SURFACE REMEDIATION IN THE ALEUTIAN ISLANDS: A CASE STUDY OF AMCHITKA ISLAND, ALASKA

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INTRODUCTION

Amchitka Island, Alaska, was at one time an integral player in the nation's defense program. Located in the North Pacific Ocean in the Aleutian Island archipelago, the island was intermittently inhabited by several key government agencies, including the U.S. Army, the U.S. Atomic Energy Commission (predecessor agency to the U.S. Department of Energy), and the U.S. Navy.

Since 1993, the U.S. Department of Energy (DOE) has conducted extensive investigations on Amchitka to determine the nature and extent of contamination resulting from historic nuclear testing. The uninhabited island was the site of three high-yield nuclear tests from 1965 to 1971. These test locations are now part of the DOE's National Nuclear Security Administration Nevada Operations Office's Environmental Management Program.

In the summer of 2001, the DOE launched a large-scale remediation effort on Amchitka to perform agreed-upon corrective actions to the surface of the island. Due to the lack of resources available on Amchitka and logistical difficulties with conducting work at such a remote location, the DOE partnered with the Navy and U.S. Army Corps of Engineers (USACE) to share certain specified costs and resources. Attempting to negotiate the partnerships while organizing and implementing the surface remediation on Amchitka proved to be a challenging endeavor. The DOE was faced with unexpected changes in Navy and USACE scope of work, accelerations in schedules, and risks associated with construction costs at such a remote location. Unfavorable weather conditions also proved to be a constant factor, often slowing the progress of work.

The Amchitka Island remediation project experience has allowed the DOE to gain valuable insights into how to anticipate and mitigate potential problems associated with future remediation projects. These lessons learned will help the DOE in conducting future work more efficiently, and can also serve as a guide for other agencies performing similar work.

BACKGROUND

Geographic Setting

Amchitka Island, Alaska, is within the Rat Island group of the Aleutian Islands, which comprise the emergent part of a long submarine ridge connecting North America and Asia, and separating the Bering Sea from the North Pacific Ocean. Amchitka is 40 miles long and one to four miles wide with an area of about 116 square miles. It is located approximately 1,340 statute miles west-southwest of Anchorage, Alaska, and 2,500 miles west-northwest of Seattle, Washington. Altitudes on the island range from sea level to 1,160 feet. The topography is varied, consisting of mountains, a high plateau, lower plateaus, and an intertidal bench. Vegetation consists primarily of alpine-zone mosses and grasses (1). Figure 1 shows the location of Amchitka Island within the Aleutian Islands.

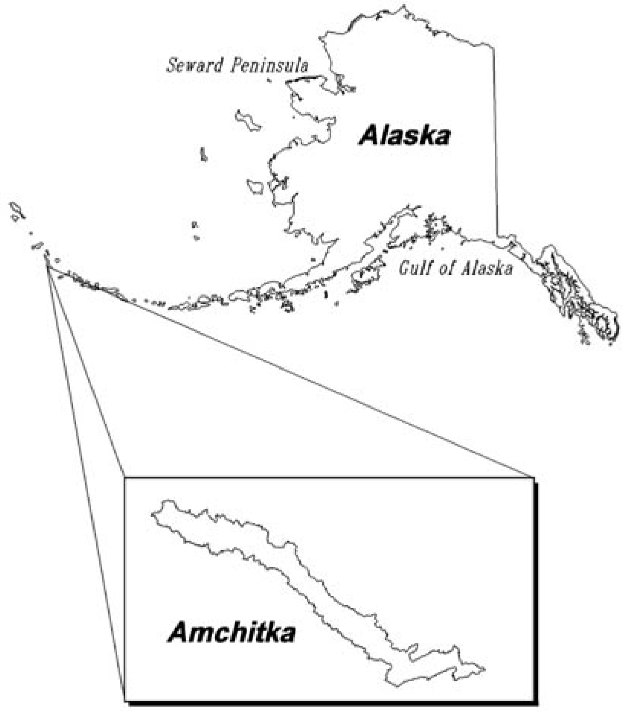

Fig. 1. Amchitka Island, Alaska location within the Aleutian Chain.

Amchitka Island has a pronounced maritime climate, including frequent storms, strong winds, and cloudy skies. Clear skies are extremely rare and fog is prevalent during the summer months. The ocean moderates the temperatures, which averages between 31 and 48 degrees Fahrenheit. Annual precipitation is about 33 inches, including approximately 71 inches of snow. The mean wind speed fluctuates between 22 miles per hour to 30 miles per hour (1).

