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Title: Remediation Report for TA-53 P-Rad Radioactive Liquid Spill

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Remediation Report for TA-53 P-Rad Radioactive Liquid Spill

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Date: 7-24-18

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Approved by:

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Date: 7-24-18

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Summary

Following several soil excavations, EPC-ES and DESHF-LFO finds that the residual radioactive materials associated with the spill area within AOC 53-013 at TA53 are below the 25 mrem/yr remediation criteria set for cleanup of the radioactive spill at TA-53. Though the area meets the remediation goals for soil contamination, posting of the site may be required and access restricted. These findings and recommendations are consistent with the requirements of DOE Order 458.1 "Radiation Protection of the Public and the Environment" and LANL procedure EPC-ES-FSD-004 "Environmental Radiation Protection." Information documenting this spill within AOC 53-013 will be updated in the LANL PRS database.

Introduction

In November of 2017, a RCT discovered that a cask containing target water filters used at LANSCE leaked radioactive liquid onto the soil beneath it (Figure 1). The spill area is located at the eastern end of the accelerator at TA 53 and just northeast of Experimental Area B (Figure 2) in a location used as a storage area for equipment associated with LANSCE operations. Initial assessments suggested the radioactivity was confined to a relatively small area ($\sim 1 \text{ m}^2$), but with unknown depth into the soil.

Figure 1 Green cask containing water filter. Red circle indicates leaking hole.

Figure 2 Spatial location of spill area within AOC 53-013.

A remediation plan was developed that included excavation of the contaminated soil using hand tools. The objectives of the remediation were to 1) reduce radioactivity levels in the soil to acceptable levels, 2) protect cleanup workers and prevent contamination spread beyond the site and to equipment used during the cleanup, 3) limit overall soil disturbance, and 4) minimize the generation of low-level waste. Soil concentration goals for cleanup of the site were established based on a 25 mrem/yr dose criteria considering a construction worker exposure scenario.

The general sampling plan was to remove the top approximately 6"-12" then measure the external exposure rate in and around the hole. After a significant decrease in external dose rates was measured, several soil samples of the residual material in the hole were taken and submitted to the LANL Health Physics Analytical Laboratory (HPAL). If the soil samples were below the 25 mrem/yr criteria, the cleanup operations could discontinue. Otherwise, additional iterations of these steps would continue until the residual radionuclide concentrations in the soil were below the cleanup criteria.

Establishing Cleanup Objectives

The cleanup objectives for this remediation were based on dose limits for public exposures, which are lower than occupational limits and conservatively assumes members of the public are working at the impacted site for a full year. DOE Order 458.1 established a 25 mrem/yr dose limit for transfer of property to the public, so soil contamination levels corresponding to 25 mrem/yr were calculated using

the pathway dose assessment model RESRAD (RESidual RADioactive materials). The Construction Worker exposure scenario was used for this dose assessment (model exposure parameters found in LANL 2016). The impacted area of the excavation was approximately 1 m² and to a final excavation depth of approximately 1 m. The hole was then fully filled with soil and base course to provide soil stability and shielding of the buried radioactivity.

Sample collection

After each excavation, soils were submitted to HPAL for gamma spectral analysis. Results were provided in units of pCi/g and the minimum detection limits were below the 25 mrem/yr cleanup criteria. The initial cleanup proceeded to depth of about 6 inches until tuff was encountered. The samples of the residual soil did not meet the cleanup criteria so additional excavation proceeded down to a depth of about 1 m.

Sample Results

Table 1 provides the results for the two excavations and a comparison to the cleanup criteria. The data show that the radionuclides primarily consist of tungsten spallation and metal activation products with half-lives ranging from hundreds of days up to about 30 years. Measurements show these radionuclides have migrated into the tuff to depths greater than 1 m over the past number of years, but the drinking groundwater table is over 1000 m precluding these radionuclides from ever reaching it. Thus, the realistic exposure pathways from the contaminated soil is through external exposure, inhalation of suspended dust and ingestion of surface soil. All these pathways were included in the dose assessment. The results in Table 1 show that after the second excavation, all the concentrations were below the 25 mrem/yr limits and that collectively the sum of fractions (measured soil concentration divided by the 25 mrem/yr soil concentration limit) was less than 1. Therefore, we conclude that the objectives of the cleanup have been satisfied and that remediation efforts are complete.

After the excavation hole was filled with soil, gamma measurements were made to characterize the post clean up exposure rates (Attachment 2). The contact reading above the excavation site was 0.5 mR/hr while the exposure rates at 30 from the surface were about 0.3 mR/hr. These exposure rates are elevated relative to background but are not sufficiently high to qualify the site as a radiation area (5 mrem/hr), but they are high enough to post the site as a radiologically-controlled area.

