Post-Closure Environmental Sampling and Inspection at the Amchitka Island, Alaska, Site – 17251

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ABSTRACT

In the 1960s and early 1970s, three underground nuclear tests were conducted on Amchitka Island, Alaska. In 1965, the US Department of Defense—in conjunction with the US Atomic Energy Commission (AEC)—conducted the first of these nuclear tests, Long Shot, to provide data that would improve US capabilities for detecting underground nuclear explosions. In 1969, AEC conducted the second test, Milrow, to explore the feasibility of detonating a much larger device. In 1971, AEC conducted the third test, Cannikin, which was the largest underground test ever conducted by the US.

The Long-Term Surveillance Plan (LTSP) for the Amchitka, Alaska, Site details how the US Department of Energy Office of Legacy Management (LM) intends to fulfill its mission to protect human health and the environment at and around the Amchitka Island site. The LTSP calls for monitoring to be performed every 5 years, at least during the initial phase of the project. The purpose of the monitoring is to develop a baseline of activity concentrations for selected radionuclides in biota, water, and soil, both on Amchitka Island and at the reference location on Adak Island, approximately 322 kilometers (200 miles) northeast of Amchitka. In addition to the environmental monitoring activities, seven mud pit caps that contain diesel-contaminated soils are inspected.

The plan for biological and water sampling (both seawater and freshwater) during the May 2016 sampling event was developed through close coordination with the primary stakeholders, including the Alaska Department of Environmental Conservation, the Aleutian Pribilof Islands Association, and the US Fish and Wildlife Service. The environmental sampling in 2016 is a continuation of LM's evaluation of Amchitka Island's environment. Previous results from similar monitoring programs in 2004 and 2011 indicate that the environment is not being impacted by radionuclide migration and uptake from the underground nuclear testing conducted beneath Amchitka Island; consequently, subsistence and commercial-catch seafood is safe for human consumption.

The collection of biota samples (rockfish, Irish lords, greenling, and rockweed) for cesium-134 (^{134}Cs), cesium-137 (^{137}Cs), plutonium-239 (^{239}Pu), plutonium-240 (^{240}Pu), and freshwater and seawater samples for ^{134}Cs, ^{137}Cs, and tritium (^{3}H) was the primary objective of the 2016 sampling effort. Rockfish, Irish lords, and greenling are resident, nonmigratory fish species that spend their entire life cycle in the marine environment, and rockweed is an intertidal species that may concentrate cesium. The seawater samples were collected primarily to determine if

leakage from the Long Shot detonation could be detected and, secondarily, to compare with the background seawater samples collected from Adak Island. Cesium isotopes are also being analyzed to better understand the potential impact that the Fukushima-Daiichi release might have on the Amchitka and Adak environments.

The target detection limits used for the 2016 sampling are lower than those used in previous studies. The lower detection limits make it possible for LM to delineate background activity levels for the radionuclides of interest. Data from the 2016 sampling event go beyond assessing food safety and focus on detecting leakage from the underground nuclear explosions. Additionally, the baseline activity concentrations obtained for the reference area (Adak Island) will enable identification of quantitative statistical trends in the results of future sampling programs. Sampling programs conducted in 2021 and beyond will have an objective to assess the statistical trends of radioactivity levels in the Amchitka Island environment.

INTRODUCTION

Amchitka Island is near the western end of the Aleutian Islands, approximately 2157 km (1340 miles) west-southwest of Anchorage, Alaska. Amchitka is part of the Aleutian Island Unit of the Alaska Maritime National Wildlife Refuge, which is administered by the US Fish and Wildlife Service. Since World War II, multiple US government agencies have used the island for various military and research activities. From 1943 to 1950, the US military occupied the island as a forward air base. During the middle 1960s and early 1970s, the US Department of Defense (DOD) and the US Atomic Energy Commission (AEC) used a portion of Amchitka as a site for underground nuclear tests. During the late 1980s and early 1990s, the US Navy constructed and operated a radar station on the island.

