

Strategy for Long-Term Stewardship and Monitoring of Amchitka Island - 12190

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ABSTRACT

The Long-Term Surveillance and Maintenance Plan (LTSMP) for Amchitka details how the U.S. Department of Energy (DOE) intends to fulfill its mission to maintain protection of human health and the environment at and around the sites on Amchitka Island. The LTSMP calls for monitoring to be performed every 5 years, at least in 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 and at the reference location on Adak Island, approximately 322 km (200 miles) northeast of Amchitka. Data compiled by the Consortium for Risk Evaluation with Stakeholder Participation (CRESP, 2006) are being included as part of the baseline data set.

The specific biological, water, and sediment samples collected during the 2011 sampling event were developed through close coordination with the primary stakeholders, including the Alaska Department of Environmental Conservation, the Aleutian Pribilof Island Association, and the U.S. Fish and Wildlife Service (USFWS). Amchitka is managed by the USFWS as part of the Alaska Maritime National Wildlife Refuge. Two plans were developed to address specific needs of the biological- and the terrestrial-monitoring programs. Results from these monitoring programs will help determine whether the environment is being impacted by radionuclide migration and uptake, and if subsistence and commercial-catch seafood is safe for human consumption. The RESRAD-BIOTA code is being used to evaluate ecological health relative to the radionuclide levels determined from this sampling event.

INTRODUCTION

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) has long-term stewardship responsibility for DOE's Nevada Offsites Program. One of the project sites in this program is Amchitka Island, Alaska, where three underground nuclear tests were conducted. In 1965, the U.S. Department of Defense, in conjunction with the U.S. Atomic Energy Commission (AEC), conducted the first nuclear test, Long Shot, to provide data that would improve the United States' capability of detecting underground nuclear explosions. In 1969, AEC conducted the second test, Milrow, to study the feasibility of detonating a much larger device. In 1971, AEC conducted the third test, Cannikin, the largest underground test ever conducted by the United States.

DOE manages the radioactive material at the Amchitka Site under the authority of the Atomic Energy Act of 1954 (Title 42 *United States Code* § 2011). DOE Order 436.1, *Departmental Sustainability*, establishes the stewardship practices that protect the environment within DOE sites, and is the guiding requirement for long-term stewardship at Amchitka Island. The long-term isolation of diesel-contaminated drilling mud on the island is managed under the *Alaska Administrative Code*. Surface disturbances associated with these tests have been remediated; however, radioactivity remains deep below the surface, contained in and around the test cavities, for which no feasible remediation technology has been identified.

Figure 1 depicts the location of the seven DOE sites on Amchitka Island, including the three detonation sites (Long Shot, Milrow, and Cannikin). Drill Sites D, E, and F were investigated as potential detonation sites, but no detonations were conducted there. The Rifle Range Site is where the drill cuttings from the Milrow Site were placed.

