Department of Energy
Washington, DC 20585

June 3, 2019

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Deputy Director
Mail Stop T8-F5
Washington, DC 20555-0001

Subject: U.S. Department of Energy, Office of Legacy Management update to U.S. Nuclear Regulatory Commission on Mexican Hat, Utah, Disposal Site, Radiological Monitoring Summary, Fourth Quarter 2018 (NRC Docket No. WM-0063)

To Whom It May Concern:

On October 24, 2018 radon detectors and environmental thermoluminescent dosimeters (TLDs) were placed at the Mexican Hat, Utah, Disposal Site, in accordance with the enclosed *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816).

On January 2, 2019 the deployed radon detectors and TLDs were collected from the site and sent to an accredited vendor for processing and analysis. Replacement radon cups and TLDs were deployed for the current quarter of monitoring at the time of collection. The enclosed Figure 1 shows the radon detectors and TLD placement locations.

The radon detectors and TLD results were evaluated and showed :

- No regulatory limits have been exceeded.[1, 2]

4th Qtr 2018 Results	
Mean on-site radon concentration (pCi/L)	0.53
Mean off-site radon concentration (pCi/L)	0.41
On-site minus off-site radon concentration (pCi/L)	0.11
Radon concentration limit at boundary (pCi/L, avg annual)	3.0
Mean on-site environmental dose (mrem per qtr)	0.44
Mean off-site environmental dose (mrem per qtr)	2.22
On-site minus off-site dose (mrem per qtr)	-1.78
Environmental dose limit at boundary (mrem per yr)	100.0

[1] Radon concentration limit is 3 pCi/L annual average (10 CFR 835 & DOE Order 458.1) as described in LMS/HAT/S18816.
[2] Environmental dose limit is 100 mrem per year (10 CFR 835 & DOE Order 458.1.4.b) as described in LMS/HAT/S18816.

- Radiological monitoring results were well below regulatory limits, which further supports the determination that residual radioactive material (RRM) has not been exposed at the depression areas.

NMSS01
NMSS

Please call me at (970) 248-6621 or email me at Angelita.Denny@lm.doe.gov if you have any questions. Please address any correspondence to:

U.S. Department of Energy
Office of Legacy Management
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Sincerely,

Angelita Denny
Site Manager

Enclosures

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DOE Read File
File: HAT 0045.10 (Records)

LMS/HAT/S18816

Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site

September 2018

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Abbreviations

CFR	*Code of Federal Regulations*
CRML	continuous radiological monitoring location
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
LM	Office of Legacy Management
LMS	Legacy Management Support
pCi/L	picocuries per liter
RRM	residual radioactive material
TLD	thermoluminescent dosimeter
UMTRA	Uranium Mill Tailings Remedial Action (Project)
UMTRCA	Uranium Mill Tailings Radiation Control Act

1.0 Introduction

This Monitoring Plan describes the methods and rationale for temporary continuous radiological monitoring activities at the U.S. Department of Energy (DOE) Office of Legacy Management (LM) Mexican Hat, Utah, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site (site).

The radiological monitoring approach for the site has been developed using the U.S. Environmental Protection Agency (EPA) Data Quality Objectives (DQO) process (EPA 2006). The DQO process is a systematic planning tool for developing technically sound data collection plans, and provides a rigorous technical framework to support the means and methods of data acquisition for the radiological monitoring approach for the site.

2.0 Purpose and Scope

The purpose of the radiological monitoring approach is to evaluate disposal cell cover performance and quantitatively monitor for the presence or absence of elevated radiological readings as a result of radon barrier degradation that has been identified at the site. Elevated radiological readings would be indicative of a breach through the disposal cell cover components, including the radon barrier, resulting in the exposure or dispersal of residual radioactive material (RRM) contained in the disposal cell. Recent real-time radiological surveys (i.e., with field instruments) performed at the site have not identified elevated radiological readings in areas of radon barrier degradation or within the disposal cell footprint compared to background conditions. However, observed degradation of the disposal cell radon barrier warrants temporary continuous radiological monitoring at the site.

The radiological monitoring approach consists of continuous radon-222 (radon) and gamma radiation monitoring through the installation of a series of paired radon monitoring cups and thermoluminescent dosimeters (TLDs) within and around the perimeter of the disposal cell and outside of the site boundary. The objective of the temporary continuous gamma radiation and radon monitoring approach is to provide project decision makers with quantitative radiological data that can be evaluated to determine the presence or absence of elevated radiological readings at the site compared to background conditions, and to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment.

3.0 Data Quality Objectives

The radiological monitoring approach for the Mexican Hat disposal site was developed using the EPA DQO process (EPA 2006). The DQO process is a systematic planning tool for developing technically sound data collection plans. The DQO process provides a rigorous technical framework for developing the type, quantity, and quality of information needed to support acquisition of radiological monitoring data for the Mexican Hat disposal site.

Components of the DQO process are as follows:

Step 1. Develop Problem Statement: Observed cover degradation indicates that there is the potential for a breach of the cell cover that could result in the exposure or dispersal of RRM contained in the disposal cell.

Step 2. Identify the Goals and Objectives of the Study: Radiological monitoring is needed to determine the presence or absence of elevated radiological readings at the site compared to background conditions, and to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment.

Step 3. Identify Information and Inputs: Relevant information and inputs include the following:

- The disposal cell cover at the Mexican Hat site is exhibiting radon barrier degradation due to erosion. Visual observations indicate that as much as 75% of the thickness of the radon barrier may be eroded in at least one location.
- Precipitation runoff on the northeast side slope may reach velocities that result in additional erosion of the radon barrier.
- LM is planning to mitigate visually-observed areas of radon barrier degradation to prevent further erosion as additional geotechnical information is being collected and engineering evaluation of the cell cover components and required follow-on actions are identified. However, due to challenges in fully determining the condition of the radon barrier, which is overlain by additional cover components, the potential exists for unknown areas of degradation to be further impacted by precipitation, resulting in the potential exposure and dispersal of RRM contained in the disposal cell.
- Previous real-time radiological surveys (i.e., with field instrumentation) associated with investigation of cover degradation features at the site have not resulted in readings that exceed background levels. Elevated radiological readings would be indicative of an exposure or dispersal of RRM.
- Continuous radiological monitoring is proposed to provide a comprehensive record of radon concentrations and associated fluctuations due to natural influences (e.g., barometric pressure and temperature), to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment, and to monitor for elevated radiological readings that would be indicative of an exposure or dispersal of RRM.

Step 4. Define the Boundaries of the Study: The boundaries of the study area will include the site and the area immediately surrounding the site (approximately 200 yards past the site boundary). The primary focus will be on the areas of observed cover degradation on the lower northeast side slope and adjacent apron and toe-drain areas.

Step 5. Develop the Analytic Approach: TLDs will be returned to the appropriate vendor and processed by the ANSI N545-1975 accredited vendor according to their standard operating procedures. Similarly, radon detectors will be analyzed by the ISO 17025 accredited vendor according to their standard operating procedures. Table 1 shows the specifications for the radon detectors and TLDs; detections limits for the applicable devices can be found in the useful dose range row.

Step 6. Specify Performance and Acceptance Criteria: TLD and radon detector measurement values will be evaluated for acceptance according to the useful dose ranges shown in Table 1. Arithmetic mean values for all background locations and for all onsite locations will then be established and compared to determine the presence or absence of elevated radiological readings at the site compared to background conditions.

Table 1. Measurement Device Specifications

Metrics	Radon Monitoring Device	Radiation Monitoring Device
Vendor name	Radonova	Mirion
Monitor name/type	Rapidos HS Environmental Radon Monitor	Environmental thermoluminescent dosimeter (TLD) 814
Description	High sensitive radon monitor (alpha track detector)	4 Element Panasonic TLD (1 LiBO:Mn [TLD800] and 3 CaSO:Dy [TLD900] elements)
Accreditations/approvals/ standards	ISO 17025 accredited	ANSI N545-1975
Monitoring duration	Between 10 and 365 days	Months to 1 year
Useful dose range	Daily: 0.02 pCi/L Total: 76 pCi/L, 10–28,000 pCi/L•days	0.05 mGy to 5 Gy

Abbreviations:
ISO = International Organization for Standardization
ANSI = American National Standards Institute
LiBO:Mn = lithium borate manganese (composition of TLD chip)
CaSO:Dy = calcium sulfate dysprosium (composition of TLD chip)
pCi/L = picocuries per liter
mGy = milligray
Gy = gray

Step 7. Plan for Obtaining Data: TLDs and radon detectors will be placed at the initial continuous radiological monitoring locations (CRMLs) as depicted on Figure 3. Initial CRMLs are based on site-specific meteorological data (i.e., prevailing wind direction) and biased in proximity to the locations of known cover degradation features. Additional CRMLs will be used to establish baseline data for areas within and outside of the site boundary. Both the TLDs and radon detectors will initially be deployed in intervals of 90 days.

