

**-DEPARTMENT OF THE AIR FORCE
INSTALLATION RESTORATION PROGRAM
KIRTLAND AIR FORCE BASE
NEW MEXICO**

FINAL SAFETY EVALUATION REPORT

December 9, 2005

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U.S. NUCLEAR REGULATORY COMMISSION
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DEPARTMENT OF THE AIR FORCE
SAFETY EVALUATION REPORT
REGARDING THE FINAL STATUS SURVEY REPORT FOR
KIRTLAND AIR FORCE BASE, ALBUQUERQUE, NEW MEXICO

1. INTRODUCTION

The U.S. Department of the Air Force (AF) is regulated by the U.S. Nuclear Regulatory Commission (NRC) under Master Materials License 42-23539-01AF. A Master Materials License (MML) is a specific materials license issued to a Federal organization, authorizing use of material at multiple sites. The MML authorizes the licensee (i.e., Department of the Air Force) to issue permits for the possession and use of licensed material under the license, ties the licensee to a framework for oversight by the NRC, and provides for internal licensee inspection of the MML permittees.

In 1961, eight radiation training sites (TS) were established at Kirtland Air Force Base (AFB) as part of the Defense Nuclear Weapons School (DNWS) to train U.S. Department of Defense, U.S. Department of Energy, Federal Emergency Management Agency and other federal and state response personnel to detect dispersed contamination as a result of a nuclear weapons accident. Known quantities of Brazilian thorium oxide sludge were applied and tilled into site soils to simulate dispersed plutonium. In 1990, training was discontinued at four of the radiation training sites: TS5, TS6, TS7 and TS8. The approximate inventory of thorium sludge which had been applied to the inactive sites was 1710 kilograms (kg) that included approximately 602 kg of thorium-232. Large pieces of military equipment, such as fuselages, vehicles, parts and other debris which were present at TS5 through TS8 were removed and redistributed to active sites TS1 through TS4. TS8 had been used as a storage site, with two buildings located within its fenced area (Buildings 28005 and 28010). During the decommissioning process, TS8, including the two buildings, was transferred to the Defense Threat Reduction Agency (DTRA) for continued use as a training facility.

Under the provisions of the MML, the U.S. Air Force issued a permit for the DNWS radiation training sites at Kirtland AFB. The U.S. Air Force submitted a Decommissioning Plan (DP) in July 2000 and a revised DP in November 2002, to release the four former DNWS radiation training sites at Kirtland AFB, Albuquerque, New Mexico, for unrestricted use as defined in 10 CFR Part 20, Subpart E. These four inactive DNWS radiation training sites (TS5, TS6, TS7 and TS8), comprise Kirtland AFB's Installation Restoration Program Site OT-10 and are located in the north central part of Kirtland AFB. The OT-10 training sites consisted of approximately 43 acres, in which approximately 9.4 acres were affected with elevated thorium concentrations.

The DP was approved by licensing action on January 8, 2003. As part of the DP review and approval process, the NRC staff prepared an environmental assessment (EA) (ML030080492) to document how the remediation would ensure protection of the public health and safety and the environment. The EA was published in the Federal Register on January 15, 2003, (68 FR 2078). The EA concludes that approval of the DP would not result in any significant impacts on the human environment and is protective of human health. In addition, the approval of the DP was based on the NRC's staff Safety Evaluation Report (SER) issued on January 6, 2003 (ML030080421). The SER concluded that the activities described in the DP were consistent with the Commission's

regulations and that approval of the DP would not be inimical to the common defense and security, or the health and safety of the public.

The licensee began excavation of the respective training sites upon approval of the DP. The first waste shipment departed the site on March 7, 2003, and the final waste shipment departed from the site on October 29, 2003. The NRC inspected the decommissioning activities and performed in-process confirmatory surveys as part of the inspection oversight process. The licensee subsequently submitted the Final Status Survey Report (FSSR) in May 2005, which recommended that TS5, TS6, TS7, and TS8 (which included Building 28010 and excluded Building 28005) be released for unrestricted use in accordance with the release criteria in 10 CFR 20.1402.