Three underground nuclear tests were conducted on Amchitka Island. US DOD, in conjunction with AEC, conducted the first nuclear test (named Long Shot) in 1965 to acquire data to improve US capabilities for detecting underground nuclear explosions. The second nuclear test (Milrow) was a weapons-related test that AEC conducted in 1969 to explore the feasibility of detonating a much larger device. Cannikin, the third nuclear test on Amchitka, conducted in 1971, was also weapons-related. With the exception of small concentrations of tritium detected in surface water shortly after the Long Shot test, radioactive fission products from the tests remain in the subsurface at each test location. Figure 1 shows the test site locations.

INSPECTION OF MUD PIT CAPS

The mud pit release sites are the result of drilling performed in support of the three underground nuclear tests conducted on Amchitka. Long Shot (approximately 80 kilotons) was detonated on October 29, 1965. Milrow (approximately 1000 kilotons) was detonated on October 2, 1969. The higher-yield Cannikin test (less than 5 megatons) was detonated on November 6, 1971. In addition to these three sites, drilling was performed at three other sites (D, E, and F in Figure 2), where nuclear

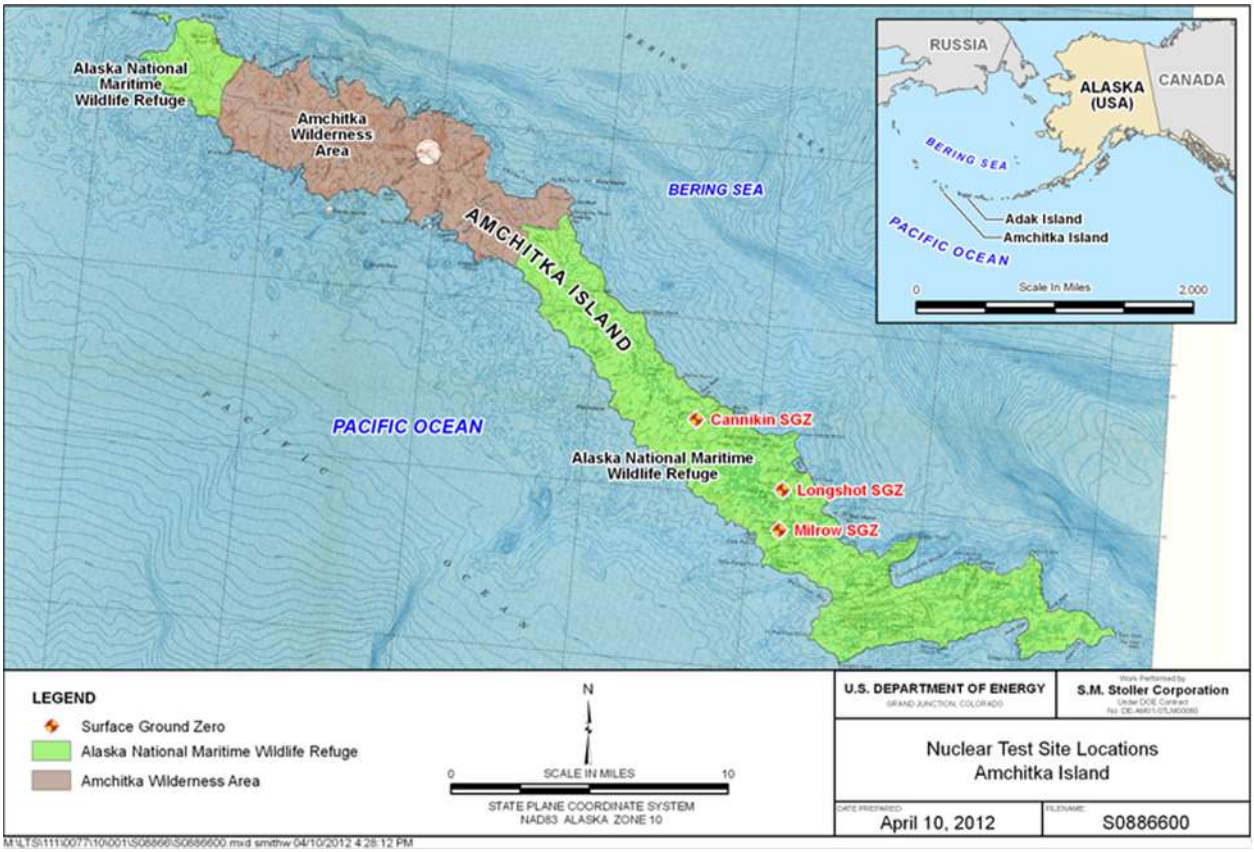

Figure 1. Amchitka Test Site Locations.

testing was considered but not performed. Figure 2 depicts the locations of these sites.