4.0 Site Description

This section provides an overview of the ownership, location, and history of the site.

4.1 Ownership and Location

The Mexican Hat disposal cell is located on the Navajo Reservation in southeast Utah. The 68-acre disposal cell is located on the approximately 119-acre disposal site. The site is held in trust by the United States of America for the Bureau of Indian Affairs; the Navajo Nation retains title to the land.

The site is located in San Juan County, Utah, in Sections 13 and 24, Township 42 South, Range 18 East, and in Sections 18 and 19, Township 42 South, Range 19 East, Salt Lake

Principal Meridian. The disposal site is located approximately 1.5 miles southwest of the town of Mexican Hat, Utah, and 1 mile south of the San Juan River. The small Navajo community of Halchita is approximately 0.5 miles southwest of the site.

4.2 History

Texas-Zinc Minerals Corporation constructed the Mexican Hat Mill on land leased from the Navajo Nation and operated the facility from 1957 to 1963. In 1963, Atlas Corporation purchased the mill and operated it until it closed in 1965. A sulfuric acid manufacturing plant operated at the site from 1957 to 1970; Atlas continued operating the sulfuric acid manufacturing plant at the site until the lease expired in 1970 and control of the site reverted to the Navajo Nation.

Ore brought to the mill contained a considerable amount of copper sulfide and other sulfide minerals and was processed to recover both copper and uranium. The milling process produced radioactive tailings, a predominantly sandy material. Spent tailings were mixed with process water and pumped through a pipeline to two onsite tailings piles: the former lower tailings pile and the former upper tailings pile.

4.3 Mill Tailings Disposal and Cell Construction

DOE remediated the site under the Uranium Mill Tailings Remedial Action (UMTRA) Project. Surface remediation and construction of the disposal cell was completed at the site in 1995. The pentagonal-shaped disposal cell was constructed at the location of the preexisting former lower tailings pile. Radioactive materials from the former upper tailings pile, demolished mill structures, and 11 vicinity properties were relocated and placed on top of the preexisting tailings at the location of the former lower tailings pile. An additional 983,000 cubic yards (1.3 million dry tons) of tailings and associated wastes were subsequently hauled from the Monument Valley, Arizona, UMTRCA Title I Processing Site (located approximately 15 miles south of the Mexican Hat site) and placed on top of the contaminated materials from the Mexican Hat site. A total of approximately 3.6 million cubic yards (4.4 million dry tons) of radioactive tailings and other RRM were ultimately encapsulated in the Mexican Hat disposal cell.

The Mexican Hat disposal cell abuts a rock outcrop on its south side and rises approximately 50 feet above the surrounding terrain to the north, east, and west. The disposal cell was designed to encapsulate radioactive tailings and other RRM in a way that minimizes the need for active maintenance and limits radon gas emanation in accordance with UMTRCA. The cell was constructed with a 2% top slope transitioning to 20% side slopes, which drain into a surrounding rock perimeter channel. The perimeter channel discharges to three engineered toe drains that drain into existing arroyos to the north and east of the cell.

Radioactive tailings and other RRM were compacted prior to being covered with a multicomponent system to encapsulate the tailings materials. The side slope cover consists of a 24-inch-thick low-permeability radon barrier placed directly over the compacted tailings, a 6-inch-thick sandy gravel bedding layer placed over the radon barrier as an initial rock erosion-protection layer, and a 12-inch-thick rock riprap final erosion-protection layer placed over the bedding layer. The top slope cover consists of the same components, with an 8-inch-thick rock riprap layer for final erosion protection (Figure 1).

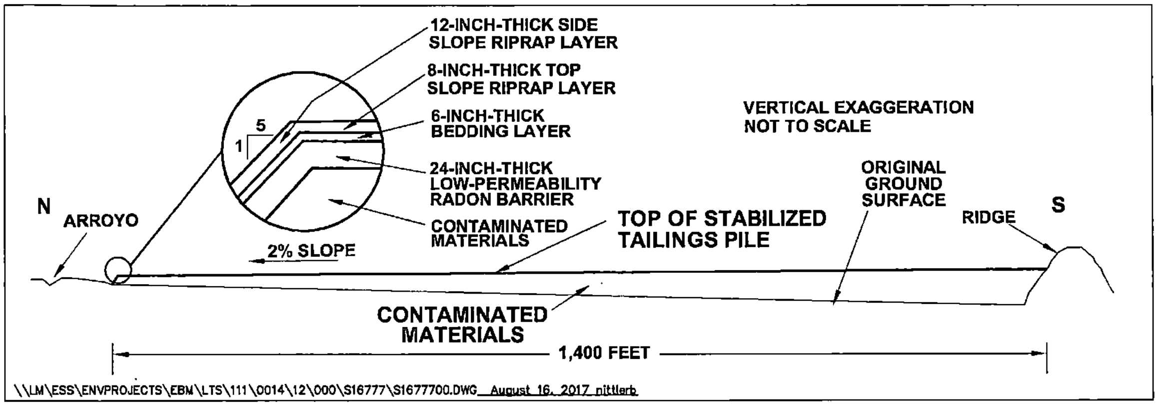


Figure 1. Typical North-South Cross Section of the Mexican Hat Disposal Cell

5.0 Basis for Radiological Monitoring

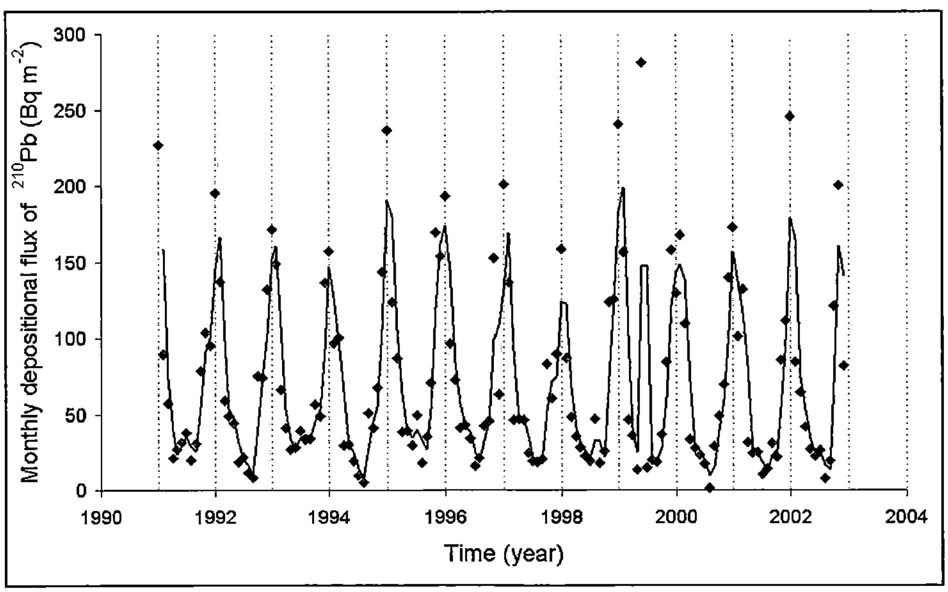
In 2016, multiple subtle depressions were identified in the rock cover along the toe and lower portions of the northeast side slope of the disposal cell. Due to concerns regarding the potential impacts of the cell cover depressions related to cell performance and erosion resistance, an evaluation of the depressions was performed. The evaluation included visual observations of the depressions, limited small-area manual removals of the rock cover components to expose the top of the radon barrier surface, review of disposal cell as-built drawings, and review of supporting design calculations for the rock cover components.