The NRC provided notification by letter dated March 5, 2004, of the decommissioning oversight actions at Kirtland AFB to the U.S. Environmental Protection Agency (EPA) as part of the October 2002 Memorandum of Understanding (MOU) between the two agencies. For sites which trigger the criteria in the MOU, NRC will consult with EPA at two points in the decommissioning process: 1) prior to NRC's approval of the license termination plan (LTP) or decommissioning plan (DP), which NRC terms Level 1 consultation; and 2) following completion of the final status survey, which NRC terms Level 2 consultation. Whereas, the DP for Kirtland AFB had already been approved when the MOU was signed; the notification letter dated March 5, 2004, was not considered a Level 1 consultation but was provided in the spirit of the MOU because the derived concentration guideline levels (DCGLs) in the DP (5.7 pCi/g) exceeded the MOU trigger values for thorium-232 in soil (5.0 pCi/g). Based on the results of the FSSR, the residual radioactive material concentrations in soil do not exceed the MOU trigger values and therefore, the NRC will not enter into Level 2 consultation with the EPA in accordance with the MOU.

2. PROPOSED ACTION

The purpose of the proposed action is to reduce residual contamination at the OT-10 training sites to meet the unrestricted use criteria in Subpart E of 10 CFR Part 20. The licensee submitted the FSSR on May 12, 2005, to demonstrate that the site meets the radiological criteria for unrestricted use. The NRC is fulfilling its responsibilities under the Atomic Energy Act to make a decision on the proposed licensing action, based on the FSSR and confirmatory measurements, to ensure protection of the public health and safety and the environment.

3. EVALUATION

In evaluating the safety of the proposed action, the NRC staff reviewed the FSSR to ensure compliance with the guidance provided in NUREG 1757, Volume 2, "Characterization, Survey, and Determination of Radiological Criteria" and NUREG 1575, Revision 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)". The FSSR soil concentrations were below the approved DCGL_w for thorium-232 (5.7 pCi/g) and below the EPA Level 1 consultation value for thorium-232 in soil (5 pCi/g). The licensee implemented a systematic method for sample collection and subsequently performed gamma spectroscopy for each sample. The licensee also used the WRS test, a non-parametric statistical method to release each survey unit.

There was one soil sample from OT-10 training site 6 (TS6), out of 413 soil samples taken for OT-10 TS6, which exceeded the $DCGL_w$ value. The soil sample had a thorium-232 concentration of 16.5 pCi/g. Further evaluation of the area surrounding the sample location failed to identify any elevated gamma activity. All soil samples were 5-point composites collected within a 3-ft diameter circle, around the sample location. The area factor of 3.65 for 1-m² area was used by the licensee as the closest resemblance to the sample area. Thus a $DCGL_{EMC}$ of 20.8 pCi/g was calculated for the 1-m² area, which is greater than the sample result of 16.1 pCi/g. Additionally, the respective survey unit passed the WRS test, which is a test of the median for the survey unit. The NRC staff finds the measurement acceptable and adequately meets the MARSSIM methodology for evaluating sample results.

Building 28005 which is located in OT-10 training site 8 (TS8) will not be released for unrestricted use and will remain on the U.S. Air Force permit as a contaminated building. The licensee has placed a fence around the respective bunker to prevent re-contamination of the OT-10 TS8 site. During the decommissioning process, TS8 land, including a second building 28010, were transferred to the DTRA for the DNWS for use as a training facility. The DTRA will assume all future responsibility for clean up of the Bunker 28005 at TS8.

In addition, TS6 contains corrective action unit (CAU) SS-69, a 50-foot (ft) by 50-ft area previously used to store drums of thorium oxide sludge, contaminated soil, and waste fuels. During a 1997 Air Force investigation, elevated concentrations of petroleum hydrocarbons and radioactive compounds were identified in area SS-69. The Air Force performed remediation of the non-radioactive wastes during 1998 under its Resource Conservation and Recovery Act Part B Permit. The residual radioactive contamination was remediated during the decommissioning process. This corrective action unit was approved for No Further Action by the New Mexico Environmental Department by letter to the licensee dated August 13, 2004.

3.1 Historical Characterization

Historical characterization of the OT-10 Training Sites involved four different radiological survey investigations which the licensee conducted between 1988 and 2001. The surveys involved sampling and analysis of soil and sediment. The soil properties were characterized to determine pH, conductivity, moisture, unconfined compression strength, dry density, field density and permeability. The land area surveys comprised scanning surveys, followed by static gamma radiation measurements and soil sampling and analysis. The licensee calculated concentration guidelines for surface contamination of soils in the impacted areas of the training sites using RESRAD code, Version 6.1. The DCGLs define the maximum amount of residual contamination in soils that would satisfy the NRC's regulations in 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination."

