Environmental Restoration of Corrective Action Unit 408: Bomblet Target Area, Tonopah Test Range, Nevada (Funded by the American Reinvestment and Recovery Act) – 11114

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ABSTRACT

The mission of the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Environmental Restoration Program is to address the environmental impacts of weapons testing conducted on the Nevada National Security Site and the Nevada Test and Training Range. The large physical size of these sites, along with limits on funding and other resources available for remediation efforts, means that environmental restoration activities must be prioritized and accomplished incrementally over time. The remediation of a bomblet target area on the Tonopah Test Range (TTR), which is located within the Nevada Test and Training Range, was originally planned in 2007 but was not carried out until funding became available in the summer of 2009 through the *American Reinvestment and Recovery Act*. This activity was implemented in accordance with the *Federal Facility Agreement and Consent Order* established between NNSA/NSO and the Nevada Division of Environmental Protection.

This activity which was complete by the end of Fiscal Year 2010, involved the excavation of disposal pits suspected of containing submunitions and the surface clearance of submunitions on seven target areas amounting to approximately 6.7 square kilometers of land at the TTR. The TTR was used by Sandia National Laboratories from the late 1960s through the mid-1980s to conduct research into the deployment of submunitions. Although there were efforts to identify, collect, and dispose various amounts of unexploded ordnance on the TTR in the past, no comprehensive effort to remediate the entire flightline area for submunitions was undertaken before this project.

INTRODUCTION

Environmental restoration at the Nevada National Security Site (NNSS), located 100 kilometers (km) northwest of Las Vegas, Nevada, is conducted by the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Site Office (NNSA/NSO). Environmental restoration is performed in areas where DOE activities have had the potential to impact the environment and include areas located on and off the NNSS. One of these off-site locations is the Tonopah Test Range (TTR), which is northwest of the NNSS approximately 50 km from the town of Tonopah, Nevada.

The environmental restoration activity completed in 2010 at the TTR consisted of clean closing an area used to test the delivery systems and dispersal of bomblets (submunitions) on targets. This testing was conducted by Sandia National Laboratories from the 1960s through 1985, and the remediation was conducted and completed by NNSA/NSO.

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The remediation was conducted by NNSA/NSO in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) [1]. The FFACO sets the requirements and expectations between NNSA/NSO and the Nevada Division of Environmental Protection (NDEP), which is the regulatory agency for the overall remediation effort on the NNSS. Corrective action units (CAUs) were established in the mid-1990s by NNSA/NSO and agreed upon by NDEP, including CAU 408: Bomblet Target Area (TTR).

Corrective Action Unit 408 is shown in Figure 1. The areas of CAU 408 that were investigated and remediated consisted of 7 distinct targets and 3 buried trenches out of 25 investigated anomalies. The largest target was a dry lake bed known as South Antelope Lake. The area of remediation on the lake bed was approximately 3.6 square kilometers (km^2). The other six target areas were smaller and cumulatively comprised approximately 2.3 km^2. In addition, a missed drop (not on a designated target) that comprised 0.8 km^2 was discovered and remediated. Both surface and subsurface remediation was conducted on the targets, but South Antelope Lake where the majority of subsurface remediation occurred because of the three buried trenches.

Streamlined Approach for Environmental Restoration

As an initial step, a document was developed to describe the planned remediation work. This document is known as the Streamlined Approach for Environmental Restoration (SAFER). The development of the CAU 408 SAFER began in early 2009, and was finalized in October 2009. Field activities were initiated in July 2009 while the SAFER was under development and were completed in September 2010. The SAFER was approved in March 2010 [2] after a thorough review by NDEP.

Federal Facility Agreement and Consent Order Process

The FFACO [1] governs the process for identifying, characterizing, and providing corrective actions for NNSA/NSO remediation activities within the state of Nevada. The FFACO is a tri-party agreement entered into by the State of Nevada, acting by and through NDEP; NNSA/NSO; and the U.S. Department of Defense. The FFACO was created in the mid-1990s with the identification of several thousand potential sites on the NNSS and other off-site locations that require investigation.