As a result of limited field investigations, voids, cavities, and incisements were discovered within the radon barrier on the north and northeast side slopes of the disposal cell. It is suspected that only 25% (6 inches) of the radon barrier is remaining in some areas of known radon barrier degradation. The observed radon barrier degradation is likely the result of erosion caused by rainwater runoff on the side slopes of the cell due to significant precipitation events of unknown magnitude and intensity. A meteorological weather station was installed at the site in 2017 to evaluate precipitation events as they relate to potential changes in the depression features.

LM's Legacy Management Support (LMS) contractor has developed a work plan to perform radon barrier protection as an interim measure to mitigate additional radon barrier degradation in areas where radon barrier degradation is visually confirmed through forensic field activities. Additionally, LMS is developing a site-specific contingency response plan to ensure response readiness in the potential event that a breach of the disposal cell cover is identified through visual or radiological observations. Plans for additional engineering evaluations are also being developed to investigate the root cause(s) of the depression features and identify the need to for corrective actions to effectively address long-term cell performance. However, due to the challenges in fully characterizing the condition of the radon barrier, which is overlain by additional cover components, the potential exists for unknown areas of degradation to be further impacted by precipitation runoff, potentially resulting in the exposure or dispersal of RRM, radiological releases, or both from the disposal cell.

A variety of real-time radiological surveys (i.e., with field instrumentation) have been performed at the site by LMS radiological control technicians (RCTs). At the time the real-time surveys were performed, survey results within areas of cover depression features as well as in areas with observed radon barrier degradation did not exhibit elevated radon or gamma radiation levels compared to background conditions. However, real-time radiological surveys have limitations compared to continuous radiological monitoring devices. Due to the limitations of real-time monitoring instruments, and to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment, LMS has recommended temporary continuous radon and radiation monitoring at the site. Compared to real-time radiological monitoring, continuous radon and radiation monitoring provides the following added benefits:

- Temporary continuous monitoring is preferable to real-time discrete monitoring for the Mexican Hat project because it provides cumulative radon concentrations throughout the duration of monitoring periods. Real-time monitoring is limited in that it only measures radiological conditions at a particular moment in time, and does not account for natural variations in radiological conditions. Continuous radon gas monitoring accounts for natural variations in radon emanation over extended time periods that are observed due to changes in barometric pressures and temperatures (see Figure 2).
- Temporary continuous monitoring is more comprehensive, relative to discrete, real-time surveying, and project decision makers are therefore provided a higher level of confidence in the acquired data, and subsequently can make better decisions regarding potential corrective actions at the Mexican Hat site.
- Temporary continuous monitoring will incorporate DQOs that will result in quality data attributes that can be used by LM to make informed decisions.



Note:
Source: Yamamoto et al. 2006

Abbreviations:
^{210}Pb = lead-210
Bq m^{-2} = becquerels per square meter

Figure 2. Example of Natural Variation in Radon Progeny Isotope: ^{210}Pb Concentration

6.0 Field Monitoring Procedures

This section describes the methods and equipment for monitoring radon and gamma radiation both onsite (directly on or immediately adjacent to the cell) and offsite (outside the site boundary).

A total of 18 initial monitoring locations are planned; monitoring locations will be optimized throughout the duration of the temporary continuous monitoring program. Figure 3 shows the initial planned continuous radiological monitoring locations (CRMLs).

Radon detectors and environmental TLDs will be installed in pairs at each monitoring location to facilitate efficient collection of data.

6.1 Monitoring Equipment

Radon will be monitored using Radonova Rapidos HS Environmental Radon Monitors (radon detectors) inside protective canisters at each monitoring location. The canisters will be affixed to existing fence lines or to metal T-posts as necessary. T-posts shall not be driven into the engineered rock cover, and tripods will be employed to affix monitors that are placed within the disposal cell footprint. The radon detectors will be stored and used according to the vendor's instructions to ensure reliable and accurate measurements. Individual radon detectors will be installed approximately 3 feet above the ground surface, in accordance with the vendor's recommendations for mounting.

Mirion model 814 (sometimes identified as badge type 17 or 20) TLDs will be used to measure environmental gamma radiation. TLDs will be mounted in protective clamshells, approximately 3 feet above the ground surface, according to the manufacturer's instructions, and will be affixed to the same T-post or area of each radon detector.

Radonova HS Radon Monitors and Mirion model 814 TLDs have been used at many other radiological sites across the United States, including the DOE Moab, Utah, UMTRA Project site and the Crescent Junction, Utah, repository site, where environmental radon concentrations and gamma radiation levels are monitored and measured.

6.2 General Considerations

The initial monitoring interval for the TLDs and radon detectors will be approximately 90 days. Once initial monitoring data are collected and analyzed, the monitoring frequency will be evaluated and modified, if appropriate. LMS personnel will retrieve and replace radon detectors and TLDs and return the exposed cups and TLDs to the appropriate vendor after approximately 90 days, according to the manufacturer's instructions and this Monitoring Plan.

Once TLDs and radon detectors have been initially placed, sample locations will be identified and recorded using sub-meter-accuracy GPS instrumentation.

If a monitoring device is determined to be missing or inoperable or is suspected to have been tampered with, the data from the device will not be included in the evaluation for that monitoring period. Monitoring devices determined to be missing or damaged or are suspected to have been tampered with during the period between change-out events will be replaced during the next scheduled monitoring device change-out. Field observations shall be documented in writing to identify monitoring devices that are suspected to be deficient.

6.3 Monitoring Locations

The initial TLD and radon monitoring locations were based on two fundamental needs: (1) ascertaining whether or not a radiation and/or radon release occurred, or is occurring, at the site (a release that would result in an exceedance of LMS non-occupational worker or public and environment radiation limits[1]), and (2) spatial distribution of the monitoring devices such that resulting data are representative of those areas of the cell cover that have been identified as being potentially impacted by surface depression features. This monitoring placement methodology is recommended by the LMS radiological control manager and the LMS Mexican Hat site lead such that the prescribed monitoring will capture data corresponding to the highest potential for environmental radiation or radon release. The initial planned CRMLs are depicted on Figure 3.

Wind direction was a factor that influenced the initial planned CRMLs. Data collected by the Mexican Hat meteorological station that was installed at the site in July 2017 (from July 2017 through May 2018) indicate a prevailing wind direction from the south-southeast (Figure 4).

As monitoring data are accumulated, the physical locations of the monitors will be evaluated throughout the project duration. New monitoring locations will be established and existing monitoring locations will be removed as appropriate.

7.0 Monitoring Results and Evaluation

Upon return from the vendor, environmental TLD and radon detector data results will be evaluated first for appropriateness (e.g., no obvious processing or reporting issues) and then for site results. TLD and radon detector measurement values will be evaluated for acceptance according to the useful dose ranges shown in Table 1.

Data will be collected and tabulated at the conclusion of each monitoring period for the duration of the project. Arithmetic means will be calculated for each discrete monitoring period, for background location TLD measurements, and onsite TLD measurements to provide average, onsite, and background data points. This information will help the LMS health physicist determine if radiation is emanating from the onsite disposal cell, and if it is, at what exposure rate (e.g., microroentgens per hour or microroentgens per day). If elevated radiation is emanating from the site, then the calculated exposure rate (site measurement minus background = site added, per year) should then be compared to Title 10 *Code of Federal Regulations* Part 835 (10 CFR 835) §208, "Limits for Members of the Public Entering a Controlled Area," and DOE Order 458.1.4.b *Public Dose Limits* for members of the general public. This annual total effective dose limit is 100 millirems.

[1] DOE Order 458.1.4.b.(1)(a), *Radiation Protection of the Public and the Environment*, and "Occupational Radiation Protection," 10 CFR 835.208 (3 picocuries per liter above background and 100 millirem annually).