3.2 Contaminated Building Surfaces

The contaminated structures at the site consist of two buildings (bunkers) located at TS8 area and designated Buildings 28005 and 28010, which are within the fenced area. Each building is approximately 10 ft by 20 ft with a maximum height of 10 ft, concrete floors, steel doors and front walls, and corrugated steel ceilings and back walls. The ceilings, side walls and back walls are covered under earth. There are no utilities in the buildings. The buildings were used for storage of concentrated thorium materials.

The licensee assumed an industrial scenario with a full time occupancy of 250 days per year, and 8 hours per day. The NRC's building occupancy scenario, including pathways for external exposure, inhalation of removable residual contamination, and ingestion of removable contamination, was considered in the dose assessment to derive the DCGLs for building surface contamination.

The NRC staff conducted deterministic dose analyses using RESRAD-Build 3.21. The NRC staff used relatively conservative input parameters as recommended in NUREG/CR-6755. The DCGLs derived with this analysis were found to be higher (e.g., less restrictive) than the DCGLs proposed by the licensee by a factor of two or three. Therefore, the NRC staff approved the licensee's proposed DCGLs by licensing action dated January 8, 2003, with no additional probabilistic analyses conducted.

The NRC approved release criteria for building surfaces was 170 dpm/100 cm² for total alpha and 34 dpm/100 cm² for removable alpha activity. The FSSR provided data for building 28010 interior survey results which supported 100 percent survey for total gross alpha surface contamination using a 2 minute scanning time. All total gross alpha measurements were significantly below the approved criteria of 170 dpm/100 cm² and the removable alpha activity was also significantly below the approved criteria of 34 dpm/100 cm², as indicated in Table 1, below.

Table 1 - Survey Results for Building 28010

Location	No. Measurements	Average Total Gross Alpha (dpm/100 cm ²)	Average Removable Alpha Swipe (dpm/100 cm ²)
Floor	28	16 ± 13	1 ± 1
West wall	24	13 ± 14	2 ± 2
East wall	25	30 ± 24	2 ± 1
Ceiling	44	19 ± 20	1 ± 1

Measurements for total gross alpha were taken on the exterior of building 28010 as well as on the exterior of reference building 28011. The calculated net activity values were below the release criteria of 170 dpm/100 cm². The NRC staff finds the survey results for building 28010 acceptable and adequately meet the MARSSIM methodology for performing surveys.

Building 28005 will remain on the U.S. Air Force permit as a contaminated building, since it will not be released for unrestricted use. There is a fence around the building to prevent re-contamination of the OT-10 TS8 site. Building 28005, as well as building 28010 and TS8 have been transferred to the DTRA for use as a training facility.

3.3 Surface and Subsurface Soils

From December 1985 to January 1990, the licensee assessed potential radionuclide contamination in surface and subsurface soils, vegetation, and surface water and assessed potential offsite migration for training sites TS5 through TS8. The results indicated radiological contamination in the environmental media. There were no indications of contaminant migration into surface water drainage or the groundwater aquifer system. In order to demonstrate compliance with the dose

criterion of 10 CFR Part 20, Subpart E, the licensee is required to account for all radionuclides present in the residual radioactive material, which are distinguishable from background, in the source term. The U.S. Air Force submitted a DP in July 2000 which included DCGLs for thorium-232 and progeny. The licensee did not develop DCGLs for other identified contaminants in soil (i.e., uranium-238 plus progeny and uranium-235 plus progeny) based on the respective health-based specific activities which were developed using EPA target risk and EPA slope factors. However, the health-based specific activities did not demonstrate compliance with the NRC's dose criterion. The NRC criterion is an all-pathways, all-radionuclides limit and dose from all radionuclides must be accounted for in the DCGLs. Therefore, at the NRC's request, the U.S. Air Force re-submitted the DP on November 19, 2002, in accordance with NUREG-1727, "NMSS Decommissioning Standard Review Plan."

The NRC staff reviewed and evaluated the site specific DCGLs which the licensee submitted. The main radionuclides of concern associated with the thorium oxide sludge include thorium-232 and its decay progenies, particularly thorium-238 and radium-228. Uranium-238 and uranium-235 and their decay progenies may also contribute to the dose but to a lesser extent. The NRC adopted the licensee's assumption that the originating ore activity was approximately 86.5 percent from the thorium-232 decay chain; 13-percent from the uranium-238 decay chain, and approximately 0.5 percent from the uranium-235 decay chain. Based on evaluations of the original ore concentrations, the radionuclides for the dose modeling were selected to represent the most conservative ratios over a 1000-year period. The dose modeling documented that the main component of the dose was related to thorium-232 and its decay progenies.