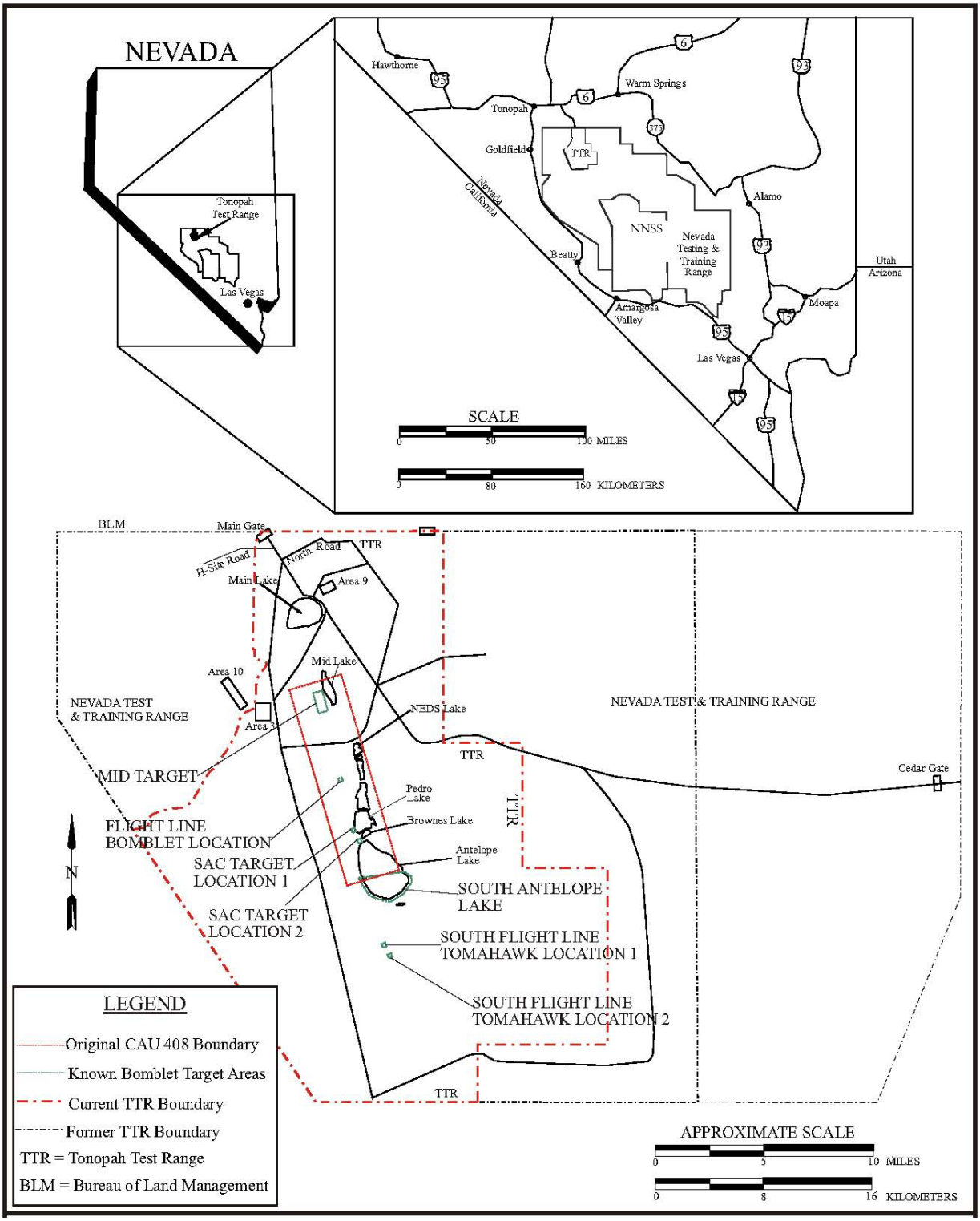

Fig. 1. CAU 408: Bomblet Target Area (TTR).