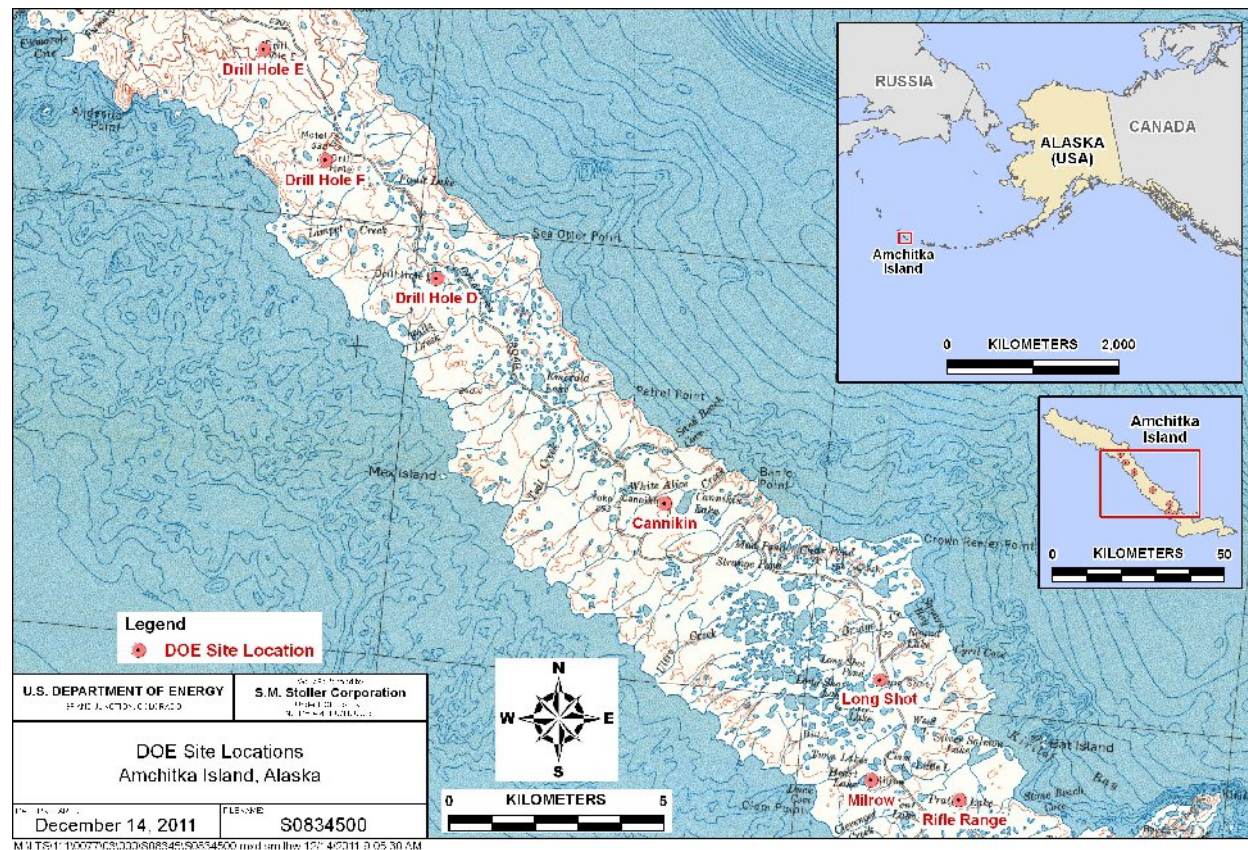


Figure 1. DOE Sites on Amchitka Island.

In addition to statutory requirements, LM participates in cooperative agreements with stakeholder groups, government agencies, and national laboratories to conduct its work on the Amchitka Island project.

STAKEHOLDER INVOLVEMENT

Because Amchitka Island is part of the Alaska Maritime National Wildlife Refuge, LM has a memorandum of understanding with the U.S. Fish and Wildlife Service (USFWS). The purpose of the memorandum is to define the roles and responsibilities of both agencies, specify the means of access and egress to Amchitka Island, and explain how LM will exercise institutional controls. The USFWS issues access permits to LM in conjunction with the periodic monitoring and sampling events.

In addition, LM has a cooperative agreement with the Alaska Department of Environmental Conservation (ADEC) and regularly meets with team partners from ADEC's Division of Water and Division of Spill Prevention and Response. For the 2011 sampling event, ADEC's two groups collaborated with the University of Alaska Fairbanks (UAF) to help plan the sampling

campaigns and recommend improvements to the LM sampling plan. Not only did UAF provide technical assistance, but the UAF marine biology program, through its cold-water certified diving group, provided divers that retrieved biological samples from the marine environment.

LM has a cooperative agreement with Aleutian Pribilof Islands Association Inc. (APIA). APIA is the federally recognized tribal organization of the Aleut people in Alaska and is an important component of the LM mission at Amchitka Island. APIA represents the interests of, and communicates with, the Aleut people and ADEC. APIA actively participates in developing important aspects of work scope related to the LM mission on Amchitka Island, participates in regular planning meetings. APIA also assisted with specialized sample collection during the 2011 sampling event.