Figure 3. Initial Planned Radiological Monitoring Locations at the Mexican Hat, Utah, Disposal Site

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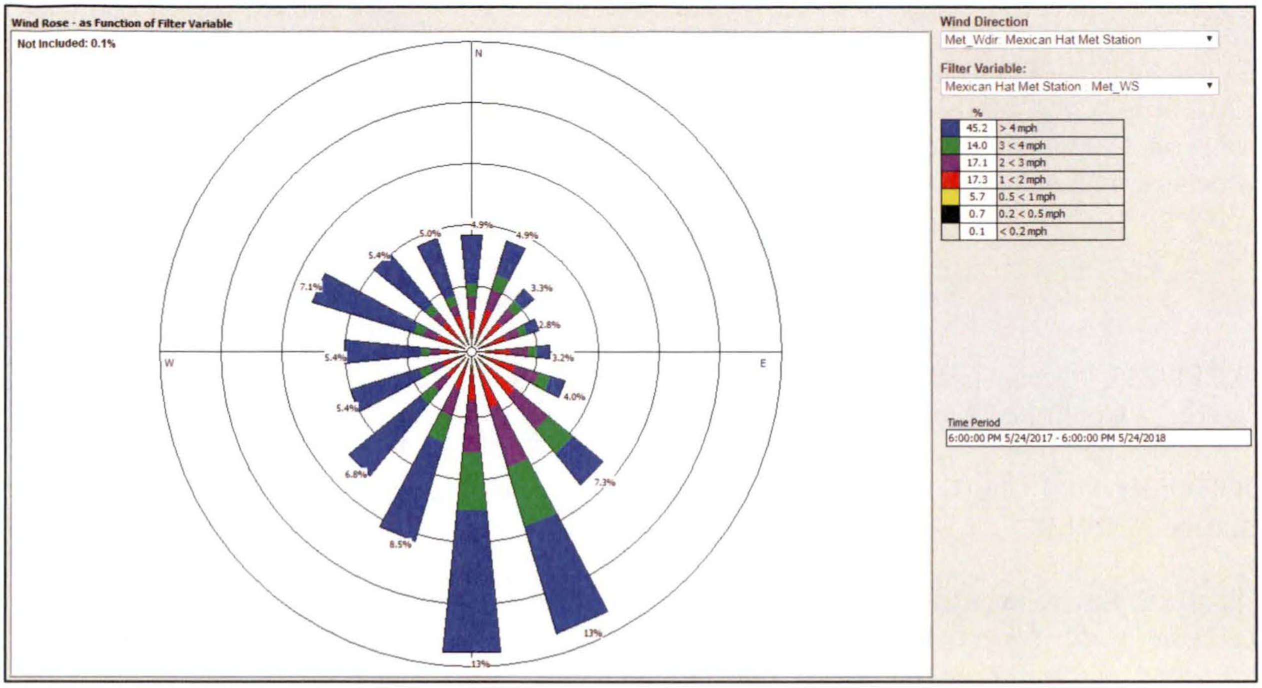

Figure 4. Mexican Hat Meteorological Station Wind Rose, July 2017–May 2018

The LMS health physicist will use a similar process to understand the level at which radon is emanating from the site. The annual average activity concentration results from the radon monitors will be compared against the DOE Order 458.1 radon concentration limit of 3 picocuries per liter (pCi/L) above background at the site boundary.

Radiological monitoring will continue at the site, as warranted, throughout the duration of ongoing evaluation activities leading up to the implementation of any necessary corrective actions. Radiological monitoring activities will be discontinued at the site subsequent to the successful completion and verification of any necessary corrective actions.

7.1 Occupational and Public Exposure Limits

Permissible limits for gamma radiation and radon concentration are presented in 10 CFR 835 and DOE Order 458.1, respectively. These rules establish the total effective dose limits for members of the public while onsite, during access to a controlled area (10 CFR 835.208), and for members of the public while offsite (DOE O 458.1.4.b(1)(a)). Additionally, radiological activities must be conducted in a manner such that the release of radon to the atmosphere will not exceed a 3 pCi/L annual average radon-222 concentration, not including background, at the site boundary (if DOE activities release radon or their decay products).

Occupational radiation worker controls will be implemented and performed during work activity periods at the site, in accordance with the LMS *Radiation Protection Program Plan* (LMS/POL/S04373) and the LMS *Radiological Control Manual* (LMS/POL/S04322).

8.0 Implementation

Implementation of this plan would require the completion of an *Environmental Review* (LM-Form-4-20.3-4.0-0.1) and any necessary environmental compliance reviews and approvals from LM. Community outreach is advisable to evaluate the potential for public controversy associated with the implementation of this plan.

9.0 References

10 CFR 835. "Occupational Radiation Protection," §208 "Limits for Members of the Public Entering a Controlled Area," *Code of Federal Regulations*.

DOE Order 458.1 Chg 3. *Radiation Protection of the Public and the Environment*, January 15, 2013.

EPA (U.S. Environmental Protection Agency), 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process,* EPA/240/B-06/001, Office of Environmental Information.

Radiation Protection Program Plan, LMS/POL/S04373, continually updated, prepared by Navarro Research and Engineering, Inc., for the U.S. Department of Energy Office of Legacy Management.

Radiological Control Manual, LMS/POL/S04322, continually updated, prepared by Navarro Research and Engineering, Inc., for the U.S. Department of Energy Office of Legacy Management.

Yamamoto, M., A. Sakaguchi, K. Sasaki, K. Hirose, Y. Igarashi, and C. Kim, 2006. "Seasonal and spatial variation of atmospheric ^{210}Pb and ^{7}Be deposition: Features of the Japan Sea side of Japan," *Journal of Environmental Radioactivity*. 86 (1): 110–131, doi:10.1016/j.jenvrad.2005.08.001.

Figure 1. Radon Detector and TLD Placement Locations at the Mexican Hat, Utah, Disposal Site

Department of Energy
Washington, DC 20585

June 3, 2019

U.S. Nuclear Regulatory Commission
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Subject: U.S. Department of Energy, Office of Legacy Management (DOE-LM) update to U.S. Nuclear Regulatory Commission (NRC) Staff on Mexican Hat, Utah, Disposal Site, Radiological Monitoring Summary, First Quarter 2019 (Docket No. WM-63)

To Whom It May Concern:

On January 2 radon detectors and environmental thermoluminescent dosimeters (TLDs) were placed at the Mexican Hat, Utah, Disposal Site, in accordance with the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816).

On April 8, the deployed radon detectors and TLDs were collected from the site and sent to an accredited vendor for processing and analysis. Replacement radon cups and TLDs were deployed for the current quarter of monitoring at the time of collection.

This is the second quarter of radiological monitoring results;

QUARTER	YEAR	DURATION
First Quarter	2019	January 2, 2019 through April 8, 2019
Fourth Quarter	2018	October 24, 2018 through January 2, 2019

The radon detectors and TLD results were evaluated and showed:

- No regulatory limits have been exceeded for the current quarter.
- The variances between monitoring quarters could have been due to the following factors:
  1. Environmental factors (e.g., barometric pressure, temperature, wind, etc.).
  2. TLD sensitivity and accuracy when monitoring results are at this low of level (< 10 mrem).
- Calculating the average radon concentration or cumulative environmental dose for all monitoring periods did not result in any exceedance of regulatory limits.
- All radiological monitoring results were below regulatory limits, which further supports the determination that residual radioactive material (RRM) has not been exposed at the depression areas, and the disposal cell continues to protect public health, safety, and the environment.

Result Metrics	4th Qtr 2018	1st Qtr 2019
Mean on-site radon concentration (pCi/L)	0.53	**0.25**
Mean off-site radon concentration (pCi/L)	0.41	**0.24**
On-site minus off-site radon concentration (pCi/L)	0.12	**0.01**
Radon concentration limit[1] at boundary (pCi/L, avg annual)	3.0	**3.0**
Mean on-site environmental dose (mrem per qtr)	0.44	**6.44**
Mean off-site environmental dose (mrem per qtr)	2.22	**7.00**
On-site minus off-site dose (mrem per qtr)	-1.78	**-0.56**
Environmental dose limit[2] at boundary (mrem per yr)	100.0	**100.0**

Avg. Radon Concentration
0.39
0.33
0.07
Cummulative Enviro. Dose
6.88
9.22
-2.34

[1] Radon concentration limit is 3 pCi/L annual average (10 CFR 835 & DOE Order 458.1) as described in LMS/HAT/S18816.
[2] Environmental dose limit is 100 mrem per year (10 CFR 835 & DOE Order 458.1.4.b) as described in LMS/HAT/S18816.

Supporting data included with this letter are the following:

- Document – *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816).
- Figure 1 – *Radon Detector and TLD Placement Locations at the Mexican Hat, Utah, Disposal Site*

Raw data is available upon request.