American Recovery and Reinvestment Act Funding

CAU 408 was originally planned for investigation and remediation in 2007, but the planned work could not be completed at that time due to funding constraints. A SAFER document was drafted and agreed upon by NNSA/NSO and NDEP, but completion of the work remained. In 2009, when funding became available to proceed with the fieldwork with the passage of the *American Recovery and Reinvestment Act* (ARRA), the SAFER document was re-examined, revised, and resubmitted to NDEP for review and approval. Fieldwork was planned and a budget established in the spring of 2009. Deployment to the field was executed on July 27, 2009, and was completed in September 2010 with the approval of the Closure Report (CR) [3] by NDEP. Implementation of the closure work at CAU 408 was a direct result of funding made available through the ARRA.

Corrective Action Unit 408

The FFACO [1] identifies characterization efforts by CAU, within which are defined specific corrective action sites. CAU 408 defines an area on the TTR of approximately 6.7 km^2 that contains seven specific targets (Figure 1). These targets were used for testing the dispersal of submunitions dropped from aircraft. Sandia National Laboratories conducted these tests to evaluate and refine dispersal patterns. Although cleanup of submunitions at the TTR had been conducted in the past, no comprehensive investigation of the area to establish clean closure had been conducted. Corrective Action Unit 408 was created to ensure clean closure of areas affected by the submunition testing.

The closure required two phases to complete. The first phase consisted of investigating anomalies on the dry lake bed target known as South Antelope Lake. These anomalies were established during geophysical investigation of the lake bed, and represented areas with the potential to be subsurface disposal pits. There was historical knowledge that the disposal of submunitions had occurred during past operations, and those pits required investigation. A total of 25 anomalies were identified during the geophysical investigation. During excavation, metal debris was found at each of the 25 locations; however, 22 of the 25 anomalies proved to have metal only at the surface or near surface (less than 15 centimeters [cm] deep). At the remaining three anomalies, significant quantities of metal, including munitions, were found at depths ranging from 1.5 to 4.6 meters (m). These locations were determined to be disposal pits, and the material was excavated and sorted to remove the metal items and submunitions. The soil was stockpiled for return to the excavation. Once the excavation was complete, soil samples were obtained to determine the nature and extent of potential soil contamination. The scrap metal was examined to ensure that there were no munitions, and once it was certified as munitions free, it was disposed as solid waste. Any live munitions, including submunitions, were rendered inert with a donor explosive and disposed as solid waste. The quantity of solid waste disposed is shown in Table I.

Table I. Waste Summary Table for CAU 408 [3].

Waste Items	Waste Characterization				Disposal Facility	Waste Mass (kg)
	Hazardous	Hydrocarbon	PCBs	Radioactive		
Recyclable lead	No	No	No	No	N/A	23
Debris-printed circuit boards and batteries	Yes	No	No	No	Waste consumed during characterization sampling	0.11
DU-contaminated debris and fragments	No	No	No	Yes	Area 5, RWMC (NNSS)	32
Debris—metal, wood, plastic, concrete	No	No	No	No	PEOT Landfill (TTR)	27,180
Inert MD	No	No	No	No	Area 9, U10c (NNSS)	14,820
DU-contaminated soil and fragments	No	No	No	Yes	Area 5, RWMC (NNSS)	190

DU = Depleted uranium
kg = Kilogram
MD = Munitions debris
N/A = Not applicable
PCB = Polychlorinated biphenyl
RWMC = Radioactive Waste Management Complex

The second phase of the closure involved the surface clearance of approximately 6.7 km^2 of areas affected by submunitions. Using handheld geophysical instrumentation, personnel walked predefined grids covering 100 percent of the surface area looking for metal to a depth of 30 cm below ground surface (Figure 2). Submunitions found during surface clearance (Figure 3) were excavated if necessary, and rendered inert with a donor explosive or moved and centrally located with other submunitions to be rendered inert. The inert submunitions were then collected and disposed as solid waste. Although the primary scope of this effort was the removal of submunitions, all other munitions found in the target areas also were removed (Figure 4).

Fig. 2. Surface clearance.

Fig. 3. Submunitions on target surface.

Fig. 4. An example of other munitions uncovered during excavation and surface clearance (M117A1, 340-kg bomb, uncovered in Mid Target Grid 53/816).

The areas investigated and activities conducted to clean close CAU 408, including the quantities of sanitary construction debris, munitions debris (MD), and munitions of explosive concern (MEC) dispositioned during the remediation, are shown in Table II.

