

Mexican Hat, Utah, Disposal Cell Radiological Monitoring Conclusion

1.0 Introduction

In September 2018, temporary radiological monitoring of the U.S. Department of Energy (DOE) Office of Legacy Management (also called LM) Mexican Hat, Utah, Uranium Mill Tailings Radiation Control Act (also called UMTRCA) Title I Disposal Site disposal cell site was initiated in accordance with the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* (LMS/HAT/S18816). Radiological monitoring was used to understand and evaluate the cell cover's performance (e.g., whether the cover was mitigating or preventing radiological releases through the cover material that could radiologically impact workers at the site) and quantitatively monitor for the presence or absence of elevated radiological activity as a result of radon barrier degradation that had been previously identified on the site's cover. Elevated radiological readings from the cover (when compared to readings at the site's boundary) would be an indicator of a breach of the cover's protective components, possibly including the radon barrier layer, and an indication of possible dispersion of residual radioactive material outside of the disposal cell or site boundary.

The objective of the monitoring approach was to (1) provide project decision makers with quantitative radiological data that could be evaluated to determine the presence or absence of elevated radiological readings when compared to "background" conditions at the site and (2) obtain a data set that would provide supporting evidence that the disposal cell cover either did or did not remain protective of worker health.

This radiological monitoring conclusion report presents the radiological data obtained during the site's monitoring period and a conclusion that the cell's cover remained radiologically protective of worker health during the investigation phase, during the repair work phase, and during inactive work periods on the cell cover. This report also identifies that the temporary radiological monitoring performed in accordance with the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* has been concluded and that the monitoring plan has been retired.

2.0 Site Monitoring

The temporary radiological monitoring approach used at the site consisted of continuous (passive) radon gas (radon) and gamma radiation monitoring through the installation of a series of paired radon cups and thermoluminescent dosimeters (TLDs) within and around the perimeter (toe) of the disposal cell and at the cell's site boundary (see the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* for monitoring details).

In addition to the temporary passive monitoring approach described in this report, real-time radiological surveys were performed by DOE-qualified radiological control technicians (RCTs) assigned to support the work. These real-time radiological surveys were performed on the cell cover over multiple months and in accordance with radiological control procedures, plans, and

manuals approved by the Legacy Management Support (LMS) Radiological Control organization. Results from the real-time surveys were also used to determine and then demonstrate that the cell's cover remained radiologically protective of worker health during the investigation and repair work phases.

Radiological monitoring at the site commenced in the fourth quarter of calendar year (CY) 2018 and continued through the fourth quarter of CY 2021. The monitoring involved work associated with the cover investigation phase and the repair phase, and it encompassed several months when no work was performed on the cell cover. Investigation and repair work performed on the cell's cover was completed in September 2019.

The purpose of monitoring was twofold. The first purpose was to radiologically monitor and then trend the results (both radiation dose and radon concentration) per yearly quarter in an attempt to determine the presence or absence of elevated radioactivity at the site compared to background conditions. The second purpose was to ensure that (1) the average occupational (i.e., excluding background) radon concentration at the fenced boundary of the site (as recorded by the Radonova Rapidos radon monitors) did not exceed the DOE Order 458.1 Chg 4 (LtdChg), *Radiation Protection of the Public and the Environment*, limit of 3 picocuries per liter (pCi/L) annual average activity, and (2) the annual occupational radiation dose recorded by the Mirion TLDs did not exceed the Title 10 *Code of Federal Regulations* Section 835 (10 CFR 835), "Occupational Radiation Protection," public dose limit of 100 millirem per year (mrem/yr).

Radiological work at DOE sites or facilities is performed in accordance with applicable DOE federal regulations and DOE orders used to manage and control worker, public, and environmental radiation dose or exposure. For the work described in this document, requirements from 10 CFR 835 and DOE Order 458.1 Chg 4 (LtdChg) were cited, implemented, and used. The limits from these two regulatory documents were identified in the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site*. As shown in Figure 1, these limits are 100 mrem/yr and 3 pCi/L annual average activity. These limits identify the radiation dose and radon concentration values that are considered protective of human health and the environment when not exceeded.

It is important to note that the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* did not implement the requirements of 10 CFR 40, Appendix A, "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," as a demonstration to meet the objective of providing supporting evidence that the disposal cell cover remained protective.

When comparing the results of the onsite monitors to boundary monitors, it is important to note that a detailed statistical evaluation or testing of the results data was not performed or required by the plan. A detailed statistical evaluation was not necessary to understand whether site boundary limits were being exceeded and whether the workforce was being exposed to occupational radiation exposures above 100 mrem annually.

The *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* was created and then implemented as a temporary measure, allowing for continuous radiological monitoring at

the site. According to the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site*, Section 7.0, “Monitoring Results and Evaluation”:

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.