Please call me at (970) 248-6621 or email me at Angelita.Denny@lm.doe.gov if you have any questions. Please address any correspondence to:

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Sincerely,

Angelita Denny
Site Manager

Enclosures

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D. Miller, Navarro (e)
DOE Read File
File: HAT 0045.10 (Records)

LMS/HAT/S18816

Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site

September 2018

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UMTRA	Uranium Mill Tailings Remedial Action (Project)
UMTRCA	Uranium Mill Tailings Radiation Control Act

1.0 Introduction

This Monitoring Plan describes the methods and rationale for temporary continuous radiological monitoring activities at the U.S. Department of Energy (DOE) Office of Legacy Management (LM) Mexican Hat, Utah, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site (site).

The radiological monitoring approach for the site has been developed using the U.S. Environmental Protection Agency (EPA) Data Quality Objectives (DQO) process (EPA 2006). The DQO process is a systematic planning tool for developing technically sound data collection plans, and provides a rigorous technical framework to support the means and methods of data acquisition for the radiological monitoring approach for the site.

2.0 Purpose and Scope

The purpose of the radiological monitoring approach is to evaluate disposal cell cover performance and quantitatively monitor for the presence or absence of elevated radiological readings as a result of radon barrier degradation that has been identified at the site. Elevated radiological readings would be indicative of a breach through the disposal cell cover components, including the radon barrier, resulting in the exposure or dispersal of residual radioactive material (RRM) contained in the disposal cell. Recent real-time radiological surveys (i.e., with field instruments) performed at the site have not identified elevated radiological readings in areas of radon barrier degradation or within the disposal cell footprint compared to background conditions. However, observed degradation of the disposal cell radon barrier warrants temporary continuous radiological monitoring at the site.

The radiological monitoring approach consists of continuous radon-222 (radon) and gamma radiation monitoring through the installation of a series of paired radon monitoring cups and thermoluminescent dosimeters (TLDs) within and around the perimeter of the disposal cell and outside of the site boundary. The objective of the temporary continuous gamma radiation and radon monitoring approach is to provide project decision makers with quantitative radiological data that can be evaluated to determine the presence or absence of elevated radiological readings at the site compared to background conditions, and to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment.

3.0 Data Quality Objectives

The radiological monitoring approach for the Mexican Hat disposal site was developed using the EPA DQO process (EPA 2006). The DQO process is a systematic planning tool for developing technically sound data collection plans. The DQO process provides a rigorous technical framework for developing the type, quantity, and quality of information needed to support acquisition of radiological monitoring data for the Mexican Hat disposal site.

Components of the DQO process are as follows:

Step 1. Develop Problem Statement: Observed cover degradation indicates that there is the potential for a breach of the cell cover that could result in the exposure or dispersal of RRM contained in the disposal cell.

Step 2. Identify the Goals and Objectives of the Study: Radiological monitoring is needed to determine the presence or absence of elevated radiological readings at the site compared to background conditions, and to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment.

Step 3. Identify Information and Inputs: Relevant information and inputs include the following:

- The disposal cell cover at the Mexican Hat site is exhibiting radon barrier degradation due to erosion. Visual observations indicate that as much as 75% of the thickness of the radon barrier may be eroded in at least one location.
- Precipitation runoff on the northeast side slope may reach velocities that result in additional erosion of the radon barrier.
- LM is planning to mitigate visually-observed areas of radon barrier degradation to prevent further erosion as additional geotechnical information is being collected and engineering evaluation of the cell cover components and required follow-on actions are identified. However, due to challenges in fully determining the condition of the radon barrier, which is overlain by additional cover components, the potential exists for unknown areas of degradation to be further impacted by precipitation, resulting in the potential exposure and dispersal of RRM contained in the disposal cell.
- Previous real-time radiological surveys (i.e., with field instrumentation) associated with investigation of cover degradation features at the site have not resulted in readings that exceed background levels. Elevated radiological readings would be indicative of an exposure or dispersal of RRM.
- Continuous radiological monitoring is proposed to provide a comprehensive record of radon concentrations and associated fluctuations due to natural influences (e.g., barometric pressure and temperature), to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment, and to monitor for elevated radiological readings that would be indicative of an exposure or dispersal of RRM.

Step 4. Define the Boundaries of the Study: The boundaries of the study area will include the site and the area immediately surrounding the site (approximately 200 yards past the site boundary). The primary focus will be on the areas of observed cover degradation on the lower northeast side slope and adjacent apron and toe-drain areas.

Step 5. Develop the Analytic Approach: TLDs will be returned to the appropriate vendor and processed by the ANSI N545-1975 accredited vendor according to their standard operating procedures. Similarly, radon detectors will be analyzed by the ISO 17025 accredited vendor according to their standard operating procedures. Table 1 shows the specifications for the radon detectors and TLDs; detections limits for the applicable devices can be found in the useful dose range row.

Step 6. Specify Performance and Acceptance Criteria: TLD and radon detector measurement values will be evaluated for acceptance according to the useful dose ranges shown in Table 1. Arithmetic mean values for all background locations and for all onsite locations will then be established and compared to determine the presence or absence of elevated radiological readings at the site compared to background conditions.

Table 1. Measurement Device Specifications

Metrics	Radon Monitoring Device	Radiation Monitoring Device
Vendor name	Radonova	Mirion
Monitor name/type	Rapidos HS Environmental Radon Monitor	Environmental thermoluminescent dosimeter (TLD) 814
Description	High sensitive radon monitor (alpha track detector)	4 Element Panasonic TLD (1 LiBO:Mn [TLD800] and 3 CaSO:Dy [TLD900] elements)
Accreditations/approvals/ standards	ISO 17025 accredited	ANSI N545-1975
Monitoring duration	Between 10 and 365 days	Months to 1 year
Useful dose range	Daily: 0.02 pCi/L Total: 76 pCi/L, 10–28,000 pCi/L•days	0.05 mGy to 5 Gy

Abbreviations:
ISO = International Organization for Standardization
ANSI = American National Standards Institute
LiBO:Mn = lithium borate manganese (composition of TLD chip)
CaSO:Dy = calcium sulfate dysprosium (composition of TLD chip)
pCi/L = picocuries per liter
mGy = milligray
Gy = gray

Step 7. Plan for Obtaining Data: TLDs and radon detectors will be placed at the initial continuous radiological monitoring locations (CRMLs) as depicted on Figure 3. Initial CRMLs are based on site-specific meteorological data (i.e., prevailing wind direction) and biased in proximity to the locations of known cover degradation features. Additional CRMLs will be used to establish baseline data for areas within and outside of the site boundary. Both the TLDs and radon detectors will initially be deployed in intervals of 90 days.

4.0 Site Description

This section provides an overview of the ownership, location, and history of the site.

4.1 Ownership and Location

The Mexican Hat disposal cell is located on the Navajo Reservation in southeast Utah. The 68-acre disposal cell is located on the approximately 119-acre disposal site. The site is held in trust by the United States of America for the Bureau of Indian Affairs; the Navajo Nation retains title to the land.

The site is located in San Juan County, Utah, in Sections 13 and 24, Township 42 South, Range 18 East, and in Sections 18 and 19, Township 42 South, Range 19 East, Salt Lake

Principal Meridian. The disposal site is located approximately 1.5 miles southwest of the town of Mexican Hat, Utah, and 1 mile south of the San Juan River. The small Navajo community of Halchita is approximately 0.5 miles southwest of the site.

4.2 History

Texas-Zinc Minerals Corporation constructed the Mexican Hat Mill on land leased from the Navajo Nation and operated the facility from 1957 to 1963. In 1963, Atlas Corporation purchased the mill and operated it until it closed in 1965. A sulfuric acid manufacturing plant operated at the site from 1957 to 1970; Atlas continued operating the sulfuric acid manufacturing plant at the site until the lease expired in 1970 and control of the site reverted to the Navajo Nation.

Ore brought to the mill contained a considerable amount of copper sulfide and other sulfide minerals and was processed to recover both copper and uranium. The milling process produced radioactive tailings, a predominantly sandy material. Spent tailings were mixed with process water and pumped through a pipeline to two onsite tailings piles: the former lower tailings pile and the former upper tailings pile.