Table II. CAU 408 Corrective Action Investigation Areas and Activities [3].

Investigation Area[a]	Activities Conducted
Mid Target Area	• Performed Mag and Dig survey of 158 100-by-100-m grids. • Performed 10% QC survey of each grid, including seeding program. • Removed and dispositioned 59 kg of sanitary construction debris. • Removed and dispositioned 2,214 kg of MD. • Removed and dispositioned/demolished 1,867 MEC items. • Collected 27 verification samples.
Flightline Target Area	• Performed Mag and Dig survey of 19 100-by-100-m grids. • Performed 10% QC survey of each grid, including seeding program. • Removed and dispositioned 17 kg of sanitary construction debris. • Removed and dispositioned 8.6 kg of MD. • Removed and dispositioned/demolished 513 MEC items (BLU-63s).
SAC 1 and 2 Target Areas	• Investigated potential disposal pit within SAC Target 1. • Collected 1 biased verification sample. • Performed Mag and Dig survey of 45 100-by-100-m grids. • Performed 10% QC survey of each grid, including seeding program. • Removed and dispositioned 159 kg of sanitary construction debris. • Removed and dispositioned 280 kg of MD. • Removed and dispositioned/demolished 1 MEC item (.50-caliber round).
South Antelope Lake Target Area	• Performed Mag and Dig survey of 357 100-by-100-m grids. • Performed 10% QC survey of each grid, including seeding program. • Removed and dispositioned DU-impacted debris and fragments. • Removed and dispositioned 524.58 kg of sanitary construction debris. • Removed and dispositioned 1,684 kg of MD. • Removed and dispositioned/demolished 22 MEC items.
Tomahawk 1 Target Area	• Performed Mag and Dig survey of 4 100-by-100-m grids. • Performed 10% QC survey of each grid, including seeding program. • Removed and dispositioned 0.2 kg of sanitary construction debris. • Removed and dispositioned 0.2 kg of MD. • Discovered no MEC items.
Tomahawk 2 Target Area	• Performed Mag and Dig survey of 6 100-by-100-m grids. • Performed 10% QC survey of each grid, including seeding program. • Removed and dispositioned 0.2 kg of sanitary construction debris. • Recovered no MD. • Discovered no MEC items.
Antelope Lake	• Investigated 24 potential disposal pits. • Discovered and remediated 2 disposal pits. • Performed Mag and Dig survey of South Antelope Lake Target Area. • Performed visual survey of North Antelope Lake Area for MEC/radiologically impacted debris. • Collected 37 verification samples.

Investigation Area[a]	Activities Conducted
Buffer Zone	• Performed visual sweep of 35.0-km^2 area. • Performed Mag and Dig survey of approximately 0.8 km^2 for step-out surveys. • Performed QC oversight during visual sweep activities. • Removed and dispositioned approximately 2,300 kg of sanitary construction debris. • Removed and dispositioned approximately 11,000 kg of MD. • Removed and dispositioned/demolished approximately 500 MEC items. • Removed and dispositioned DU-impacted debris and fragments.

[a]See Appendix B to the CAU 408 CR [3] for additional information.

QC = Quality control
SAC = Strategic Air Command

Effectiveness of the Streamlined Approach for Environmental Restoration

The process of conducting environmental restoration under the FFACO [1] at the NNSS is well defined and consistent. One of the primary components for documenting planned restoration effort is the SAFER document. The SAFER process was developed to allow for fieldwork to proceed with the implementation of corrective actions based on available and sufficient information regarding the release and extent of contamination. CAU 408 fieldwork was conducted following the SAFER process.

One of the initial steps in completing the SAFER was the development of a conceptual site model. The conceptual site model developed for CAU 408 assumed that no munitions would be found buried at depths greater than 4.6 m. This proved to be true during the implementation of fieldwork.