The activities at these six sites resulted in 12 drilling mud pits, where drilling spoils were stored. The large-diameter emplacement boreholes were drilled using methods that employed large quantities of drilling mud (a mixture of bentonite, diesel fuel, and other compounds including chrome lignosulfonate and chrome lignite) to control viscosity and mitigate loss of drilling mud in the boreholes. The composition of the drilling mud used at Amchitka included 91–93% water, 6–8% oil, and other additives including cement, bentonite, paper, chrome lignosulfonate, chrome lignite, and sodium bicarbonate [1]. The drilling mud was commonly stored near the drill sites, in bermed pits excavated to hold large quantities of drilling fluid produced from drilling the boreholes. Table 1 provides a summary of the mud pit closures on Amchitka.

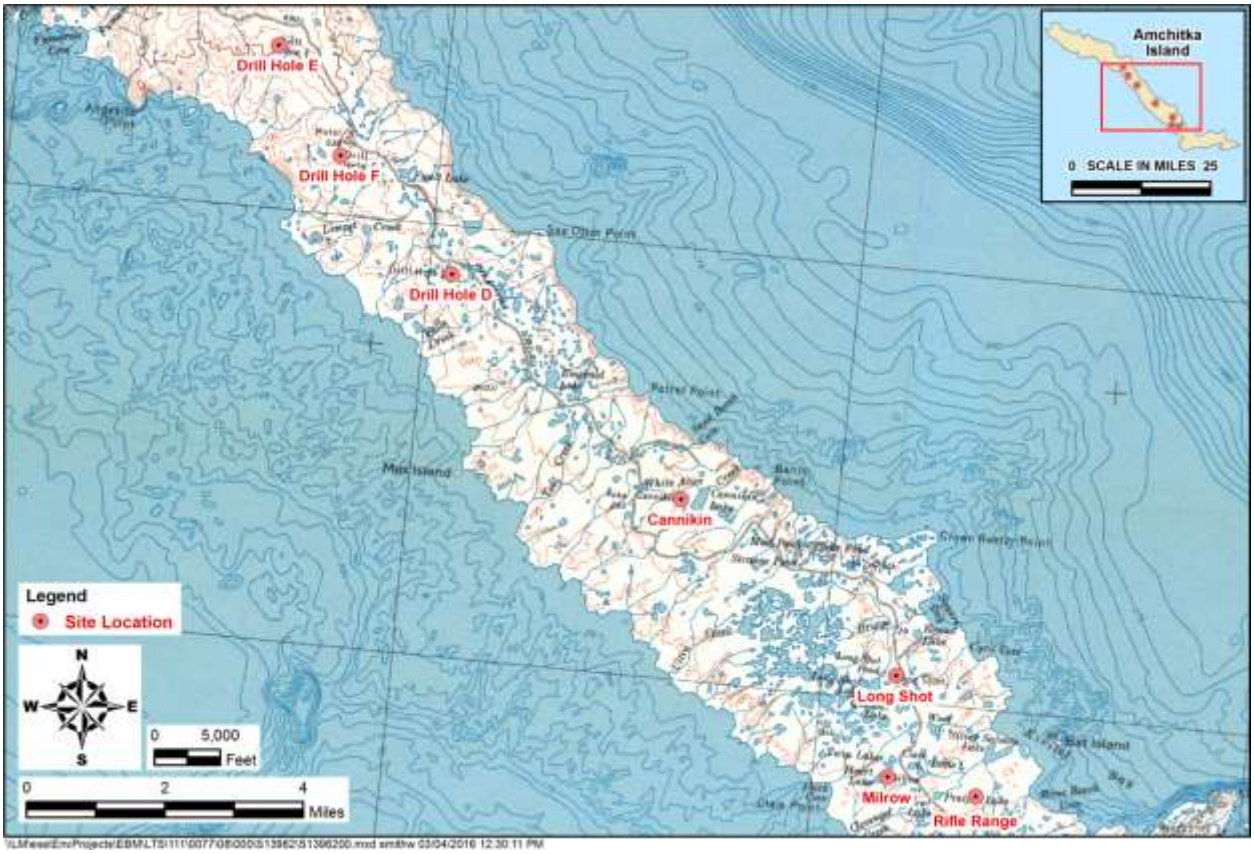

Figure 2. Mud Pit Cap Locations.

POST-CLOSURE MONITORING AND INSPECTION REQUIREMENTS

The cap inspections are conducted every 5 years as provided for in the Long-Term Surveillance Plan (LTSP) [2]. Post-closure monitoring and inspections of the mud pit sites are intended to determine whether:

- The geosynthetic caps are performing as designed.
- The geosynthetic caps are subsiding or eroding.
- The drainage ditches and/or energy dissipators are eroding.
- The vegetation is established and stable.
- Modifications to the administrative controls are needed.

The mud pit inspections will include the following activities:

- Cap integrity monitoring (subsidence and erosion)
- Vegetative cover monitoring
- Photographic documentation

Table 1. Amchitka Mud Pit Sites Closure Summary

Mud Pit Site	Location on Infantry Road	USFWS Survey Monument[a]	Number of Mud Pits	Number of Caps Installed	Number of Energy Dissipators Installed
Milrow (Rifle Range)	Mile Marker 2.4	Northing: 187,163.93 Easting: 2,187,922.29 Elevation: 55.88	1	1	2
Long Shot	Mile Marker 4.6	Northing: 196,199.27 Easting: 2,181,923.93 Elevation: 140.24	2 (East and West)	1 (East and West combined)	1
Cannikin—North/South Site	Mile Marker 10.4	Northing: 207,336.49 Easting: 2,165,121.83 Elevation: 255.87	2 (North and South)	1 (South consolidated into North)	1
Cannikin—Ground Zero Site	Mile Marker 10.4	Northing: 209,413.21 Easting: 2,165,078.89 Elevation: 202.11	1	1	2