The NRC staff evaluated the dose modeling approaches, the appropriate scenario(s) compatible with the unrestricted use of Kirtland AFB OT-10 training facilities and the input parameters used in the dose impact analysis submitted by the licensee. There were no listed species or critical habitats which would adversely effect the decommissioning activities; therefore, the dose to humans was a limiting case and no separate ecological risk analyses were performed. The NRC staff conducted probabilistic dose analysis, using site specific parameters and the applicable resident farmer scenario, using RESRAD Version 6.21. The NRC staff used realistic distributions of the most sensitive input parameters. Based on these site-specific probabilistic analyses, and using the best estimate of the dose results as recommended in NUREG-1727, the calculated DCGLs were found comparable with the licensee's proposed DCGLs, which were based on deterministic dose analysis and input parameters using RESRAD Version 6.1. The NRC staff concluded that the dose modeling was reasonable and appropriate for the exposure scenarios under consideration. The dose estimate provided reasonable assurance that the dose to the average member of the critical group will not exceed 25 mrem/year dose criterion in 10 CFR 20.1402. The following DCGLs were approved by licensing action dated January 8, 2003.

Table 2- NRC Approved DCGLs for Soil

Radionuclide	DCGLs above background (pCi/g)
Thorium-232 Decay Series	
Thorium-232	5.7
Radium-228	5.7
Thorium-228	5.7

Table 2- NRC Approved DCGLs for Soil (cont'd)

Radionuclide	DCGLs above background (pCi/g)
Uranium-238 Decay Series	
Uranium-238	0.31
Uranium-234	0.31
Thorium-230	0.62
Radium-226	0.28
Lead-210	0.28
Uranium-235 Decay Series	
Uranium-235	0.02
Protactinium-231	0.03
Actinium-227	0.30

The licensee remediated the site in accordance with the DP. The first waste shipment departed the site on March 7, 2003, and the final waste shipment was on October 29, 2003. A total of 373,145 cubic feet (ft³) of waste were manifested and shipped to Envirocare of Utah for disposal. The activity of the waste shipped for disposal was calculated to be 0.1518 curies of thorium-232.

The FSSR provided survey results for surface and subsurface soils for the remediated training sites TS5 through TS8. The licensee performed 100% of gamma scans in Class 1 and Class 2 survey units, which were tagged with location coordinates using a differential correction global-positioning system. Static gamma radiation measurements were used for correlation studies of gamma count rates and soil radionuclide concentrations during the remedial action process. The licensee performed static gamma measurements at each soil sample location in Class 1 survey units and performed static gamma measurements in 113 Class 2 survey units as part of the final status survey. Table 3 and 4 provide a summary of the final status survey results for static measurements and soil analyses, respectively.

Table 3 - Summary of Static Measurements for Class 1 Survey Units

Training Site	No. Class 1 Survey Units	No. Soil Samples	No. Static Measurements	Average of the Mean (cpm)	Average of the Median (cpm)
TS5	19	256	190	14,501	14,166
TS6	35	413	350	13,905	13,435
TS7	10	110	100	13,854	12,783
TS8	7	80	73	13,438	13,226

Table 4 - Summary of Soil Sample Results for Class 1 Survey Units

Training Site	No. Soil Samples	Min. Th-232 (pCi/g)	Max. Th-232 (pCi/g)	Avg. Mean Th-232 (pCi/g)	Avg. Median Th-232 (pCi/g)	Stand. Dev.
TS5	256	0.44	3.02	1.13	1.05	0.39
TS6	413	0.29	16.5	1.13	0.97	0.96
TS7	110	0.5	3.27	1.06	0.915	0.48
TS8	80	0.53	1.4	0.84	0.805	0.18

3.4 Radiological Status of Groundwater and Surface Water

Between December 1985 to January 1990, the licensee assessed potential radionuclide contamination in surface and subsurface soils, vegetation, and surface water and assessed potential offsite migration for training sites TS5 through TS8. The results indicated radiological contamination in the environmental media. There were no indications of contaminant migration into surface water drainage or the groundwater aquifer system.

The gamma radiation scanning surveys did not identify contaminant migration into surface water drainages. In addition, there is a difference of approximately 495 feet between the maximum depth of soil contamination and groundwater at OT-10 that prevents contaminant migration to groundwater.