4.3 Mill Tailings Disposal and Cell Construction

DOE remediated the site under the Uranium Mill Tailings Remedial Action (UMTRA) Project. Surface remediation and construction of the disposal cell was completed at the site in 1995. The pentagonal-shaped disposal cell was constructed at the location of the preexisting former lower tailings pile. Radioactive materials from the former upper tailings pile, demolished mill structures, and 11 vicinity properties were relocated and placed on top of the preexisting tailings at the location of the former lower tailings pile. An additional 983,000 cubic yards (1.3 million dry tons) of tailings and associated wastes were subsequently hauled from the Monument Valley, Arizona, UMTRCA Title I Processing Site (located approximately 15 miles south of the Mexican Hat site) and placed on top of the contaminated materials from the Mexican Hat site. A total of approximately 3.6 million cubic yards (4.4 million dry tons) of radioactive tailings and other RRM were ultimately encapsulated in the Mexican Hat disposal cell.

The Mexican Hat disposal cell abuts a rock outcrop on its south side and rises approximately 50 feet above the surrounding terrain to the north, east, and west. The disposal cell was designed to encapsulate radioactive tailings and other RRM in a way that minimizes the need for active maintenance and limits radon gas emanation in accordance with UMTRCA. The cell was constructed with a 2% top slope transitioning to 20% side slopes, which drain into a surrounding rock perimeter channel. The perimeter channel discharges to three engineered toe drains that drain into existing arroyos to the north and east of the cell.

Radioactive tailings and other RRM were compacted prior to being covered with a multicomponent system to encapsulate the tailings materials. The side slope cover consists of a 24-inch-thick low-permeability radon barrier placed directly over the compacted tailings, a 6-inch-thick sandy gravel bedding layer placed over the radon barrier as an initial rock erosion-protection layer, and a 12-inch-thick rock riprap final erosion-protection layer placed over the bedding layer. The top slope cover consists of the same components, with an 8-inch-thick rock riprap layer for final erosion protection (Figure 1).

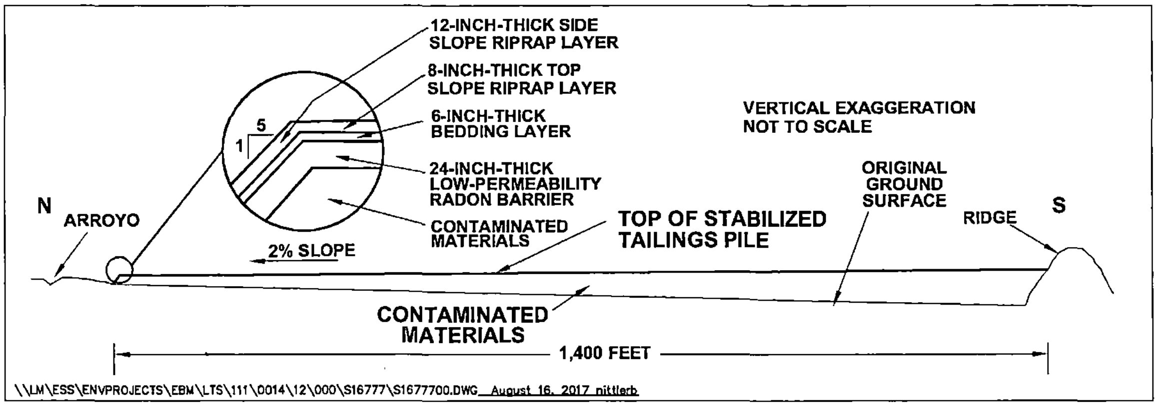


Figure 1. Typical North-South Cross Section of the Mexican Hat Disposal Cell

5.0 Basis for Radiological Monitoring

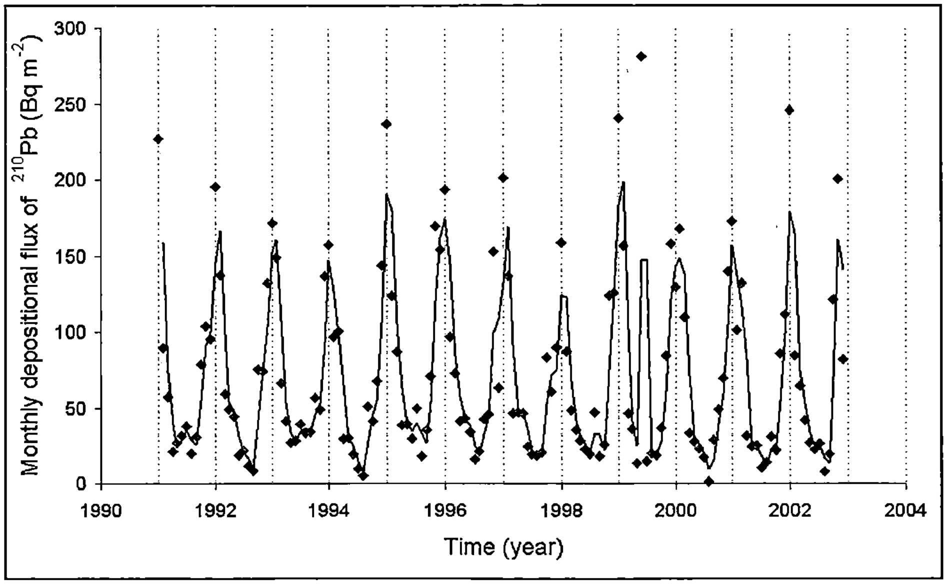
In 2016, multiple subtle depressions were identified in the rock cover along the toe and lower portions of the northeast side slope of the disposal cell. Due to concerns regarding the potential impacts of the cell cover depressions related to cell performance and erosion resistance, an evaluation of the depressions was performed. The evaluation included visual observations of the depressions, limited small-area manual removals of the rock cover components to expose the top of the radon barrier surface, review of disposal cell as-built drawings, and review of supporting design calculations for the rock cover components.

As a result of limited field investigations, voids, cavities, and incisements were discovered within the radon barrier on the north and northeast side slopes of the disposal cell. It is suspected that only 25% (6 inches) of the radon barrier is remaining in some areas of known radon barrier degradation. The observed radon barrier degradation is likely the result of erosion caused by rainwater runoff on the side slopes of the cell due to significant precipitation events of unknown magnitude and intensity. A meteorological weather station was installed at the site in 2017 to evaluate precipitation events as they relate to potential changes in the depression features.

LM's Legacy Management Support (LMS) contractor has developed a work plan to perform radon barrier protection as an interim measure to mitigate additional radon barrier degradation in areas where radon barrier degradation is visually confirmed through forensic field activities. Additionally, LMS is developing a site-specific contingency response plan to ensure response readiness in the potential event that a breach of the disposal cell cover is identified through visual or radiological observations. Plans for additional engineering evaluations are also being developed to investigate the root cause(s) of the depression features and identify the need to for corrective actions to effectively address long-term cell performance. However, due to the challenges in fully characterizing the condition of the radon barrier, which is overlain by additional cover components, the potential exists for unknown areas of degradation to be further impacted by precipitation runoff, potentially resulting in the exposure or dispersal of RRM, radiological releases, or both from the disposal cell.

A variety of real-time radiological surveys (i.e., with field instrumentation) have been performed at the site by LMS radiological control technicians (RCTs). At the time the real-time surveys were performed, survey results within areas of cover depression features as well as in areas with observed radon barrier degradation did not exhibit elevated radon or gamma radiation levels compared to background conditions. However, real-time radiological surveys have limitations compared to continuous radiological monitoring devices. Due to the limitations of real-time monitoring instruments, and to obtain a robust data set that provides supporting evidence that the disposal cell remains protective of human health and the environment, LMS has recommended temporary continuous radon and radiation monitoring at the site. Compared to real-time radiological monitoring, continuous radon and radiation monitoring provides the following added benefits:

- Temporary continuous monitoring is preferable to real-time discrete monitoring for the Mexican Hat project because it provides cumulative radon concentrations throughout the duration of monitoring periods. Real-time monitoring is limited in that it only measures radiological conditions at a particular moment in time, and does not account for natural variations in radiological conditions. Continuous radon gas monitoring accounts for natural variations in radon emanation over extended time periods that are observed due to changes in barometric pressures and temperatures (see Figure 2).
- Temporary continuous monitoring is more comprehensive, relative to discrete, real-time surveying, and project decision makers are therefore provided a higher level of confidence in the acquired data, and subsequently can make better decisions regarding potential corrective actions at the Mexican Hat site.
- Temporary continuous monitoring will incorporate DQOs that will result in quality data attributes that can be used by LM to make informed decisions.