LONG-TERM SURVEILLANCE AND MAINTENANCE PLAN

The *Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy Amchitka, Alaska, Site* (LTSM Plan) [1] details how DOE will fulfill its mission to maintain protection of human health and the environment at and around the site. The LTSM Plan calls for monitoring every 5 years, at least in the initial phase of the project. The purpose of the monitoring is to develop a baseline of activity levels for selected radionuclides in biota, water, and soil, both on Amchitka Island and at the reference location on Adak Island, approximately 322 km (200 miles) northeast of Amchitka Island. Data compiled by the Consortium for Risk Evaluation with Stakeholder Participation [2] in 2004 are being included as part of the baseline data set.

PREVIOUS WORK

Previous scientific studies have been performed on and around Amchitka Island. Merritt and Fuller [3] provide a concise review of the geology, ecology, and radionuclides in air, water, and biota. Their evaluation showed that no radionuclides escaped from the underground sites to the surface of the three nuclear detonations at Amchitka Island, except for tritium, which was detected in water and soil gas samples taken in the immediate vicinity of the Long Shot test.

The University of Washington began its Amchitka Radiobiological Program in 1970. The program continued through 1979. Its principal objective was to collect biological and environmental samples for radiobiological analyses, and to assess the extent of radioactive contamination from worldwide atmospheric fallout and from the detonation of the three underground nuclear tests on Amchitka Island. Leakage of radionuclides from the underground test sites would be suspected if the amount of contamination were significantly greater than could be attributed to worldwide fallout or if an unexpected assemblage of radionuclides were detected. The *Amchitka Radiobiological Program Final Report July 1970 to December 1979* [4] determined that no radionuclides from the underground sites were detected, except for tritium from the Long Shot test, which produced increased tritium concentrations in surface water and freshwater plants near the site.

Another DOE-sponsored program that monitored Amchitka Island radioactivity levels in groundwater was the Off-Site Environmental Monitoring Program for the Nevada Test Site and Other Test Areas Used for Underground Nuclear Detonations (Off-Site Program). Amchitka Island monitoring under the Off-Site Program began in 1977 and has continued intermittently since then. Samples were taken from 1977 through 1989, in 1991, - 1993, - 1997, and in 2001. The U.S. Environmental Protection Agency (EPA) carried out this program and monitored Amchitka Island to measure levels and trends of radioactivity in the off-site environment

surrounding testing areas to evaluate whether radioactivity levels comply with existing radiation protection standards.

Over time, the Off-Site Program became known as the Long-Term Hydrological Monitoring Program (LTHMP). In 1997, the LTHMP at Amchitka Island was expanded to include radiobiological sampling and analyses. This change was based on the results of a survey of selected aquatic biota that Greenpeace conducted on the island [5]. Greenpeace speculated that several long-lived manmade radionuclides were leaking into the surface environment from nuclear test cavities more than 700 m (2,300 feet) below the surface of the island [6]. Briefly summarized, the results of the 1997 LTHMP radiobiological sampling indicated that there was no evidence for leakage from the underground test cavities into the terrestrial or freshwater environments on Amchitka Island [6,7].

In 2004, the Consortium for Risk Evaluation and Stakeholder Participation (CRESP), a group of independent universities, convened to conduct assessments for and publish the *Amchitka Independent Science Assessment: Biological and Geophysical Aspects of Potential Radionuclide Exposure in the Amchitka Marine Environment* [8]. CRESP found that the levels of anthropogenic radionuclides in marine resources around Amchitka were too low to put people or the environment at risk.

