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31 May 2018

Mr. Mark Roginske, P.E.
Hill Air Force Base (AFB) Project Manager
Air Force Civil Engineer Center, Environmental Restoration
Hill Air Force Base, Utah

RE: Site WR111 - Site Closure Report, Little Mountain Test Facility
EA Project No. 62369.06

Dear Mr. Roginske:

EA Engineering, Science, and Technology, Inc., PBC (EA) is pleased to provide the Draft Site Closure Report for Site WR111 (Little Mountain Test Facility, Hill AFB, Utah) to U.S. Air Force (USAF) for review and comment. This Site Closure Report was developed by EA and Cabrera Services Inc. (Cabrera) to provide documentation of the completion of remedial excavation and Final Status Survey (FSS) activities at Site WR111, under Hill AFB Performance-Based Remediation Contract No. FA8903-09-D-8560, Task Order 0006. In support of the report, the U.S. Nuclear Regulatory Commission (NRC), in a letter dated 23 May 2018, provided concurrence on the use of and guidance regarding EA's development and application of area factors for areas of elevated residual radioactivity. However, the suggested calculations provided by the NRC appear to be in conflict with MARSSIM guidance. A detailed discussion is provided below.

During preparation of the Site Closure Report, EA submitted a memorandum to USAF titled "Summary of Final Status Survey Data and Evaluation to Achieve Clean-up Goals at Site WR111 (Magnesium-Thorium Disposal Trench), Little Mountain Test Facility, Hill Air Force Base, Utah", dated 23 February 2018. The purpose of this memorandum was to summarize Final Status Survey (FSS) data collected at Site WR111 and to provide an approach for data evaluation, specifically regarding areas of elevated radioactivity and multiple radionuclides of concern (ROCs), to support site closure and decommissioning. The NRC reviewed this memorandum and provided a response in a NRC letter titled "Review of Final Status Survey Data and Evaluation of Site WR111, Hill Air Force Base, Utah", dated 23 May 2018 (see Enclosure 1). Based on its review, NRC concluded that EA's proposed area factors for elevated areas of residual radioactivity in soil were acceptable and noted that the proposed application of area factors for the two hot spots (SU02 and SU04) were appropriately conservative. The NRC also determined that EA's modified MARSSIM Equation 8-2, which employs a sum of ratios method in lieu of concentrations and DCGLs due to the presence of multiple radionuclides of concern, was generally acceptable for use in demonstrating compliance with release criteria, although the NRC indicated that the modified equation should be further adjusted to incorporate both elevated areas in the calculation (versus evaluating each elevated area via separate calculation, as proposed in EA's memorandum). In conclusion, the NRC letter confirmed that "using the updated version of the proposed equation that includes both elevated areas, the staff confirms that the area meets the regulatory release criteria for the site."

EA and Cabrera have technical concerns associated with NRC's adjustment of modified MARSSIM Equation 8-2. Specifically, NRC indicates that the equation should be adjusted so that "survey unit and both elevated areas should be incorporated into one equation consistent with NUREG-1575", and then cites the following statement from Section 8.5.2 of MARSSIM as justification for this action: "[i]f there is more than one elevated area, a separate term should be included for each." In EA's interpretation of the MARSSIM guidance, this statement is referring to more than one elevated area in a survey unit (SU), not more than one area in all SUs at the site. MARSSIM clearly indicates throughout that decisions are made



on a survey unit basis. If a SU has an elevated area, then the SU is evaluated using elevated measurement comparison ($DCGL_{EMC}$) to determine if the SU meets the release criteria. If that survey unit meets the release criteria, and all other survey units meet the release criteria, then the entire site meets the release criteria. In EA's opinion, it would be inappropriate to combine elevated areas from different survey units in this equation. Further support for this position is provided in the previous paragraph in Section 8.5.2 of MARSSIM, where it specifically indicates that Equation 8-2 should be used to evaluate data within a survey unit: "If residual radioactivity is found in an isolated area of elevated activity-in addition to residual radioactivity distributed relatively uniformly across the survey unit-the unity rule (Section 4.3.3) can be used to ensure that the total dose is within the release criterion."