History

The earliest human occupation of Amchitka dates back to at least 2,500 years ago with the subsistence-living Aleuts, but was first discovered by western man in the late 1700s. In 1913, by Executive Order of the President, the Aleutian Islands were dedicated as a wildlife preserve and eventually came under the management of the U.S. Fish and Wildlife Service (USFWS) as the Aleutian Islands National Wildlife Refuge.

Arctic foxes were introduced to Amchitka Island in the 1920s under a permit for fox farming. This practice was later found to have contributed to a decrease in bird life on the island and the endangerment of the Aleutian Canada Goose, one of the first species protected under the 1973 *Endangered Species Act* (2). Fox farming ceased around 1939 and an eradication process was implemented. The Aleutian Canada Goose was officially delisted by the USFWS one month before the base camp was mobilized, due to of the successful recovery of the species.

Beginning in 1943, the U.S. Army established an air base on the island for strikes against Japanese positions on the Islands of Attu and Kiska. The air base was active until 1950. During the occupation, facilities were constructed to house and support nearly 15,000 personnel. The Army's occupation left various surface environmental impacts, including roads, three airstrips, and a dock in Constantine Harbor.

Plans for using Amchitka Island as a site for nuclear testing began with the U.S. Department of Defense's (DoD) Project Windstorm in 1951. The DoD wanted information about the cratering potential of nuclear blasts and planned to detonate two 20-kiloton tests. The right geological conditions were not present on Amchitka and the project was later moved to the Nevada Test Site.

In 1964, the Atomic Energy Commission and DoD began looking at Amchitka for tests associated with the Vela Uniform Program, which was developed in late 1963. The goal of the Vela Uniform Program was to improve the nation's ability to detect, identify, and locate underground nuclear explosions, and to distinguish the associated seismic activity of a nuclear explosion from that of an earthquake. Long Shot, the first nuclear test on Amchitka Island, was detonated on Amchitka as part of this program. Long Shot was an 80-kiloton device and was detonated on October 29, 1965. The project was unique in two respects; it was the first underground test planned for a remote island area, and the first test managed by the DoD. Milrow was the second nuclear test conducted on Amchitka Island. Milrow, an approximate 1,000-kiloton device, was detonated on October 2, 1969. The purpose of the Milrow test was to study the feasibility of detonating a much larger device on the island at some point in the future. The final nuclear test performed on Amchitka Island was Cannikin. The Cannikin test was a less-than 5-megaton, weapons related test, and was detonated on November 6, 1971. Cannikin was the largest underground nuclear test conducted in United States history and was conducted as part of the development of the Spartan antiballistic missile system.

In addition to the three test sites, six other sites were considered for testing but were never used. These sites were designated A, D, E, F, G, and H (sites B and C became Milrow and Cannikin, respectively). Large-diameter emplacement holes were drilled at sites D and F and an exploratory hole was drilled at site E. Site H was graded in preparation for drilling activities, but no drilling took place. The other sites were not disturbed. Figure 2 shows the location of the test and drill sites on Amchitka Island.

Fig. 2. U.S. Department of Energy Test and Drill Sites on Amchitka Island.

In 1980, the Alaska National Interest Lands Conservation Act established the Alaska Maritime National Wildlife Refuge, designating land which included the 22,000 acres on Amchitka Island, as a National Wildlife Refuge Wilderness Area. In May 1986, a Memorandum of Agreement between the USFWS and the Navy established joint use of Amchitka Island. Thus, the Navy began the last major occupation of Amchitka by constructing and operating the Remote Over-the-Horizon Radar (ROTHR) facility from 1987 until 1992. In 1993, the system was suspended and the Navy demobilized from the site. In 1998, the Navy declared the ROTHR system outdated and declared that it would never be reactivated (3).

Each agency's occupation of Amchitka Island left an imprint on the environment. Under state and federal laws, each agency is responsible for remediation of its respective sites and in the late 1990s each had begun plans to perform corrective actions.

ENVIRONMENTAL ASSESSMENTS

During the 1960s and 1970s, both before and after the Atomic Energy Commission conducted the three nuclear tests, scientists carried out extensive investigations concerning the environment on Amchitka Island. These investigations were aimed at understanding the viability of the island's capacity and usefulness to support a testing program. Since the inception of the DOE's Environmental Management program in 1989, the DOE has performed additional studies on the island to assess environmental impacts attributed to past activities.