Note:
Source: Yamamoto et al. 2006

Abbreviations:
^{210}Pb = lead-210
Bq m^{-2} = becquerels per square meter

Figure 2. Example of Natural Variation in Radon Progeny Isotope: ^{210}Pb Concentration

6.0 Field Monitoring Procedures

This section describes the methods and equipment for monitoring radon and gamma radiation both onsite (directly on or immediately adjacent to the cell) and offsite (outside the site boundary).

A total of 18 initial monitoring locations are planned; monitoring locations will be optimized throughout the duration of the temporary continuous monitoring program. Figure 3 shows the initial planned continuous radiological monitoring locations (CRMLs).

Radon detectors and environmental TLDs will be installed in pairs at each monitoring location to facilitate efficient collection of data.

6.1 Monitoring Equipment

Radon will be monitored using Radonova Rapidos HS Environmental Radon Monitors (radon detectors) inside protective canisters at each monitoring location. The canisters will be affixed to existing fence lines or to metal T-posts as necessary. T-posts shall not be driven into the engineered rock cover, and tripods will be employed to affix monitors that are placed within the disposal cell footprint. The radon detectors will be stored and used according to the vendor's instructions to ensure reliable and accurate measurements. Individual radon detectors will be installed approximately 3 feet above the ground surface, in accordance with the vendor's recommendations for mounting.

Mirion model 814 (sometimes identified as badge type 17 or 20) TLDs will be used to measure environmental gamma radiation. TLDs will be mounted in protective clamshells, approximately 3 feet above the ground surface, according to the manufacturer's instructions, and will be affixed to the same T-post or area of each radon detector.

Radonova HS Radon Monitors and Mirion model 814 TLDs have been used at many other radiological sites across the United States, including the DOE Moab, Utah, UMTRA Project site and the Crescent Junction, Utah, repository site, where environmental radon concentrations and gamma radiation levels are monitored and measured.

6.2 General Considerations

The initial monitoring interval for the TLDs and radon detectors will be approximately 90 days. Once initial monitoring data are collected and analyzed, the monitoring frequency will be evaluated and modified, if appropriate. LMS personnel will retrieve and replace radon detectors and TLDs and return the exposed cups and TLDs to the appropriate vendor after approximately 90 days, according to the manufacturer's instructions and this Monitoring Plan.

Once TLDs and radon detectors have been initially placed, sample locations will be identified and recorded using sub-meter-accuracy GPS instrumentation.

If a monitoring device is determined to be missing or inoperable or is suspected to have been tampered with, the data from the device will not be included in the evaluation for that monitoring period. Monitoring devices determined to be missing or damaged or are suspected to have been tampered with during the period between change-out events will be replaced during the next scheduled monitoring device change-out. Field observations shall be documented in writing to identify monitoring devices that are suspected to be deficient.

6.3 Monitoring Locations

The initial TLD and radon monitoring locations were based on two fundamental needs: (1) ascertaining whether or not a radiation and/or radon release occurred, or is occurring, at the site (a release that would result in an exceedance of LMS non-occupational worker or public and environment radiation limits[1]), and (2) spatial distribution of the monitoring devices such that resulting data are representative of those areas of the cell cover that have been identified as being potentially impacted by surface depression features. This monitoring placement methodology is recommended by the LMS radiological control manager and the LMS Mexican Hat site lead such that the prescribed monitoring will capture data corresponding to the highest potential for environmental radiation or radon release. The initial planned CRMLs are depicted on Figure 3.

Wind direction was a factor that influenced the initial planned CRMLs. Data collected by the Mexican Hat meteorological station that was installed at the site in July 2017 (from July 2017 through May 2018) indicate a prevailing wind direction from the south-southeast (Figure 4).

As monitoring data are accumulated, the physical locations of the monitors will be evaluated throughout the project duration. New monitoring locations will be established and existing monitoring locations will be removed as appropriate.

7.0 Monitoring Results and Evaluation

Upon return from the vendor, environmental TLD and radon detector data results will be evaluated first for appropriateness (e.g., no obvious processing or reporting issues) and then for site results. TLD and radon detector measurement values will be evaluated for acceptance according to the useful dose ranges shown in Table 1.

Data will be collected and tabulated at the conclusion of each monitoring period for the duration of the project. Arithmetic means will be calculated for each discrete monitoring period, for background location TLD measurements, and onsite TLD measurements to provide average, onsite, and background data points. This information will help the LMS health physicist determine if radiation is emanating from the onsite disposal cell, and if it is, at what exposure rate (e.g., microroentgens per hour or microroentgens per day). If elevated radiation is emanating from the site, then the calculated exposure rate (site measurement minus background = site added, per year) should then be compared to Title 10 *Code of Federal Regulations* Part 835 (10 CFR 835) §208, "Limits for Members of the Public Entering a Controlled Area," and DOE Order 458.1.4.b *Public Dose Limits* for members of the general public. This annual total effective dose limit is 100 millirems.

[1] DOE Order 458.1.4.b.(1)(a), *Radiation Protection of the Public and the Environment*, and "Occupational Radiation Protection," 10 CFR 835.208 (3 picocuries per liter above background and 100 millirem annually).

Figure 3. Initial Planned Radiological Monitoring Locations at the Mexican Hat, Utah, Disposal Site

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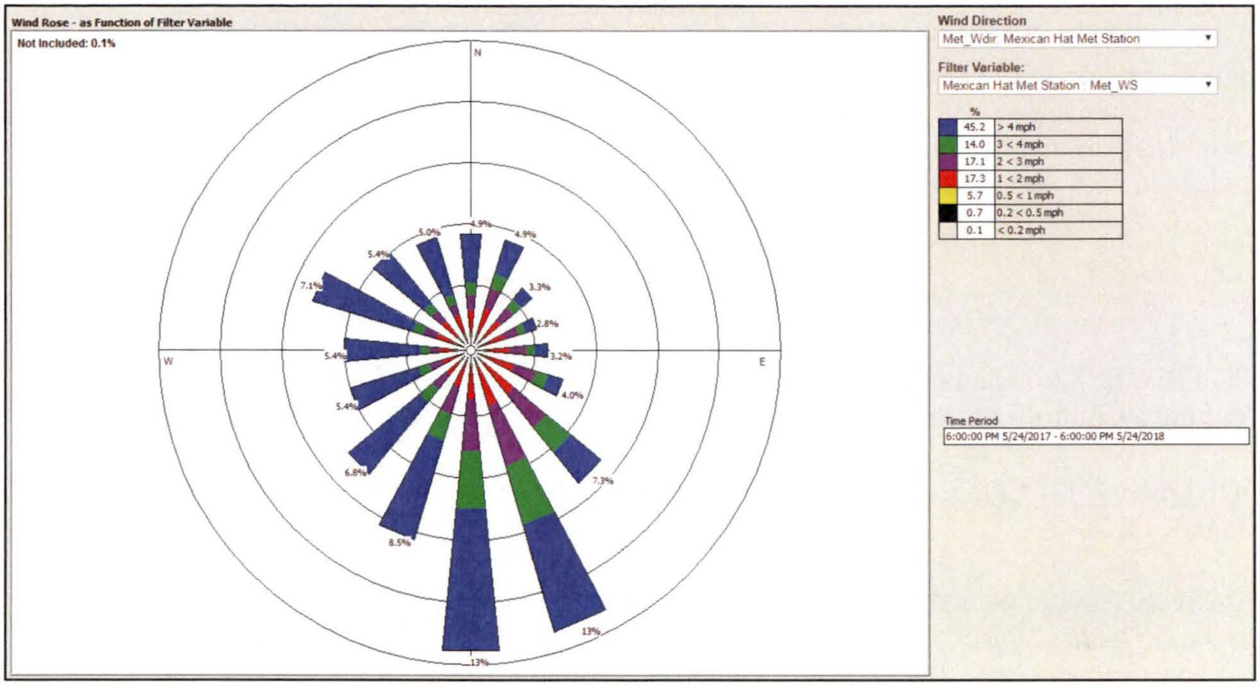

Figure 4. Mexican Hat Meteorological Station Wind Rose, July 2017–May 2018

The LMS health physicist will use a similar process to understand the level at which radon is emanating from the site. The annual average activity concentration results from the radon monitors will be compared against the DOE Order 458.1 radon concentration limit of 3 picocuries per liter (pCi/L) above background at the site boundary.

