

Lake City Army Ammunition Plant (LCAAP)
Evaluation of FSSR for the Release of Remediated Areas once Occupied by the Building
3A Depleted Uranium Wing, Sump and Trench Line, and 600-Yard Bullet Catcher
August 28, 2001

A. Background

In support of activities identified in the LCAAP Decommissioning Plan (DP), an evaluation was conducted of the following two documents:

- a. Final Radiological Status Report - Lake City Army Ammunition Plant Building 3A Depleted Uranium Wing, Rev. 1, August 2001
- b. 600 Yard Bullet Catcher Final Status Survey Report - Lake City Army Ammunition Plant, Lake City, MO, Rev. 3, August 23, 2001

The reports were submitted by the licensee to document completion of the remediation work involving depleted uranium (DU). The review and evaluation of radiological conditions were conducted to determine if post-remediation survey results comply with the cleanup criteria of the approved DP for the facility. The review consisted of evaluating radiological survey results and supporting technical information presented in each report, and the results of a confirmatory survey conducted for the NRC by the Oak Ridge Institute for Science and Education (ORISE)¹. The licensee and contractors were contacted for the purpose of getting technical clarifications or obtaining updated and/or corrected information. The radiological results presented in the report were evaluated by performing comparisons with cleanup criteria using the licensee's analysis or independently derived evaluations. The discussions that follow present the results of the evaluation for each area.

B. Building 3A Depleted Uranium (DU) Wing

The DU Wing has been demolished and the resulting wastes were shipped either as radioactive waste or as clean waste to the appropriate disposal facilities. The only portions of Building 3A that remain are parts of the structure which once connected the DU Wing to the remaining non-affected portions of Building 3A. The sumps and drain lines associated with the DU Wing were surveyed and removed when found contaminated. The remaining area consists of the footprint of where the DU Wing once stood and parts of the concrete footing of both the DU Wing and loading dock buried below grade.

The final status surveys conducted by the licensee included soil sampling and analysis for DU, and measurement of ambient (1-meter) radiation exposure rates and surface gamma scans. The following summarizes the results of the evaluation.

- a. A total of 170 soil samples were taken in both impacted and non-impacted areas. The samples were analyzed by high resolution gamma spectroscopy (assuming

¹Confirmatory Survey of the Excavated Drain System of the Southeast Wing of Building 3A, Lake City Army Ammunition Plant, Blue Springs, Missouri, Final Report, May 2001, Environmental Survey and Site Assessment Program, ORISE, Oak Ridge, TN.

equilibrium of Th-234m and Pa-234m with U-238), with the results multiplied by a factor of 1.2 to convert U-238 concentrations to corresponding DU concentrations², taking into account the isotopic presence of U-238 (83.1%), U-234 (15%), and U-235 (1.9%). The results indicate DU (total U) soil concentrations ranging from 2.0 to 11.0 pCi/g (expressed on a dry soil basis, pCi/g), with an average of 4.7 +/-1.0 pCi/g. The results include the contribution of U present in natural soils, estimated to be 2.4 pCi/g³. The average at the 95% confidence level is 4.9 pCi/g. All results are under the DU cleanup criterion of 35 pCi/g above background.

A total of 19 samples were jointly analyzed by the remediation contractor and a third party laboratory for quality assurance (QA) purposes. Since the samples were characterized by low DU concentrations, a direct comparison between the two sets of results is limited to only two samples with results above detection limits. For the remaining 17 samples, the results were reported to be within a detection limit of 4.1 pCi/g, which is well below the cleanup limit of 35 pCi/g. In comparison, the stated detection limits of the independent laboratory was reported to vary from 1.3 to 2.6 pCi/g. The results reported at the detection limit indicate that its stated detection limit is bounding. For the two samples with a matching set of results, the relative percent difference between the samples were found to be in good agreement (+/-8 and +/-12%).