Initial Studies

In 1993, the DOE collected samples of soil, surface water, and near-surface groundwater from the three underground nuclear test sites to evaluate possible chemical impacts at the sites. The sampling program included analyses for Target Analyte List metals, volatile organic compounds, and semivolatile organic compounds.

In 1997, the DOE returned to Amchitka Island to analyze plants and sediments for the existence of radionuclides that may have leaked to the surface from the test cavities. The plants and sediments were collected from streams that drain the three nuclear test sites and from one stream not affected by site activities. In addition to radionuclide studies, approximately half of the stream sediment samples collected were analyzed for 32 types of metals and for total organic carbon. Scientists also collected and analyzed three samples of drilling mud from the Long Shot mud pits for 32 metals and diesel-range organics (DRO).

The DOE went back to Amchitka in 1998 to complete its site characterization and determine the possible environmental impacts caused by chemicals from past drilling activities and underground testing. Scientists performed chemical sampling which included sediment and water sampling from the 13 open drilling mud pits at the drill and test sites. Several potentially impacted lakes and eight streams that drain the sites were also sampled. Sediment and water samples were also collected from four streams not affected by site activities, to provide background data for comparison. Additionally, a TRIAD analysis, which incorporates sediment chemistry, sediment toxicity, and benthic macroinvertebrate community assessments, was performed in the eight streams. Fish were collected from each of the drainage streams and analyzed for bioaccumulation of contaminants in the food web (4).

Following these assessments, the DOE met with the State of Alaska, the USFWS, and the Aleutian/Pribilof Islands Association (A/PIA) to discuss the site characterization data. The parties agreed that remediation of the drill site mud pits would significantly reduce risks to the environment and the public. With this determination made, the DOE proceeded to develop remedial action alternatives that would later be presented for regulator and stakeholder approval.

Engineering Field Study

Additional information on the physical properties of the drilling mud pits was obtained in June 2000 to assist in developing remedial action alternatives for the sites. Until this time, no reliable drawings of the sites or geotechnical data for any drilling mud or soils on the island existed. Topographic surveys of each mud pit were completed to aid in the remedial design for each of the sites. Workers took geotechnical samples of the drilling mud and soils within on-site borrow areas as well as chemical samples of standing water within the mud pits to aid in the closure design. In addition, supplemental data was collected based on Alaska Department of Environmental Conservation (ADEC) and USFWS comments on the 1998 Drill Site Characterization Sampling Report. Scientists determined that the sole contaminants of concern within the drilling mud pits at the six DOE sites were the DRO. Samples taken from the shallow groundwater directly downgradient of each mud pit indicated that there was no DRO contamination above established state cleanup levels, and that no contaminant migration had occurred. However, the mud pits posed a potential physical hazard due to the possible instability of the surrounding berms and the viscosity of the drilling mud. If a berm should fail, drilling mud could enter nearby streams causing stress to the stream ecology.

Selected Remedial Action

To address the DRO contamination, the DOE considered remediation alternatives selected from a wide variety of established technologies based on the type of contaminant, the capability of the technology to achieve the desired results, and the logistical conditions associated with the remoteness of the island. Alternatives considered included no further action, institutional controls, geosynthetic capping, and clean closure (complete removal of all drilling mud).

The DOE selected the geosynthetic capping process for remediation on Amchitka Island. This method, which is in accordance with applicable state regulations, was determined to be cost effective, could be accomplished in one construction season, and had the least potential for damaging surrounding environmentally-sensitive areas.

Under this approach, the standing water on the drilling mud pits would be pumped off, and soil from an on-site borrow area would be brought in and mixed with the drilling mud to stabilize it and create a mixture capable of supporting a geosynthetic cap. Additional soil would then be placed on top of the mixture and graded to promote surface water runoff. A 30-mil liner would be placed on top of the soil and an additional layer of soil laid over the liner. This final layer would be graded and covered with a seed mat of native grasses to stabilize the soil (4).

Closure Design

The information that was gathered during the June 2000 engineering field study aided engineers in the design of the synthetic caps. A series of bench scale tests were conducted in the laboratory to determine the optimum mix ratio of soils to drilling mud which would provide adequate shear strength to support construction equipment, withstand seismic activity, and support the cap itself. Slope stability, frost penetration, and settlement calculations were performed for each mud pit. Surface water channels, check dams, and a sedimentation basin were designed in accordance with applicable Alaska regulations to minimize erosion and sedimentation deposition. A bench scale treatability study was conducted on a mixture of drilling mud and the standing water within the pits to determine the most effective method for treating the water to meet the State of Alaska’s discharge standards. It was determined that a combination of flocculation using both ionic and anionic polymers combined with filtration through sand filters and treatment by activated carbon would produce effluent below the state standards. Because of time constraints, the design was completed concurrently with procurement activities for the remediation activities, meaning that contractors would be bidding on a draft, unapproved design.