3.5 ALARA Analysis

The "Statements of Consideration" for 10 CFR Part 20, Subpart E (62 FR 39065, July 21, 1997), and the Final Generic Impact Statement (NUREG-1496), indicate that disposal of surface soil, at a licensed facility, for unrestricted use exposure scenarios meets the as low as reasonable achievable (ALARA) requirement and therefore, the licensee does not have to perform a cost justification as required by the standard review plan. The U.S. Air Force remediated contaminated soil to achieve a calculated dose of less than 25 mrem/year; which is sufficient to comply with ALARA requirements. Site controls were implemented to prevent unauthorized, untrained, or unprotected personnel from entering the site, to limit the spread of contamination, and to reduce the radiation exposures to safe ALARA levels.

The NRC staff inspected the ALARA controls established by the U.S. Air Force during the remediation activities. The U.S. Air Force demonstrated compliance during remediation by meeting the concentration limits established in the DP and implemented a protocol to optimize ALARA concepts during the remediation activities. The NRC staff determined that the established ALARA controls were satisfactory.

3.6 Remediation Activities

The NRC performed inspection oversight of the decommissioning activities between March 2003 and February 2004. The NRC observed the radioactive waste management program, reviewed the licensee's operating procedures and their implementation, reviewed the exposure monitoring program and performed in-process confirmatory measurements. As part of the NRC independent

confirmatory surveys, soil samples from each training site were collected and swipe samples from building 28010 were analyzed for gross alpha contamination. The soil samples were analyzed by NRC's independent laboratory with several samples split between the licensee and NRC for comparative analysis. Results of confirmatory surveys for the four training sites and building 28010, were consistent with measurements taken by the licensee and met the criteria for unrestricted use. Additionally, the FSSR adequately addressed the minimum detectable concentration (MDC) determinations for scanning and static MDC.

The licensee's "Quality Assurance Project Plan" as submitted in Appendix E to the DP adequately met the requirements in NUREG 1757, Volume 1, "Consolidated NMSS Decommissioning Guidance," Section 17.6, Quality Assurance Program in support of decommissioning of the OT-10 training sites at Kirtland AFB. The NRC reviewed the licensee's laboratory quality assurance and quality control requirements and determined they were adequately implemented.

The remediation work was conducted by a prime contractor, who had project management oversight and by a subcontractor who provided construction activities and served as the waste broker. A second subcontractor implemented the site radiation protection program and conducted radiological surveys. There was sufficient staff to implement the remediation activities and radiation protection program. The U.S. Air Force was responsible for the decommissioning activities at the OT-10 training sites and contractor work was adequately monitored by the licensee.

4. CONCLUSIONS

Based on the FSSR and the NRC's in-process confirmatory measurements, the U.S. Air Force OT-10 site at Kirtland AFB is approved for unrestricted use, except for building 28005 located at TS8 area, in accordance with 10 CFR Part 20.1402, "Radiological Criteria for Unrestricted Use."

5. REFERENCES

NRC, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG-1575, December 1997

NRC, "Consolidated NMSS Decommissioning Guidance," NUREG-1757, Volume 2, September 2003.

NRC Inspection Report, March 26, 2003 (ML030850371)

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NRC Inspection Report, September 9, 2003 (ML032521325)

NRC Inspection Report, May 3, 2004 (ML041250063)

USAF, July 2000. *Decommissioning Plan for Site OT-10, Radiation Training Sites, Kirtland Air Force Base, New Mexico.* (ML011560740)

USAF November 2002, *Decommissioning Plan for Site OT-10, Radiation Training Sites, Kirtland Air Force Base, New Mexico, Revised August 2002.* (ML023390060)

USAF 2005, *Final Status Survey Report for Environmental Restoration Program Site OT-10, Radiation Training Sites, Kirtland Air Force Base, New Mexico* (ML051570099 and ML051570105)

10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination," Code of Federal Regulations, 62 FR 139, July 21, 1997

10 CFR 40.42, "Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas," Code of Federal Regulations: Office of Federal Register National Archives and Records Administration. Washington, D.C.

6. REGIONAL COORDINATION

Rachel S. Browder, Health Physicist, Region IV

bcc: (via ADAMS e-mail distribution):
 LDWert
 JEWhitten
 DBSpitzberg
 RSBrowder
 RJEvans
 FCDB File
 RIV Files-4th floor file room (40-Docket)

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