Radiological monitoring will continue at the site, as warranted, throughout the duration of ongoing evaluation activities leading up to the implementation of any necessary corrective actions. Radiological monitoring activities will be discontinued at the site subsequent to the successful completion and verification of any necessary corrective actions.

7.1 Occupational and Public Exposure Limits

Permissible limits for gamma radiation and radon concentration are presented in 10 CFR 835 and DOE Order 458.1, respectively. These rules establish the total effective dose limits for members of the public while onsite, during access to a controlled area (10 CFR 835.208), and for members of the public while offsite (DOE O 458.1.4.b(1)(a)). Additionally, radiological activities must be conducted in a manner such that the release of radon to the atmosphere will not exceed a 3 pCi/L annual average radon-222 concentration, not including background, at the site boundary (if DOE activities release radon or their decay products).

Occupational radiation worker controls will be implemented and performed during work activity periods at the site, in accordance with the LMS *Radiation Protection Program Plan* (LMS/POL/S04373) and the LMS *Radiological Control Manual* (LMS/POL/S04322).

8.0 Implementation

Implementation of this plan would require the completion of an *Environmental Review* (LM-Form-4-20.3-4.0-0.1) and any necessary environmental compliance reviews and approvals from LM. Community outreach is advisable to evaluate the potential for public controversy associated with the implementation of this plan.

9.0 References

10 CFR 835. "Occupational Radiation Protection," §208 "Limits for Members of the Public Entering a Controlled Area," *Code of Federal Regulations*.

DOE Order 458.1 Chg 3. *Radiation Protection of the Public and the Environment*, January 15, 2013.

EPA (U.S. Environmental Protection Agency), 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process,* EPA/240/B-06/001, Office of Environmental Information.

Radiation Protection Program Plan, LMS/POL/S04373, continually updated, prepared by Navarro Research and Engineering, Inc., for the U.S. Department of Energy Office of Legacy Management.

Radiological Control Manual, LMS/POL/S04322, continually updated, prepared by Navarro Research and Engineering, Inc., for the U.S. Department of Energy Office of Legacy Management.

Yamamoto, M., A. Sakaguchi, K. Sasaki, K. Hirose, Y. Igarashi, and C. Kim, 2006. "Seasonal and spatial variation of atmospheric ^{210}Pb and ^{7}Be deposition: Features of the Japan Sea side of Japan," *Journal of Environmental Radioactivity*. 86 (1): 110–131, doi:10.1016/j.jenvrad.2005.08.001.

Department of Energy
Washington, DC 20585

June 3, 2019

Ms. Madeline Roanhorse, Director
Navajo UMTRA Program
Division of Natural Resources
PO Box 1875
Window Rock, AZ 86515

Subject: Notification of Mexican Hat, Utah, Disposal Site, Radiological Monitoring Summary, Fourth Quarter 2018

Dear Ms. Roanhorse:

On October 24, 2018 radon detectors and environmental thermoluminescent dosimeters (TLDs) were placed at the Mexican Hat, Utah, Disposal Site, in accordance with the enclosed *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816).

On January 2, 2019 the deployed radon detectors and TLDs were collected from the site and sent to an accredited vendor for processing and analysis. Replacement radon cups and TLDs were deployed for the current quarter of monitoring at the time of collection. The enclosed Figure 1 shows the radon detectors and TLD placement locations.

The radon detectors and TLD results were evaluated and showed:

- No regulatory limits have been exceeded.[1, 2]

4th Qtr 2018 Results	
Mean on-site radon concentration (pCi/L)	0.53
Mean off-site radon concentration (pCi/L)	0.41
On-site minus off-site radon concentration (pCi/L)	0.11
Radon concentration limit at boundary (pCi/L, avg annual)	3.0
Mean on-site environmental dose (mrem per qtr)	0.44
Mean off-site environmental dose (mrem per qtr)	2.22
On-site minus off-site dose (mrem per qtr)	-1.78
Environmental dose limit at boundary (mrem per yr)	100.0

[1] Radon concentration limit is 3 pCi/L annual average (10 CFR 835 & DOE Order 458.1) as described in LMS/HAT/S18816.
[2] Environmental dose limit is 100 mrem per year (10 CFR 835 & DOE Order 458.1.4.b) as described in LMS/HAT/S18816.

- Radiological monitoring results were well below regulatory limits, which further supports the determination that residual radioactive material (RRM) has not been exposed at the depression areas.

Please call me at (970) 248-6621 or email me at Angelita.Denny@lm.doe.gov if you have any questions. Please address any correspondence to:

U.S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

Sincerely,

Angelita Denny
Site Manager

Enclosures

cc w/enclosures:
J. Tallbull, NN AML/UMTRA
S. Austin, NN EPA
D. Orlando, NRC (Docket No. WM-0063)
M. Kautsky, DOE-LM (e)
K. Lott, Navarro (e)
D. Miller, Navarro (e)
DOE Read File
File: HAT 0045.10 (Records)

Department of Energy
Washington, DC 20585

June 3, 2019

Ms. Madeline Roanhorse, Director
Navajo UMTRA Program
Division of Natural Resources
PO Box 1875
Window Rock, AZ 86515

Subject: Notification of Mexican Hat, Utah, Disposal Site, Radiological Monitoring Summary, First Quarter 2019

Dear Ms. Roanhorse:

On January 2 radon detectors and environmental thermoluminescent dosimeters (TLDs) were placed at the Mexican Hat, Utah, Disposal Site, in accordance with the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816).

On April 8, the deployed radon detectors and TLDs were collected from the site and sent to an accredited vendor for processing and analysis. Replacement radon cups and TLDs were deployed for the current quarter of monitoring at the time of collection.

This is the second quarter of radiological monitoring results;

QUARTER	YEAR	DURATION
First Quarter	2019	January 2, 2019 through April 8, 2019
Fourth Quarter	2018	October 24, 2018 through January 2, 2019

The radon detectors and TLD results were evaluated and showed:

- No regulatory limits have been exceeded for the current quarter.
- The variances between monitoring quarters could have been due to the following factors:
    1. Environmental factors (e.g., barometric pressure, temperature, wind, etc.).
    2. TLD sensitivity and accuracy when monitoring results are at this low of level (< 10 mrem).
- Calculating the average radon concentration or cumulative environmental dose for all monitoring periods did not result in any exceedance of regulatory limits.
- All radiological monitoring results were below regulatory limits, which further supports the determination that residual radioactive material (RRM) has not been exposed at the depression areas, and the disposal cell continues to protect public health, safety, and the environment.

Result Metrics	4th Qtr 2018	1st Qtr 2019
Mean on-site radon concentration (pCi/L)	0.53	**0.25**
Mean off-site radon concentration (pCi/L)	0.41	**0.24**
On-site minus off-site radon concentration (pCi/L)	0.12	**0.01**
Radon concentration limit[1] at boundary (pCi/L, avg annual)	3.0	**3.0**
Mean on-site environmental dose (mrem per qtr)	0.44	**6.44**
Mean off-site environmental dose (mrem per qtr)	2.22	**7.00**
On-site minus off-site dose (mrem per qtr)	-1.78	**-0.56**
Environmental dose limit[2] at boundary (mrem per yr)	100.0	**100.0**

Avg. Radon Concentration
0.39
0.33
0.07
Cummulative Enviro. Dose
6.88
9.22
-2.34

[1] Radon concentration limit is 3 pCi/L annual average (10 CFR 835 & DOE Order 458.1) as described in LMS/HAT/S18816.

[2] Environmental dose limit is 100 mrem per year (10 CFR 835 & DOE Order 458.1.4.b) as described in LMS/HAT/S18816.

Supporting data included with this letter are the following:

- Document – *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816).
- Figure 1 – *Radon Detector and TLD Placement Locations at the Mexican Hat, Utah, Disposal Site*

Raw data is available upon request.

Please call me at (970) 248-6621 or email me at Angelita.Denny@lm.doe.gov if you have any questions. Please address any correspondence to:

U.S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

Sincerely,

Angelita Denny
Site Manager

Enclosures

cc w/enclosures:
S. Austin, NN EPA
J. Tallbull, NN AML/UMTRA
D. Orlando, NRC (WM-0063)
M. Kautsky, DOE-LM (e)
K. Lott, Navarro (e)
D. Miller, Navarro (e)
DOE Read File
File: HAT 0045.10 (Records)