Drill Site D	Mile Marker 16.1	Northing: 226,896.76 Easting: 2,147,772.85 Elevation: 304.75	3 (South, Northwest and Northeast)	2 (South; Northwest and Northeast combined)	2
Drill Site F	Mile Marker 18.8	Northing: 235,803.50 Easting: 2,139,216.90 Elevation: 480.96	1	1	1
Drill Site E	Mile Marker 20.25	Northing: 244,303.70 Easting: 2,134,932.10 Elevation: 524.52	2 (North and South)	1 (South only; North—no further action)	1

Notes:
[a] Horizontal datum AK State Plane 1983, NAD 83; Vertical datum NAVD 29.

BIOLOGICAL MONITORING

The purpose of biological sampling is to carry out LM's responsibility—described in the LTSP for the Amchitka Island site and its reference site, Adak, Alaska—to further assess the possibility that selected residual radionuclides from nuclear tests may enter the marine food chain, resulting in potential ecological and human health effects. Previous scientific studies were performed on and around Amchitka Island that were similar in purpose to this plan.

The collection of biota samples for cesium-134 (^{134}Cs), cesium-137 (^{137}Cs), plutonium-239 (^{239}Pu), plutonium-240 (^{240}Pu), and freshwater and seawater samples for ^{134}Cs, ^{137}Cs, and tritium (^{3}H) was the primary objective of the 2016 sampling effort. These sampling activities are specified in the LTSP and agreed to by the Alaska Department of Environmental Conservation. A similar sampling event was conducted at Adak, which is used as a reference area unaffected by the underground nuclear tests at Amchitka. The 2016 laboratory analytical method detection limits are lower than those used previously. The lower detection limits should provide data to enable US Department of Energy to delineate background activity concentrations of the radionuclides of interest included for analyses. Data

from the 2016 sampling event will be used to assess whether leakage from blast cavities can be detected and to provide baseline activity concentrations that will support analyses of quantitative statistical trends using previous and future sampling results. Sampling programs conducted in 2016 and beyond will include the objective of assessing the statistical trends of activity concentrations in biota and ocean water.