Reference

LANL 2016. Derivation of Authorized Limits for land transfer at Los Alamos National Laboratory. Los Alamos National Laboratory Report LA-UR-16-27038.

Table 1. Results of HPAL measurements of residual soil concentrations from first and second excavations. Two samples were submitted to HPAL following the second excavation and the data for both are presented. The 25 mrem/yr soil limits are provided and a sum of fractions is provided in the last column.

Radionuclide	Half-life	First excavation (pCi/g)	Second excavation (pCi/g)	Second excavation (pCi/g)	Mean 2 nd excavation (pCi/g)	Ratio 1 st and 2 nd excavation	25 mrem/yr soil limit w/0.5 m soil equiv. cover (pCi/g)	Fraction of limit
Lu-172	Eq. w/Hf-172	1.71E+04	3.46E+03	1.37E+03	2.42E+03	7.08E+00	1.10E+04	2.20E-01
Lu-174	3.6 yr	1.42E+03	<MDC	<MDC	<MDC	NA	NA	NA
Lu-173	1.37 y	3.98E+03	3.02E+02	7.54E+01	1.89E+02	2.11E+01	4.00E+06	4.72E-05
Hf-178m	31 y	4.15E+02	8.33E+01	3.11E+01	5.72E+01	7.26E+00	5.28E+04	1.08E-03
Zn-65	244 d	1.31E+02	2.92E+01	<MDC	2.92E+01	4.49E+00	4.27E+04	6.84E-04
Hf-172	5 y	1.58E+04	3.55E+03	1.32E+03	2.44E+03	6.49E+00	1.10E+04	2.21E-01
Co-60	5.27 y	1.30E+02	1.33E+01	<MDC	1.33E+01	9.77E+00	5.07E+03	2.62E-03
Eu-152	13.5 y	2.15E+02	<MDC	<MDC	<MDC	NA	1.49E+04	1.44E-02
Rh-102	207 d	<MDC	1.66E+01	<MDC	1.66E+01	NA	1.67E+05	9.94E-05
Average reduction						9.36E+00	Sum of fractions	4.60E-01

Attachment 1

RP Survey Number: 29220781

Page: 1 of 3

Remarks:	All personnel passed upon PCM prior to completion of the job.
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$\beta_{kg}: 0.3 \text{ mP/hr}$

Control 0.5 mP/hr Contact $10:30$
 0.3 mP/hr @ 30 cm

Activity 12.1 Kcpm NaI

RP Tracking Number

29220781

Page 2 of 3

Sample Report

Batch ID: TA-53 Samples - 201806281413
 Group: E
 Device: S5XLBG Unit2
 Batch Key: 4361
 BC#:
 Bldg:

Count Date: 6/28/2018 2:13:27PM
 Count Minutes: 1.00
 Count Mode: Simultaneous
 Operating Volts: 1380
 Gamma Volts: 828
 Selected Geometry 5/16" Stainless Steel

Background (cpm)			Efficiency (%)		
Alpha Rate:	0.13	± 0.12	Alpha:	30.57	± 0.05
Beta Rate:	1.48	± 0.29	Beta:	46.29	± 0.05
Gamma Rate:	159.77	± 3.97	Gamma:	8.80	

gamma = 247.74 dpm

Sample ID	Alpha (dpm)	Unc	Alpha MDA (dpm)	Beta (dpm)	Unc	Beta MDA (dpm)	Gamma (dpm)
20180628141327-E1	-0.43	0.38	12.75	1.12	3.12	14.54	25.34
20180628141458-E2	-0.43	0.38	12.75	1.12	3.12	14.54	36.70
20180628141608-E3	-0.43	0.38	12.75	-3.20	0.62	14.54	93.52
20180628141718-E4	-0.43	0.38	12.75	5.44	4.36	14.54	116.25
20180628141838-E5	2.85	3.29	12.75	-3.20	0.62	14.54	173.07
20180628141948-E6	-0.43	0.38	12.75	1.12	3.12	14.54	-88.30
20180628142058-E7	-0.43	0.38	12.75	-1.04	2.25	14.54	-99.66
20180628142208-E8	9.39	5.68	12.75	-1.04	2.25	14.54	-111.02
20180628142318-E9	-0.43	0.38	12.75	3.28	3.79	14.54	-20.11
20180628142438-E10	2.85	3.29	12.75	-1.04	2.25	14.54	207.16

RP Tracking Number *X10*

29220781

MDALimits *JV*

Reviewed by:

JV