*
- *Records and Information Management Transition Guidance* (LM-Guide-4-10.2-1.0)

3.10 Quality Assurance

The long-term care of the Slick Rock disposal site and all activities related to the annual surveillance, monitoring, and maintenance of the site comply with DOE Order 414.1D Chg 1, *Quality Assurance*; applicable requirements of 10 CFR 830, Subpart A, "Quality Assurance Requirements"; and ANSI/ASQ E4-2004. Quality assurance requirements are routinely fulfilled by use of a work planning process, standard operating procedures, trained personnel, documents and records maintenance, and assessment activities. These requirements will be transmitted through procurement documents to LMS subcontractors when appropriate.

3.11 Safety and Health

Health and safety requirements and procedures for LM and LMS contractor activities are consistent with DOE orders, federal regulations, and applicable codes and standards. The DOE Integrated Safety Management System serves as the basis for the LMS contractor's safety and health program.

Project-specific safety plans are used to identify specific hazards associated with the anticipated scope of work and provide direction for the control of these hazards. During the preinspection briefing, inspectors are required to review project-specific safety plans and the LTSP to ensure that they have an understanding of the site. Before entering the site, all personnel are briefed on the potential hazards and the safety and health requirements associated with the site and any work to be performed.

4.0 References

10 CFR 40 et seq. U.S. Nuclear Regulatory Commission, "Domestic Licensing of Source Material," *Code of Federal Regulations*.

10 CFR 40, Appendix A. U.S. Nuclear Regulatory Commission, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," *Code of Federal Regulations*.

10 CFR 830, Subpart A. "Quality Assurance Requirements," *Code of Federal Regulations.*

36 CFR 1220–1238, Subchapter B. "Records Management," *Code of Federal Regulations.*

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations.*

42 USC 7901 et seq. "Uranium Mill Tailings Radiation Control Act," *United States Code*.

44 USC 29. "Records Management by the Archivist of the United States and by the Administrator of General Services," *United States Code.*

44 USC 31. "Records Management by Federal Agencies," *United States Code.*

44 USC 33. "Disposal of Records," *United States Code.*

60 FR 21984. Land Management Bureau, "Transfer of Public Land for the Slick Rock Disposal Site; Colorado," *Federal Register*, May 4, 1995.

ANSI/ASQ E4-2004. *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use,* American National Standards Institute/American Society for Quality, 2004.

DOE Order 151.1D, *Comprehensive Emergency Management System*, U.S. Department of Energy, August 11, 2016.

DOE Order 231.1B Chg 1 (Admin Chg), *Environment, Safety, and Health Reporting,* U.S. Department of Energy*,* November 28, 2012*.*

DOE Order 243.1C, *Records Management Program*, U.S. Department of Energy, February 7, 2022.

DOE Order 414.1D, Chg 1, *Quality Assurance*, U.S. Department of Energy, May 18, 2013.

DOE Policy 454.1 Chg 1 (Admin Chg), *Use of Institutional Controls*, U.S. Department of Energy, January 12, 2015.

DOE (U. S. Department of Energy), 1994. *Environmental Assessment of Remedial Action at the Slick Rock Uranium Mill Tailings Sites, Slick Rock, Colorado,* DOE/EA-0339 Rev. 1, September.

DOE (U. S. Department of Energy), 1995. *Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Sites at Slick Rock, Colorado*, DOE/AL 62350-21F, Rev. 1, September.

DOE (U. S. Department of Energy), 1997. *Slick Rock, Colorado, NRC Copy, Final Completion Report Volume 1, 2 and 3*, June.

DOE (U.S. Department of Energy), 1998. *Long-Term Surveillance Plan for the Burro Canyon Disposal Cell Slick Rock, Colorado,* DOE/AL/62350-236, Office of Legacy Management, May.

DOE (U.S. Department of Energy), 2001. Art Kleinrath, Program Manager, U.S. Department of Energy, letter (about "Termination of Water Level Monitoring Within the Slick Rock, Colorado, Disposal Cell") to Melvin Leach, Branch Chief, U.S. Nuclear Regulatory Commission Fuel Cycle Licensing Branch, June 29. Access at: NRC Agencywide Documents Access and Management System (ADAMS) Accession No. ML012140228.

DOE (U.S. Department of Energy), 2012. *Guidance for Developing and Implementing Long-Term Surveillance Plans for UMTRCA Title I and Title II Disposal Sites*, LMS/S00336, Office of Legacy Management, November.