PURPOSE OF THE 2011 SAMPLING EVENT

The ocean around Amchitka Island is a biologically rich food resource for local human populations practicing subsistence fishing and for the commercial fishing industry. Subsistence populations that rely on the fishery include the Aleut villages at Adak, Atka, Nikolski, and Unalaska [9]. Commercial fishing occurs around the island (however, Steller sea lion rookery restrictions are in place at East Cape and Column Rocks). Nonmarketable items collected in commercial fishing (such as halibut cheeks) also form part of the diet of subsistence populations [2]. If radionuclides from test cavities were to migrate to the marine environment in the future, these radionuclides could enter the food chain near the island; because of this potential pathway, the near-island biota are being monitored to assess human radiological risk.

Data from CRESP [8] clearly show that (1) radionuclide levels in samples of biota around Amchitka Island during the summer of 2004 were consistent with expected baseline levels from global fallout and (2) there is no evidence of radionuclides from testing on the island. No systematic offshore sampling for tritium from nuclear testing was done, but tritium is believed to be the fastest-moving radionuclide in groundwater and should be the first to arrive if contaminant migration from one or more cavities is occurring. If tritium contamination is absent, then the source of anthropogenic radionuclides is likely attributable to global fallout.

Modeling indicates that groundwater transport of radioactive constituents to the marine environment will not occur in the next 2000 years [10]. Monitoring will provide a basis for evaluating if radionuclides are transported through groundwater into the ocean and accumulated by the biota.

PROPOSED FIELD ACTIVITIES

Two plans were developed to address specific needs of the biological and terrestrial monitoring programs, respectively. The terrestrial monitoring program was designed to assess the integrity of drilling mud disposal cells and whether the venting of gases from the underground tests has impacted ecological receptors. The biological monitoring program was designed to include lower

trophic levels in the ecosystem, such as algae and filter-feeding organisms, and higher-trophic-level organisms, such as resident and migratory fishes found in the local diet. The seawater sampling program was designed to distinguish background tritium concentrations from elevated concentrations potentially associated with leakage from the nuclear detonations. Tritium concentrations in seawater would be evaluated to assess the results of transport modeling that DOE's Office of Environmental Management performed previously.

The target detection limits that would be used on the 2011 samples were lower than those from previous studies. The lower detection limits would make it possible for DOE to delineate background activity levels for the radionuclides of interest. Data from the 2011 sampling event would go beyond assessing food safety alone. The baseline activity concentrations obtained for the reference area would enable quantitative statistical trending of future sampling results. Sampling conducted in 2016 and beyond would include the objective of assessing the statistical trends of radioactivity levels in biota, soil, and ocean water. The RESRAD-BIOTA code [11] would then be used to evaluate ecological health relative to the radionuclide levels determined from this sampling event.

To meet the objective of qualitatively comparing the 2011 data to the 2004 data, the sampling locations would be in the same general areas as those included in the CRESP sampling event, with one exception: Adak Island, instead of Kiska Island, would be the new reference location. The Amchitka working group selected Adak as the reference location for the 2011 sampling event because Adak is easier to access for sampling purposes. Data from Adak, like data from Kiska, would be unimpacted by the nuclear tests conducted at Amchitka Island and therefore, would be useful for comparing to results from Amchitka.

Radioactive material remains in the subsurface environment in and adjacent to the test cavities at the three test sites on Amchitka Island. Sampling by CRESP in 2004 indicated that levels of test-related radionuclides in biota (including subsistence- and commercial-catch species) are safe for consumption [8].

Subsistence- and commercial-catch seafood near Amchitka Island continues to be harvested; therefore, the test-related radionuclides were targeted for analysis to assess whether these foods are safe for human consumption. The 2011 sampling event will provide the first set of data to address the objectives of the LTSM Plan. Results from the 2011 sampling event will be compared qualitatively to CRESP results [8] and serve as the basis for future trending to begin in 2016.

Table 1 identifies the targeted species and the radionuclides that were selected for analysis. This table also identifies whether the samples were collected from the ocean or the land.