Interim cell cover corrective actions were completed in September 2019 to address the areas with the most pervasive erosion features until a long-term solution is determined and constructed. Temporary radiological monitoring at the site was concluded and the *Radiological Monitoring Plan for the Mexican Hat, Utah, Disposal Site* was retired.

3.0 Mexican Hat Radiological Survey Results

Radiological monitoring activities initially consisted of quarterly placement and retrieval of installed monitors (radon cups and TLDs) with the associated vendor processing the monitors for data at the completion of each 3-month monitoring period. During coronavirus disease 2020 (also called COVID-19) restrictions to the site and supply chain issues that delayed delivery of the radon cups and TLDs, radon cups and TLDs were left in place for longer than the identified 3-month monitoring period. The performance of the radon cups and TLDs and the work planned allowed for an extended monitor placement duration (of up to a full year) without degradation or loss of the monitor’s performance or affecting the monitor’s results. In Table 1, there are two columns of monitor results data that exceed the 3-month monitoring period.

In accordance with the monitoring plan, TLD and radon cup measurement results were first evaluated for appropriateness (e.g., no obvious processing or reporting issues) and then for radiological results. No abnormal radiological results were identified during the monitoring periods from the start of monitoring in 2018 through the completion of monitoring in February 2022. Monitor data was collected and tabulated at the conclusion of each monitoring period. Arithmetic means were calculated for each discrete monitoring period, for background location TLD and radon cup measurement results, and for onsite TLD and radon cup measurement results. Figure 2 presents the locations of the background monitoring locations.

The mean results of the onsite and background TLD measurements were compared by subtracting the mean background measurement result from the mean onsite measurement result for that monitoring period. Once acquired, the annual cumulative onsite dose (minus background cumulative dose) was compared to the plan’s cumulative annual dose limit of 100 mrem. No cumulative annual dose (i.e., onsite minus background dose) exceeded the 100 mrem annual limit. In fact, all cumulative annual doses (and most quarterly doses) turned out to be a negative dose value number. This is significant in that it indicates that the cell’s cover shielded what is considered terrestrial radiation that would have otherwise emanated from the naturally occurring radioactive material associated with the earth’s crust located beneath the disposal cell at the site.

The mean results of the onsite and background radon cup measurements were compared by subtracting the mean background measurement result from the mean onsite measurement result. The annual average onsite radon activity (minus background radon activity) was compared to the plan's annual average radon concentration limit of 3 pCi/L (excluding natural background radon radioactivity) at the site's boundary. No annual average radon activity concentration (minus background radon radioactivity) exceeded 3 pCi/L. In fact, the annual average radon concentrations (regardless of the time period used to obtain the average annual activity concentration value) were significantly (by an order of magnitude) below the 3 pCi/L limit. This is significant in that it indicates that the cell's cover mitigated the emanation of radon from the uranium mill tailing material located beneath the cell cover, even during periods when radon barrier material erosion was present.

4.0 Cited Regulations

Permissible limits for radiation doses and radon activity concentrations are presented in 10 CFR 835 and DOE Order 458.1. These rules establish the total effective dose limits for workers and members of the public while onsite, during access to a controlled area (10 CFR 835.208), and while offsite (DOE Order 458.1 Chg 4 (LtdChg), Section 4.b(1)(a)). When elevated radiation is emanating from a site, then an annual calculated radiation exposure (site measurement value minus a background value) should be compared to 10 CFR 835.208, "Limits for Members of the Public Entering a Controlled Area," and DOE Order 458.1 Chg 4 (LtdChg), Section 4.b, "Public Dose Limits," for members of the general public. This annual total effective dose limit for visitors and nonoccupational radiological workers is 100 mrem. 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 activity concentration, not including background, at the site boundary (if DOE activities release radon or their decay products).

5.0 Monitoring Results Conclusion

Monitoring results presented in this conclusion report show that the site's cell cover remained radiologically protective of human health during the investigation phase, during the repair work phase, and during inactive work periods at the site. Additionally, it should be concluded that radiation total effective dose and radon activity concentration limits established in 10 CFR 835 and DOE Order 458.1 Chg 4 (LtdChg) were not exceeded (or approached) during the monitoring period for the site.

Radiological monitoring at the site was concluded during the fourth quarter of CY 2021.