STRATEGIC PLANNING

Interagency Collaboration

The history of federal agency occupation and activities on Amchitka Island provided for the potential of interagency collaboration. At the time of the first interagency meeting in August 1999, the DOE, Navy, and USACE, were independently developing their own environmental closeout plans. The DOE’s Environmental Management baseline showed remediation work on Amchitka scheduled for 2002, and it had begun negotiations with the State of Alaska to determine the remediation activities necessary to meet state environmental regulations. At the same time, the DOE was working closely with the A/PIA, as the official representative of the twelve federally recognized native villages in the Aleutians, to meet their cultural expectations related to environmental restoration.

It became clear at this first interagency meeting that considerable cost savings could be achieved if the federal agencies agreed to perform their work in the summer of 2001 and share base camp expenses. Fiscal Year 2001 was identified as the target year because the Navy had secured strong assurance from its headquarters that funds would be available in that year's budget. Although the DOE had not completed the characterization of its sites, and no agreement was in place with the other agencies as to which sites they were responsible for, the DOE agreed to complete its remediation activities in 2001.

In order for the DOE to be ready to execute fieldwork in 2001, preparation activities would have to be accelerated. Of the full list of tasks to be completed by DOE, there were a number that were self-driven while others were externally controlled by the State's numerous regulatory bodies and the USFWS. Both the Navy and the USACE faced a similar dilemma. Adding to the challenge was the typical difficulty associated with getting federal agencies to work collaboratively when each has its own project priorities and budget development concerns. Similarly, it was with some difficulty that the agencies were able to agree on which one would be the designated responsible party for some sites/structures that had been used and reused by all three since the 1940s. It was obvious that to achieve success, all parties involved would have to collaborate often and work together in a very open and trusting manner in order to succeed and remain on schedule.

The key to successful coordination was monthly conference calls interspersed with face to face meetings, which became weekly conferences as the pace of preparation accelerated. Interagency coordination continued on the island with joint plan of the day meetings and safety briefings, shared resources, and regular discussions between project managers about project implementation.

Regulatory Requirements

In fall 2000 the DOE was conducting reviews to determine the scope of remediation activities and to identify the appropriate environmental controls that would be necessary to perform work on the island. The regulatory basis for DOE's Amchitka Island remediation project stems from Section 120(a)(4) of *Comprehensive Environmental Compensation and Liability Act* (CERCLA) which requires federal agencies to comply with state laws concerning removal and remedial actions at facilities not included on the National Priority List. The decision by the U.S. Environmental Protection Agency's Region X not to place Amchitka on the National Priority List was driven by two factors, the absence of radioactivity leaking to the surface from the test cavities and the lack of any permanent residents at this remote location. Therefore, the Oil and Hazardous Substances Pollution Control Regulations, enforced by the ADEC, became the driver for DOE's remedial actions.

A complete identification of support activities had to be compiled in order to determine the appropriate environmental controls that would be required to perform work on the refuge. The DOE determined the following activities:

- Loading/off loading of seagoing transport vessels carrying construction equipment, fuels, and base camp facilities, and supplies at the existing concrete dock
- Storage of fuels (e.g. diesel and gasoline) for vehicles and camp facilities
- Transport to, and dispensing of, fuels at various locations on the island
- Storage and use of hazardous materials
- Discharge and/or treatment of standing water on top of drilling mud
- Solid, special wastes (e.g. batteries, light bulbs, aerosol cans), and hazardous waste management
- Collecting anadromous fish for polychlorinated biphenyls analysis
- Surface disturbance related to removing borrow material for processing drilling mud prior to construction of the protective cap
- Surface disturbance related to construction of the protective cap on 12 mud pits
- Surface and/or stream disturbance associated with potential maintenance of roadways and culverts
- Revegatation of mud pit caps

- Plugging and abandonment of 16 shallow groundwater monitoring wells
- Removal of petroleum products from two underground storage tanks
- Closure in-place of two underground storage tanks
- Gray water management
- Black water management
- Extracting fresh water for drinking and food preparation from Constantine Spring

To perform these activities the DOE was required to prepare an assortment of plans and obtain a variety of permits. The DOE's list of the plans and permits can be found in Table I.