Another key assumption in the CAU 408 conceptual site model was that submunitions were dropped only on the target areas. Historical data on submunition dispersal indicated that drops were made along the full length of the targets and most of the width. No documented evidence was found to indicate that the submunitions were confined to the original target boundaries or that submunition drops were always on target. The decision was made to establish a buffer zone around the known target areas where visual surface clearance would be conducted to ensure that an entire missed drop of submunitions did not exist outside the established target areas. The buffer zone established was approximately 16 km long and 2 km wide. The inclusion of the buffer zone turned out to be a prudent contingency. During the investigation of one of the last portions of the buffer zone, an entire drop of approximately 280 submunitions was found in an area that was not one of the seven targets. Upon discovery, this missed drop was given the same level of scrutiny as a target, i.e., grids were established, complete surface clearance was performed using geophysical equipment, and adjacent grids were established when a submunition was discovered at the edge of an existing grid. Without the establishment of the buffer zone, a significant quantity of submunitions would not have been remediated.

The SAFER process was successfully used in the implementation of corrective action for CAU 408. The SAFER process allowed the fieldwork to begin in July 2009 while the investigation process was still under way. The SAFER was submitted to NDEP in August 2009

for initial review. The SAFER was subsequently revised in response to comments received from NDEP, and the revised SAFER was submitted to NDEP for final approval in March 2010 [2]. The SAFER was an effective and efficient tool that allowed field investigation and environmental restoration to proceed while approval of the characterization document was pending.

Personnel

Implementation of submunition investigation, excavation, and treatment of MEC must be conducted by properly trained personnel. For CAU 408 investigation and fieldwork, unexploded ordnance (UXO) technicians were contracted to conduct the physical work of identifying, excavating, and rendering submunitions inert. These technicians were specially trained on these activities, including the operation of geophysical instruments, the identification and excavation of munitions, and the techniques used to place explosive charges on munitions to render them inert.

Field technicians were overseen by a Senior UXO Supervisor who was the subject matter expert for issues related to munitions during the execution of CAU 408 environmental restoration. A UXO Safety/Quality Control (QC) Officer was on site to coordinate and supervise site activities and to ensure that UXO technicians were working safely and in compliance with procedures. These personnel were overseen by a Project Site Supervisor who was responsible for ensuring that additional work required outside of UXO operations, such as soil sampling, excavation backfill, and documentation of environmental restoration, was completed.

Together, these 12 to 14 individuals formed a cohesive team that, over the course of the 12-month field deployment, was responsible for conducting and completing CAU 408 field activities safely in accordance with the SAFER [2], and on schedule and within the estimated budget. This entire team was funded by the ARRA during the 12-month field deployment.

Closure Documentation

The FFACO [1] requires that closure field work be documented. This documentation is in the form of a CR that documents field activities, the restoration that was performed, and the results of the sampling conducted during the effort. The CR is the final documentation submitted to NDEP to demonstrate that clean closure was achieved and that the requirements of the SAFER were implemented.

The CAU 408 CR [3] was drafted and submitted to NDEP for review in early August 2010. The CR was prepared to give a full account of the remediation work conducted at CAU 408, and included information about the areas investigated, sample results, deviations from the SAFER, photographs, maps, waste disposal records, and documentation of QC implemented during the effort. The NDEP review of the CR found no deficiencies, and the CAU 408 CR was finalized and approved before the due date of September 30, 2010.

SUMMARY

Environmental restoration activities at the NNSS and the Nevada Test and Training Range, including the TTR, are managed by NNSA/NSO though the implementation of the FFACO process. CAU 408 was designated as the Bomblet Target Area (TTR), and consisted of the remediation of disposal pits and surface clearance of submunitions on approximately 6.7 km^2 of former target areas within the TTR. The work was initiated in early 2009, and personnel were deployed to the field in July 2009 to conduct field operations that lasted until July 2010. The activity was completed in September 2010 with the approval of the CR by NDEP. This activity was accelerated and completed with funding made available through the ARRA of 2009. The CAU 408 site is now considered clean closed.

REFERENCES

1. *Federal Facility Agreement and Consent Order*, agreed to by the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management (1996; as amended March 2010).

2. U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA SITE OFFICE, *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 408: Bomblet Target Area, Tonopah Test Range (TTR), Nevada*, DOE/NV--171-Rev.1 (2010).

3. U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA SITE OFFICE, *Closure Report for Corrective Action Unit 408: Bomblet Target Area, Tonopah Test Range (TTR), Nevada*, DOE/NV--1409 (2010).

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