2018 - 2021 Mexican Hat Cumulative Monitoring Results										
Result Metric	Regulatory Limits	4th Qtr 2018	1st Qtr 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	1st, 2nd and 3rd Qtr 2020	4th Qtr 2020 & 1st Qtr 2021	2nd Qtr 2021	3rd Qtr 2021
Mean on-site radon concentration (pCi/L)		0.53	0.25	0.14	0.26	0.56	0.20	0.42	0.14	0.59
Mean off-site radon concentration (pCi/L)		0.41	0.24	0.16	0.24	0.50	0.17	0.42	0.17	0.57
On-site minus off-site radon concentration (pCi/L)		0.11	0.01	-0.02	0.02	0.05	0.03	0.00	-0.03	0.01
DOE radon concentration limit at boundary (pCi/L, avg annual)	3									
Mean on-site environmental dose (mrem per qtr)		0.44	6.44	1.11	0.11	3.78	7.78	3.67	1.33	3.89
Mean off-site environmental dose (mrem per qtr)		2.22	7.00	2.44	1.78	3.11	12.56	6.00	2.56	7.00
On-site minus off-site dose (mrem per qtr)		-1.78	-0.56	-1.33	-1.67	0.67	-4.78	-2.33	-1.22	-3.11
DOE dose limit at boundary (mrem per yr)	100									

Figure 1. 2018—2021 Mexican Hat Monitoring Results

CRML = Continuous Radiological Monitoring Location
Note: CRMLs were installed on October 24, 2018

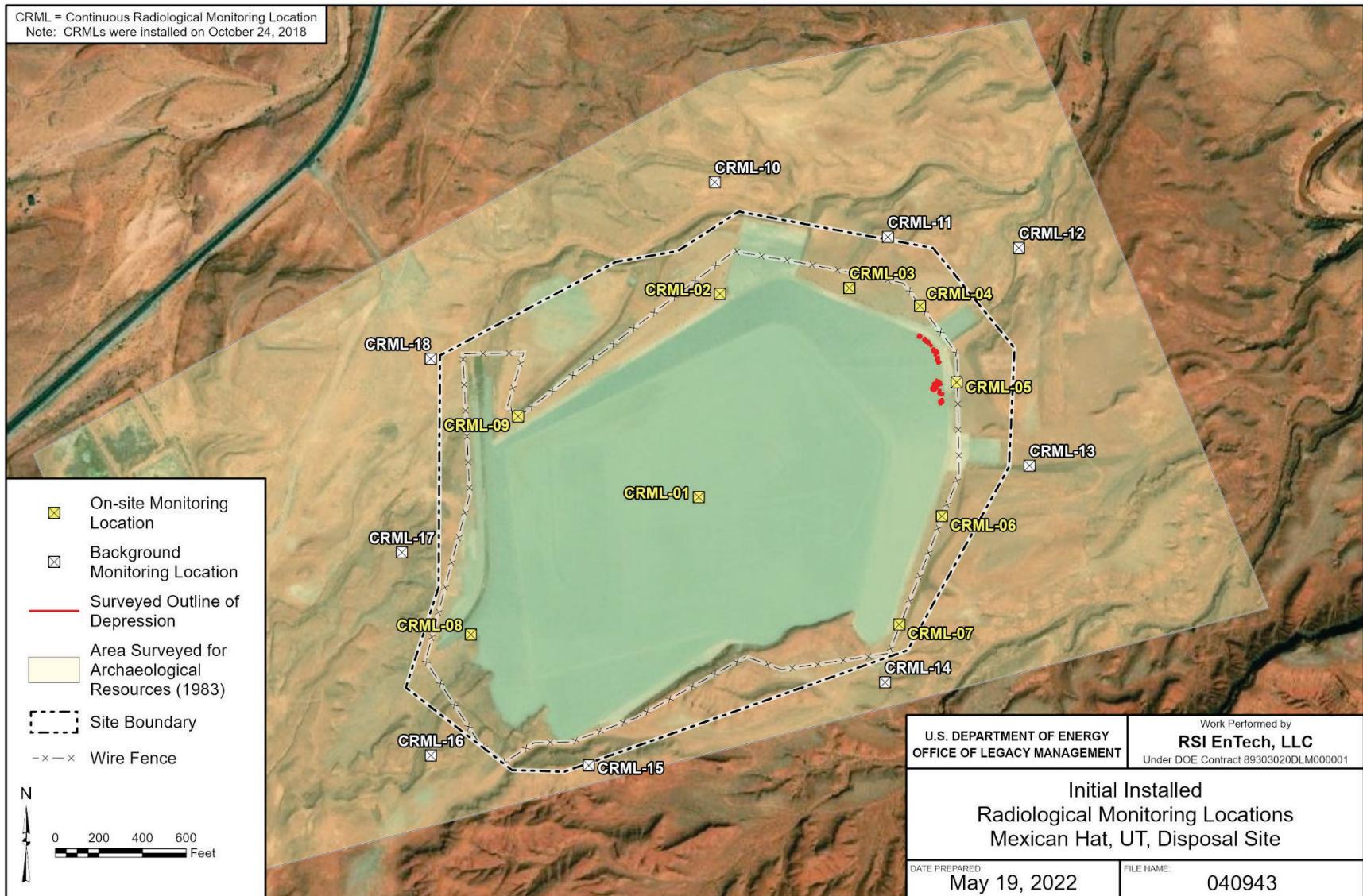


Figure 2. Locations of the Background Monitoring Location