The 2016 sampling event required an ocean-going vessel be chartered to take the scientific team from Adak Island out to Amchitka Island and provide the necessary services to allow the scientific team to complete their assignments. The scientific team traveled on the *Qualifier 105* from Homer, Alaska, shown in Figure 3.

Figure 3. *Qualifier 105*.

The Environmental Sampling Plan directed collection of four species of fish and one species of algae:

- Yellow or red Irish lords (*Hemilepidotus jordani* or *H. hemilepidotus*) (see Figure 4)
- Kelp or rock greenling (*Hexagrammos decagrammus* or *H. lagocephalus*) (see Figure 5)
- Black or dusky rockfish (*Sebastes melanops* or *S. cilatus*) (see Figure 6)
- Dolly Varden (*Salvelinus malma*) (see Figure 7)
- Rockweed (*Fucus distichus*), a species of brown algae (see Figure 8)

Figure 4. Irish Lord.

Figure 5. Greenling.

Figure 6. Rockfish.

Figure 7. Dolly Varden.

Figure 8. Rockweed.

The scientific team sampled the fish species using hook and line (fishing) and collected the rockweed by hand from the shoreline. Seawater was sampled in each area where fish were caught and in a specified area off the coastline of the Long Shot site. The team collected freshwater samples from lakes on both Amchitka and Adak Islands.

SEAWATER SAMPLING

Seawater sampling off the coastline of the Long Shot site took 1 full day and part of 2 days. The University of Alaska Fairbanks provided two sampling technicians and a Sea-Bird Electronics ECO water sampler with a six-bottle configuration (4 liters per bottle). This ECO water sampler enabled the scientific team to meet the volume requirement of 20-liters per sample for the Long Shot site seawater samples. The ECO seawater sampler was deployed from the deck of the *Qualifier 105* to the desired depth. The ECO water sampler and a portable instrumentation winch were utilized to optimize real-time conductivity, temperature, and depth (CTD) measurements and water-sample profiling at the desired depths off the coast of the Long Shot site. The ECO water sampler is shown in
Figure . The scientific team also conducted transect seawater sampling at each of the five sampling areas where biological samples were collected.