- b. A total of 170 ambient radiation measurements (1-meter height above soil) were made at the center of both impacted and non-impacted areas. The results indicate net external radiation exposure rates (above a typical background of 9 to 11 microRoentgen per hour ($\mu\text{R/h}$) ranging from -0.2 to 4.0 $\mu\text{R/h}$, with an average of 1.9 +/-0.9 $\mu\text{R/h}$. The average at the 95% confidence level is 2.0 $\mu\text{R/h}$ net above background. All results are under the cleanup criterion of 10 $\mu\text{R/h}$ above background.
- c. Surface scan radiation measurements were made within both impacted and non-impacted areas. The data supplied by the licensee only include the highest surface scan readings (56) obtained in each grid. The results indicate net external surface scan rates ranging from -2,450 to 3,550 counts per minute (cpm), with an average of 746 +/-1,976 cpm and a typical background of 8,900 to 12,000 cpm. The average at the 95% confidence level is 1,188 cpm net above background. All results are under the cleanup criterion of twice background and none of the measurements needed to be corrected using the provisions of the elevated area factor $(100/A)^{1/2}$, where "A" represents the surface area (expressed in meter squared) of the part of the survey grid in excess of the cleanup limit.

²The factor is based on an earlier report used for the disposal of exempted waste at the WCS facility.

³Engineering Evaluation/Cost Analysis Area 10 Sand Pile, Lake City Army Ammunition Plant, Independence Missouri, Draft Final, June 2001, Table 1-3.

- d. A total of 21 soil samples were taken in the trench left after the removal of the sumps and sump drain lines - the trench is about 100 feet long. The samples were analyzed as collected and corrected to dry concentrations by adjusting all results for an assumed moisture content of 25% (i.e., all raw results were multiplied by a factor of 1.25). The U-238 results were converted to DU concentrations using the same method noted above. The moisture-corrected results indicate DU (total U) soil concentrations ranging from -1.21 to 27.4 pCi/g, with an average of 6.9 +/-9.9 pCi/g. The results include the contribution of U present in natural soils. The average at the 95% confidence level is 10.6 pCi/g. All results are under the DU cleanup criterion of 35 pCi/g above background.

C. 600-Yard Bullet Catcher

The 600-Yard Bullet Catcher (BC) has been demolished and the resulting wastes (soil, sand, steel, and wood) were shipped either as radioactive waste or as clean waste to the appropriate disposal facilities. Live munitions that were found during remediation were isolated and turned over to the facility operator and/or shipped for disposal at a proper facility. The only portions of the Bullet Catcher that remain are part of the wooden shell and the footprint of where the Bullet Catcher once stood. In addition, a portion of the road in front of the bullet catcher was excavated since DU was found in that area.

The final status surveys conducted by the licensee included soil sampling and analysis for DU, measurement of ambient (1-meter) radiation exposure rates and surface gamma scans, and removable surface contamination. The following summarizes the results of the evaluation.

- a. A total of 135 surface soil samples were taken in the impacted areas. The samples were analyzed by high resolution gamma spectroscopy (assuming equilibrium of Th-234m and Pa-234m with U-238), with the results multiplied by a factor of 1.2 to convert U-238 concentrations to corresponding DU concentrations⁴. In addition, all results were corrected to dry soil concentration (pCi/g) assuming a 25% moisture content. The results indicate DU (total U) soil concentrations ranging from -39.1 to 37.6 pCi/g, with an average of 4.1 +/- 11.3 pCi/g. The results include the contribution of U present in natural soils. The average at the 95% confidence level is 5.7 pCi/g. Except for one sample, all initial results are under the DU cleanup criterion of 35 pCi/g above background. For the sample above the criterion, the cleanup limit is still met because: (a) once adjusted for the presence of naturally occurring uranium in soils (about 2.4 pCi/g), the residual concentration equates the limit, and (b) the result is less than three times the limit and less than twice the limit based on the provisions of the area factor $(100/A)^{1/2}$.