Table I. Plans and Permits Associated with Amchitka Island Remediation Activities

Title	Purpose	Agency
Spill Prevention, Control and Countermeasures Plan	Identifies the methods to be employed to control leaks that could occur at the two temporary fuel tank farms built to supply fuel for construction equipment, vehicles, generators, space and water heating systems, and food preparation.	State of Alaska
Clean Water Act, Section 404 Nationwide Permit #38	Addresses potential impacts to wetlands following the observation of emergent vegetation on the periphery of some mud pits.	U.S. Army Corps of Engineers
Alaska Fish Resource Permit	Required for taking fish for analysis for the presence of polychlorinated biphenyls.	State of Alaska
Special Use Permit	Allows access to the refuge and authorizes work on the island. Stipulations include the requirement of workers to attend briefings on Aleutian Canada Goose protection requirements and restrictions regarding collecting or disturbing historical or archaeological sites.	U.S. Fish and Wildlife Service
National Pollutant Discharge Elimination System Stormwater General Permit	Covers stormwater discharges from the remediation work areas and borrow sites. Required the development and implementation of a Stormwater Pollution Prevention Plan describing best management practices for control of erosion and sedimentation.	U.S. Environmental Protection Agency
Alaska Wastewater General Permit	Governs the conditions for releases of untreated and treated water from the mud pits to the ground surface.	State of Alaska
Alaska Coastal Management Program Consistency Determinations	Authorize work in coastal and tideland areas and place controls on certain inland activities	State of Alaska

FIELD WORK

In order to meet the accelerated schedule proposed by the U.S. Navy to be in the field during the 2001 construction season, it was necessary to streamline the design and procurement process. Base camp and barge transportation services had to be procured prior to the approval of the closure design and award of the construction contract. In addition, it was necessary for construction companies to bid on a draft design and technical specification package before it had been approved by the ADEC. Fortunately, the ADEC approved the design with no significant revisions.

Basecamp

As Amchitka is an uninhabited island, a fully operational base camp had to be setup to support remediation activities. The barge carrying the base camp supplies reached the island on April 10, 2001. Setup personnel were mobilized via aircraft and the base camp was operational on May 1, 2001. The Navy contractor was the first to mobilize to the island with DOE contractors arriving three weeks later. The base camp consisted of three modular dormitories each with a capacity of 50 personnel. Each dormitory was equipped with shower and wash facilities. Due to ADEC restrictions, all blackwater had to be transported off of the island. Therefore, the portable toilets were installed outside of each dormitory and cleaned weekly with the contents placed in tanks for transport and disposal in Anchorage. The source of potable water for the camp was Constantine Spring, located approximately one mile from the camp area. A small water treatment system was constructed to chlorinate and filter the spring water prior to use. Treated water was stored in 5,000-gallon bladders at the base camp. All gray water was containerized and transported to an ADEC permitted leachfield, which was constructed approximately three miles from the base camp. The camp was also equipped with a recreation trailer with satellite television, a Federal Aviation Administration certified weather station, a dining facility, contractor office trailers, and a full service clinic staffed with a Physician's Assistant and an Emergency Medical Technician III. Additional medical equipment included a medivac plane stationed on the island for personnel evacuation, and a 4-wheel drive ambulance.

Remediation Activities

The barge carrying the remediation equipment arrived on May 25, 2001. Once the barge was off-loaded, a fuel farm containing 39 6,000-gallon modular fuel tanks with a 30-mil geomembrane for secondary containment, was constructed. An abandoned building was transformed into the mechanic's shop and maintenance area. With these facilities in place, the DOE was ready to begin remediation activities.

To prepare the mud pits for capping, it was necessary to pump off and treat the standing water, which had accumulated from rainfall and snowmelt. ADEC regulations allowed for the direct discharge of water to the ground surface as long as no visible sheen was seen leaving the mud pit. A condition of the ADEC water treatment permit added the requirement of keeping the turbidity of the discharged water less than 5 Nephelometric Turbidity Units (NTUs). Since Drill Site D had the largest mud pits and the largest quantity of water to pump off (three-million gallons) it was determined that all water requiring treatment would be transported to Drill Site D and placed in one of the pits at that site for treatment. A crew was dedicated to pumping off all water directly to the ground surface until the turbidity reached five NTUs. Once that occurred, the water would be pumped into a 2,500-gallon tank truck and transported to Drill Site D for treatment.