LM/LMS All Hazards Emergency Management Plan, LM-Procedure-3-20-17.0, LMS/POL/S37643, continually updated, prepared by the LMS contractor for the U.S. Department of Energy Office of Legacy Management.

MK-F (MK-Ferguson), 1997. *Slick Rock, Colorado, Final Completion Report*, prepared by MK-F for the U.S. Department of Energy, Environmental Restoration Division, UMTRA Project Team, Albuquerque, New Mexico.

NRC (U.S. Nuclear Regulatory Commission), 1998. Joseph Holonich, Chief, Uranium Recovery Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, letter (about "Acceptance of the Long-Term Surveillance Plan for the Slick Rock, Colorado, Disposal Site"), to George Rael, Director, U.S. Department of Energy, August 31.

NRC (U.S. Nuclear Regulatory Commission), 2002. Melvin Leach, Branch Chief, U.S. Nuclear Regulatory Commission Fuel Cycle Licensing Branch, letter (about "Termination of Water Level Monitoring Within the Disposal Cell at the Slick Rock, Colorado, UMTRA Project Site") to Art Kleinrath, Program Manager, U.S. Department of Energy, February 13. Access at: Agencywide Documents Access and Management System (ADAMS) Accession No. ML020440335.

Records and Information Management Transition Guidance, LM-Guide-4-10.2-1.0, continually updated, prepared by the U.S. Department of Energy Office of Legacy Management.

Appendix A

Inspection Checklist

Inspection Checklist

SLICK ROCK, COLORADO, UMTRCA TITLE I DISPOSAL SITE

Date of Inspection:	
Scheduled Inspectors:	
Date of Previous Inspection:	
Inspectors Present:	

ITEM (no.)	INFORMATION/OBSERVATIONS	ACTION
Preinspection		
Notification	Notify Colorado Department of Public Health and Environment (CDPHE) manager.	Contact CDPHE via email approximately 1 month before inspection to verify schedule. NRC and the Agreement State receive inspection schedule updates.
Inspectors	Meet requirements in Section 3.3.2.	
Site map	Use Figure 3 to record observations during inspection.	
Safety meeting	An onsite safety meeting is required. Discuss any safety issues and emergency procedures as applicable. Include current applicable Job Safety Analysis forms.	Signature of participants may be required.
General Features		
Access	Note road condition and gates operational status.	
Site boundary	Check condition of the gate and effectiveness of access controls and for possible vehicular access to the site from other locations.	
Outlying area	Check for activities that could affect site security and integrity.	
Specific Site Features		
Entrance sign (1)	Legibility/condition: Location as indicated on the site figure.	
Perimeter signs (32)	Legibility/condition: Locations as indicated on the site figure.	
Site markers (2)	Legibility/condition: Locations as indicated on the site figure.	
Survey monuments (2)	SM-1 and SM-3: Located as indicated on the site figure. SM-2 was not located during resurvey of site; it may be buried. Note presence/condition.	
Boundary monuments (6)	Locations as indicated on the site figure. Note presence/condition.	

Inspection Checklist

ITEM (no.)	INFORMATION/OBSERVATIONS	ACTION
Aerial survey quality control monuments (5)	Locations as indicated on the site figure. Note presence/condition.	
Settlement plates (3)	Located on disposal cell top slope. Note presence/condition.	
Fence	Stock barbed-wire fence. Top and bottom strands are smooth to allow wildlife to pass; middle strands are barbed wire. Note condition and any repairs necessary.	
Disposal Cell Features		
Disposal cell top slope	Check for settlement/subsidence, slumping, erosion, rock degradation, and vegetation. Note type and extent of vegetation.	
Disposal cell side slopes	Check for settlement/subsidence, slumping, erosion, slope failure, rock degradation, and vegetation. Note type and extent of vegetation.	
Key trench	Located on northeast side of site slope. Check for subsidence, condition; note vegetation type and extent.	
Apron	Check for standing water, willow growth, headcutting from downslope area.	
Drainage ditches	Locations as indicated on the site figure. Note erosion, headcutting, or occlusion.	
Area Between Disposal Cell and Site boundary		
Retention pond	Check the condition of the pond and spillway. Check for erosion and note whether it is healing or ongoing. Check rills and gullied areas marked on inspection map. Note if erosion repairs are required. Note vegetation occurrences and tamarisk. Note culvert occlusion.	
Reclaimed area	Disturbed area north of the disposal cell. Check for erosion or changes in land use.	
Outlying Areas		
Outlying area	The area beyond the site boundary for 0.25 mile. Observe erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site.	