NRC also states the following in their letter dated 23 May 2018: "The first term in the modified equation evaluates the average SOR for the entire survey unit, including both elevated areas." EA and Cabrera do not understand this conclusion. The first term of the equation represents the average SOR in the survey unit. If elevated areas from different survey units are combined, as directed by NRC, it is unclear about what this term would actually represent. For example, would it be the average SOR from SU 2 alone, SU 4 alone, or the average SOR from both SUs? The first two options do not seem reasonable, and the last option raises other questions, such as, would individual terms for the average dose from every SU at the site be included, whether there was an elevated area or not? Would doses from all other SUs be averaged to calculate this term? These additional difficult questions support the simpler interpretation of MARSSIM - that data from each SU should be evaluated individually.

EA and Cabrera would appreciate a conference call with NRC as soon as possible to facilitate resolution of the concerns and questions regarding NRC's adjustments to modified MARSSIM Equation 8-2. In the meantime, for the Draft Site Closure Report for Site WR111, EA has performed data evaluation for elevated areas using the modified MARSSIM Equation 8-2 as presented in EA's memorandum "Summary of Final Status Survey Data and Evaluation to Achieve Clean-up Goals at Site WR111 (Magnesium-Thorium Disposal Trench), Little Mountain Test Facility, Hill Air Force Base, Utah", dated 23 February 2018.

If you have any questions about this letter or need further information, please do not hesitate to contact me at 410-329-5103.

Sincerely,

Amy Jo Sponaugle, P.E.
Project Manager
EA ENGINEERING, SCIENCE,
AND TECHNOLOGY, INC., PBC

Enclosures:

Enclosure 1 – U.S. NRC letter "Review of Final Status Survey Data and Evaluation of Site WR111, Hill Air Force Base, Utah" dated 23 May 2018.

cc: S. Staigerwald
G. Bright
file



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION IV
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May 23, 2018

Ramachandra K. Bhat, Ph.D., CHP
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**SUBJECT: REVIEW OF FINAL STATUS SURVEY DATA AND EVALUATION OF SITE
WR111, HILL AIR FORCE BASE, UTAH**

Dear Dr. Bhat,

By Memorandum dated March 1, 2018 (Agencywide Documents Access Management System [ADAMS] Accession No. ML18060A451), you submitted a technical memorandum to the U.S. Nuclear Regulatory Commission (NRC) entitled, "Summary of Final Status Survey Data and Evaluation to Achieve Clean-up Goals at Site WR111 (Magnesium-Thorium Disposal Trench), Little Mountain Test Facility, Hill Air Force Base, Utah." This technical report was developed by your contractor EA Engineering, Science, and Technology, Inc. (EA).

EA found two locations at the site that contained residual radioactivity in soil above the cleanup criteria. To demonstrate compliance with the release requirements of 10 CFR Part 20, Subpart E, the contractor calculated area factors and used an adapted version of Equation 8-2 from NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), which was modified to include multiple radionuclides.

In response to your submittal, Region IV staff consulted with the NRC program office. The consultation included a technical review of the equation used by the contractor as well as the proposed area factors. The staff concluded that the area factors were acceptable. The staff also determined that the contractor's modified MARSSIM equation was acceptable for use; however, the NRC concluded that you did not incorporate the terms for both elevated areas together with the term associated with the survey unit, consistent with MARSSIM guidance. The staff revised the equation accordingly, and confirmed that the WR111 site meets the criteria for unrestricted release per regulatory requirements.

In accordance with 10 CFR 2.390 of the NRC's "Agency Rules of Practice and Procedure," a copy of this letter will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>.

R. Bhat

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Should you have any questions concerning this letter, please contact Rachel Browder, Senior Health Physicist, at 817-200-1452, or the undersigned at 817-200-1191.