A total of 135 subsurface soil samples were taken at a 1-m depth in the impacted areas. The samples were analyzed by high resolution gamma spectroscopy (assuming equilibrium of Th-234m and Pa-234m with U-238), with the results

⁴ibid, see footnote 2.

multiplied by a factor of 1.2 to convert U-238 concentrations to corresponding DU concentrations⁵. In addition, all results were corrected to dry soil concentration (pCi/g) assuming a 25% moisture content. The results indicate DU (total U) soil concentrations ranging from -19.4 to 21.2 pCi/g, with an average of 1.4 +/- 9.1 pCi/g. The results include the contribution of U present in natural soils. The average at the 95% confidence level is 2.7 pCi/g. All results are under the DU cleanup criterion of 35 pCi/g above background.

A total of 38 surface soil samples were taken in the non-impacted areas. The samples were analyzed by high resolution gamma spectroscopy (assuming equilibrium of Th-234m and Pa-234m with U-238), with the results multiplied by a factor of 1.2 to convert U-238 concentrations to corresponding DU concentrations⁶. In addition, all results were corrected to dry soil concentration (pCi/g) assuming a 25% moisture content. The results indicate DU (total U) soil concentrations ranging from -24.8 to 22.4 pCi/g, with an average of 3.8 +/- 10.9 pCi/g. The results include the contribution of U present in natural soils. The average at the 95% confidence level is 6.8 pCi/g. All results are under the DU cleanup criterion of 35 pCi/g above background.

Samples (total of 43) were jointly analyzed by the remediation contractor and a third party laboratory for QA purposes. Since the samples were characterized by low DU concentrations, a direct comparison between the two sets of results is limited to only one sample with results above detection limits. For the remaining samples, the results generated by the project contractor were reported at their detection limits ranging from 16.7 to 37 pCi/g, including moisture correction. In comparison, the stated detection limits of the independent laboratory were reported to vary from 1.2 to 4.0 pCi/g. The remediation contractor's results reported at the detection limit indicates that its stated detection limits are bounding. For the one sample with a matching set of results (36.8 pCi/g for the third party laboratory vs 37.6 pCi/g for the contractor), the relative percent difference between the samples were found to be in good agreement (+/- 2%).

- b. A total of 560 ambient radiation measurements (1-meter height above soil and on contact with soils) were made at the center of both impacted and non-impacted areas. The results indicate total average external radiation exposure rates, ranging from 8.2 to 9.8 µR/h, including a background of 9.8 to 10.1 µR/h. The highest average at the 95% confidence level is 10.0 µR/h, including background. All results are under the cleanup criterion of 10 µR/h above background.
- c. Surface scan radiation measurements were made within both impacted and non-impacted areas. The results indicate total external surface scan rates ranging from 6,535 to 16,904 cpm, with an average of 12,403 +/- 1,110 cpm including a typical background count-rate of 12,000 cpm. The average at the 95% confidence level is 12,413 cpm, including background. All results are under the

⁵Ibid, see footnote 2.

⁶ibid, see footnote 2.

cleanup criterion of twice background and none of the measurements needed to be corrected using the provisions of the elevated area factor $(100/A)^{1/2}$.

- d. Direct scans and smear/wipe surveys were conducted on the remaining wooden portions of the Bullet Catcher. The results indicate that all residual contamination levels were found to be non-detectable (i.e., less than 122 dpm/100 cm² (disintegration per minute per 100 squared centimeters) for beta activity and less than 10 dpm/100 cm² for alpha activity). Direct surface beta/gamma scans revealed results that were not detectable above background, less than 4,000 dpm/100 cm². The survey results indicate that residual surface contamination levels are less than the limits of 1,000 and 5,000 dpm/100 cm² for removable and fixed surface contamination, respectively.

D. Conclusions

The results indicate that DU surface and subsurface soil sample concentrations, surface residual activity levels, and ambient radiation exposure rates and surface scans meet the cleanup criteria. The conclusions reached in this evaluation concur with the findings noted in Region's III inspection report, observed during and after completing all remediation work.