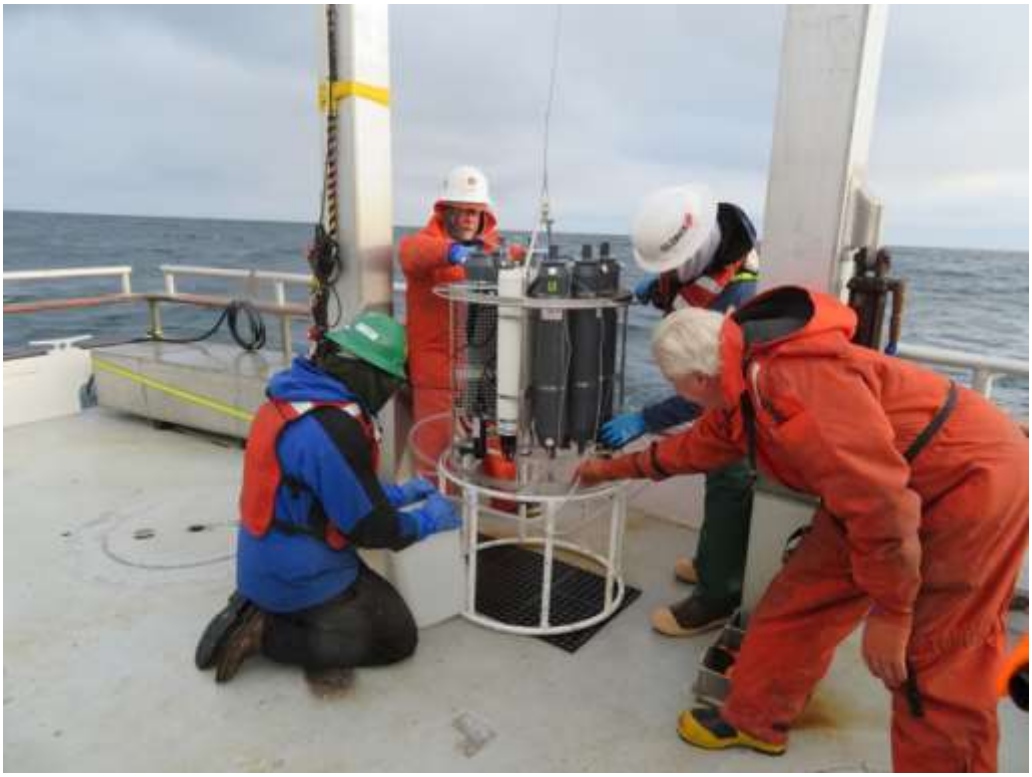

Figure 9. ECO Water Sampler.

LABORATORY ANALYSES

The two laboratories that the Amchitka Working Group agreed on to perform the environmental sample analyses were Lawrence Livermore National Laboratory (LLNL) in Livermore, California, and the University of Miami's Tritium Laboratory in Miami, Florida. Overall, the scientific team collected 268 environmental samples at Amchitka and Adak Islands, duplicates included, which were comprised of the following:

- Greenling: 50 samples (10 from each of the following sites: Long Shot, Milrow, Cannikin, Adak North, and Adak South) sent to LLNL
- Irish Lords: 50 samples (10 from each of the following sites: Long Shot, Milrow, Cannikin, Adak North, and Adak South) sent to LLNL
- Rockfish: 50 samples (10 from each of the following sites: Long Shot, Milrow, Cannikin, Adak North, and Adak South) sent to LLNL
- Dolly Varden: 3 samples (2 from Adak Island and 1 from Amchitka Island) sent to LLNL
- Rockweed: 15 samples (3 from each of the following sites: Long Shot, Milrow, Cannikin, Adak North, and Adak South) sent to LLNL
- Seawater: 96 samples (88 from the Long Shot site and 2 each from the Milrow, Cannikin, Adak North, and Adak South sites); half of the samples were 20-liters

each and sent to LLNL; the other half of the samples were 1-liter each and sent to the University of Miami

- Freshwater: 4 samples (2 from Adak Island and 2 from Amchitka Island); one set of samples sent to each laboratory

CURRENT ACTIVITIES

Results from the seawater samples for tritium were received in September 2016. Results from the 2016 environmental sampling are still being analyzed. Once all results are in, the data will be evaluated and an environmental sampling report should be available in late 2017 or early 2018.

CONCLUSION

The cap inspection activities, observations, and deficiencies were documented using inspection checklists, site drawings, photographs and photo logs, vegetative cover logs, and field notes. An inspection report was prepared and submitted to LM. The report also contains the results of follow-up inspections and/or maintenance performed since the previous inspection. LM, in turn, submitted the report to the Alaska Department of Environmental Conservation for information and review.

If corrective action is required to repair damage to a site during an inspection, a corrective action plan and subsequent corrective action report may also be prepared, at the discretion of LM. The corrective action documents may be submitted separately from the inspection report or as an attachment to it.

Biota sample concentrations in 2011 indicated that radionuclide levels were protective of the subsistence diet and were similar to levels found at the background reference location (Adak Island) [3]; 2016 data collected from resident fish species and rockweed were collected to determine if there has been any statistically significant change in concentration. If increases are found, they could be an indication of possible leakage of radionuclides from the test cavities.

REFERENCES

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3. U.S. Department of Energy, 2013. "Amchitka Island, Alaska, Biological Monitoring Report 2011 Sampling Results," LMS/AMC/S08833, Office of Legacy Management, Grand Junction, Colorado, September.