Sincerely,

/RA by LEBrookhart Acting for/

Ray L. Kellar, P.E., Chief
Fuel Cycle and Decommissioning Branch
Division of Nuclear Materials Safety

Docket: 030-28641

License: 42-23539-01AF

Enclosure:

Staff review of Site WR111 Final Status
Survey Data and Evaluation

cc:

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STAFF REVIEW OF SITE WR111 FINAL STATUS SURVEY DATA AND EVALUATION

The Department of the Air Force submitted a summary of final status survey data and evaluation performed by the contractor EA Engineering, Science, and Technology, Inc. (EA) for the WR111 magnesium-thorium disposal trench at Hill Air Force Base (AFB), Utah, to the U.S. Nuclear Regulatory Commission (NRC) by Memorandum dated March 1, 2018 (ADAMS Accession No. ML18060A451). During an evaluation of data collected from the WR111 site, it was found that two locations on the site, SU02 (60 square meters, or m²) and SU04 (339 m²), contained residual radioactivity in soil above the cleanup criteria. To demonstrate compliance of the WR111 site with the unrestricted release requirements specified in 10 CFR Part 20, Subpart E, the contractor, under contract with the Air Force Civil Engineer Center (AFCEC), used area factors and sum-of-ratios (SOR) calculation in accordance with NUREG-1575, Revision 1, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). The licensee's calculation was based on Equation 8-2 from MARSSIM, adapted by the licensee to include multiple radionuclides.

The NRC staff approved site-specific derived concentration guideline levels (DCGL_{Ws}) for the three radionuclides of concern (Ra-226, Th-230, and Th-232) at the WR111 site in a technical evaluation report dated October 19, 2015 (ADAMS Accession No. ML15299A164). Using these site-specific parameters, EA calculated elevated measurement comparison DCGLs (DCGL_{EMCS}) for areas with elevated contamination levels of various sizes. The DCGL_{EMCS} in turn were used to derive area factors for each radionuclide of concern. The staff's review concluded that the DCGL_{EMCS} and corresponding area factors were acceptable. The staff also noted that the licensee's analysis used area factors of 75 m² and 500 m² for the two hot spots (SU02 and SU04) which are larger and therefore more conservative than the actual size of these areas (60 m² and 339 m², respectively).

The NRC staff also reviewed the modified MARSSIM Equation 8-2, which employed a SOR method in lieu of concentrations and DCGLs due to the presence of multiple radionuclides of concern. NUREG-1575 gives Equation 8-2 as a method to demonstrate that the total dose is within the release criterion, when residual radioactivity is found in an isolated area of elevated activity. The contractor adapted the equation to conservatively account for multiple radionuclides:

- The smallest area factor is used for the radionuclides of concern for each hot spot;
- An average SOR is used for the systematic sample results in each survey unit, in place of the estimated average residual radioactivity;
- An average SOR is used for elevated area sample results in place of the average concentration in each elevated area; and
- An SOR of 1.0 is used in place of the DCGL_W.

The staff reviewed EA's modified equation and determined that it was acceptable for use in demonstrating compliance with release criteria. The values used for area factor and DCGL_W are appropriately conservative. The equation as used by the licensee demonstrated that the sum of ratios was less than 1.0 for each elevated area. However, per Section 8.5.2 of NUREG-1575, "[i]f there is more than one elevated area, a separate term should be included for each." Therefore the staff revised the modified equation to include both terms:

$$\frac{\delta}{1} + \frac{(Average\ SOR\ in\ SU02 - \delta)}{SU02\ Area\ Factor} + \frac{(Average\ SOR\ in\ SU04 - \delta)}{SU04\ Area\ Factor} < 1$$

As in the equation used by the contractor, $\bar{\delta}$ here represents the average SOR in a survey unit, and the area factor is the smallest area factor calculated for the radionuclides of concern in each elevated area. The first term in the modified equation evaluates the average SOR for the entire survey unit, including both elevated areas. The second and third terms evaluate the contributions from elevated areas SU02 and SU04, respectively. In accordance with NUREG-1575, the overall SOR, the sum of all 3 terms, would need to be less than 1 in order to meet the regulatory release criteria

Using the updated equation, the staff calculated an overall sum of 0.98 for the survey unit and both elevated areas together. Furthermore, the staff calculated site-specific area factors for SU02 and SU04, using their actual sizes and not the conservatively large areas assumed by the licensee. When these are applied to the updated equation, the overall SOR equals 0.92.

In conclusion, the staff has determined that the area factors calculated by the licensee are acceptable. In addition, the staff found that the licensee's modified MARSSIM Equation 8-2 was generally appropriate for use; however, the survey unit and both elevated areas should be incorporated into one equation consistent with NUREG-1575. Using the updated version of the proposed equation that includes both elevated areas, the staff confirms that the area meets the regulatory release criteria for the site.