IMPLEMENTATION OF FIELD ACTIVITIES

Two ships were chartered for the 2011 Amchitka Island logistical support, the research vessels (R/Vs) *Ocean Pioneer* and *Norseman*. The R/V *Ocean Pioneer* transported the scientific team and equipment to perform the on-island work. The R/V *Norseman* transported the scientific team to perform the biological sampling work adjacent to Amchitka and Adak Islands.

The R/V *Ocean Pioneer* transported 14 scientists and engineers, four Jeep Grand Cherokees, and one John Deere backhoe to Amchitka Island to perform the on-island tasks of inspecting seven earthen covers; repairing Infantry Road where needed; repairing the bronze plaque at the Milrow Site; collecting biological specimens of rockweed (along the shoreline), Dolly Varden

Table I. Amchitka Island Monitoring: Sample Species and Radionuclides Selected for Analysis

Species	Cs-137 (gamma spectroscopy)	Am-241	Pu-239	Pu-240	U-234	U-235	U-238	Enriched Tritium
Ocean Sampling								
Dragon kelp (<i>Eualaria</i>)	X	X	X	X	X	X	X	
Chiton (<i>Cryptochiton stelleri</i>)	X	X	X	X	X	X	X	
Horse mussel (<i>Modiolus modiolus</i>)	X	X	X	X	X	X	X	
Sea urchin (<i>Strongylocentrotus spp</i>)	X	X	X	X	X	X	X	
Octopus (<i>Enteroctopus dofleini</i>)	X	X	X	X	X	X	X	
Rockfish (<i>Sebastes spp</i>), greenling (<i>Hexagrammos spp</i>), and/or Irish lord (<i>Hemilepidotus spp</i>)	X	X	X	X	X	X	X	
Halibut (<i>Hippoglossus stenolepis</i>)	X	X	X	X	X	X	X	
Pacific cod (<i>Gadus macrocephalus</i>)	X	X	X	X	X	X	X	
Seawater								X
Marine sediment	X							
Terrestrial Sampling								
Blue mussel (<i>Mytilus trossulus</i>)	X	X	X	X	X	X	X	
Rockweed (<i>Fucus distichus</i>)	X	X	X	X	X	X	X	
Star reindeer lichen (<i>Cladina stellaris</i>)	X							
Glaucous-winged gull (<i>Larus glaucescens</i>) eggs	X	X	X	X	X	X	X	
Dolly Varden (<i>Salvelinus malma</i>)	X	X	X	X	X	X	X	
Soil ^a	X							

^a Soil will be collected from beneath the lichen sample.

(from Cannikin Lake), glaucous-winged gull eggs, Star reindeer lichen, and soil samples from beneath the lichen. Three groundwater monitoring wells remaining on the island were logged with a down-hole camera and subsequently abandoned based on the results of that inspection.

Eight divers and six scientists worked aboard the R/V *Norseman* while the vessel was operating off the Bering and Pacific coasts of Amchitka and Adak Islands. The divers collected samples of dragon kelp, chiton, horse mussel, sea urchin, octopus, rock fish, kelp greenling, and Irish lord. Divers also collected samples of seawater and marine sediment. Seawater samples were also collected from the R/Vs *Ocean Pioneer* and *Norseman* off the Cannikin Site's coastline.

RESULTS

The samples were sent to three laboratories for analysis. With the exception of the seawater samples, most of the samples were sent to the Center for Accelerator Mass Spectrometry at the Lawrence Livermore National Laboratory. A smaller subset of rockweed samples, Star reindeer lichen samples, and soil samples collected from beneath the lichen were sent to UAF for cesium-137 analysis. Marine sediment samples were also collected and sent to UAF for testing. The seawater samples were sent to the University of Miami Tritium Laboratory for enriched tritium analysis.

Results from the seawater samples for tritium were received in September 2011. Results from the 2011 sampling are expected to be available on the LM website in 2012.

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