A second crew set up and operated the mobile screening plant in the main borrow area and began processing soils for use as mud consolidation material and capping material. As mud pits were emptied of the standing water, workers hauled processed soils from the borrow areas in six wheeled articulated dump trucks and offroad end dumps. The soils were then mixed with the drilling muds using two trackhoes, one equipped with a large slash blade, and the other with a hydraulic mixing wheel. The soils and drilling mud were mixed until a homogeneous mixture capable of supporting low ground pressure tracked equipment was achieved. Once the material reached the desired consistency, density tests were conducted to record the wet density of the material to compare the field densities with those achieved in the laboratory during the bench scale testing. The mud mixture was graded with low ground pressure bulldozers to the design grades, and a 12-inch layer of processed soil (particle size < 1 inch diameter) was placed over the drilling mud and compacted with the tracked equipment. This soil layer served as the base for the geomembrane cap. Siemens Corp XR-5® was the geomembrane used because of its excellent resistance to DRO and its proven use in the extreme cold of Alaska's North Slope. The material was transported to the island in large panels that were accordion folded and palletized. Panel width varied from 50 to 75 feet with lengths up to 150 feet. These panels were placed by hand and seamed with a hot wedge welder. Destructive samples of the field seams were taken every 500 linear feet and tested on site for shear and peel. In addition to the destructive testing, 100 percent of the field seams were non-destructively tested using a vacuum box. All leaks in the seams were repaired and then retested.

As the geomembrane was deployed and seams tested, an additional 30 inches of processed soils were placed over the liner in successive lifts and compacted with the tracked equipment. Once the design grades were reached, 6 inches of topsoil was placed over the site and the area seeded with a native seed mix. In order to minimize erosion to the cap, the seed mix was within a mat consisting of coconut fiber, straw, and plastic mesh. All disturbed areas were fine graded and reseeded with the native seed mix.

The fieldwork was completed on September 10, 2001, with all equipment and cargo staged at the dock for demobilization. The demobilization of the remediation equipment occurred on October 7, 2001, and the base camp was demobilized on October 13, 2001.

The project successfully capped 12 mud pits, with approximately 8 acres of geomembrane placement. In the process, the DOE discharged 3.9-million gallons of untreated water and 1.7-million gallons of treated water to the surface, solidified over 35,000 cubic yards of drilling mud, placed over 60,000 cubic yards of cover soil, and revegetated 30 acres of disturbed land.

LESSONS LEARNED

As the Amchitka Island project unfolded, positive and negative events were noted. These now form the basis for a complete examination of the project and help to record lessons that were learned from the process. These lessons will be useful to the DOE as it continues to remediate sites, often under difficult or atypical circumstances, and to other agencies planning similar projects.

Lessons learned during the Amchitka project are categorized as follows: dealing with unexpected revisions in the schedules and scope of other government agencies, impacts arising from the push of an accelerated schedule, the effects of risk on construction contract costs, and the potential adverse effects of the weather.

Revisions to Agency Schedules and Scope

One of the difficulties in interagency coordination is the inability for all of the agencies involved to maintain the original schedule and scope of the individual projects. Each agency is working under different regulatory requirements, management, and budgetary restrictions. Two major challenges existed in the coordination between the DOE, Navy, and USACE on the Amchitka project: the effects of the Navy accelerating its mobilization date, and the USACE not receiving anticipated funding.

In an effort to capitalize on cost sharing activities, the DOE took the responsibility to set up and operate the base camp for all personnel on the island. After the scope of work was reviewed by all agencies, the DOE sent out the scope and schedule to three bidders. After all the bids were evaluated and the contract about to be awarded, the Navy notified the DOE of its plan to mobilize in early May as opposed to the previously agreed upon date of June 1, 2001. This one month acceleration in schedule caused DOE to issue an amendment to the base camp procurement, which resulted in a premium being paid to the base camp provider to expedite the camp mobilization and set up.

In order to obtain pricing for the food and lodging on the island, the DOE provided the base camp contractor with the anticipated number of personnel from each federal agency. This loading allowed the base camp contractor to provide a price per person per day. During the base camp mobilization process, the DOE was informed that the USACE had been unsuccessful in gaining work activity approvals from the USFWS and the State, and that it had failed to obtain the required funding for its proposed scope of work; therefore, it was forced to reduce its manpower and duration on the island. This reduction in personnel was great enough to justify an increase in the cost per person per day for all agencies. The base camp was now too large for the anticipated personnel and the fixed costs associated with the mobilization, setup, and demobilization of the camp infrastructure caused an elevation in the day rate. The DOE was notified too late in the mobilization process to reduce the size of the camp because it was already in transit to the island. All three agencies absorbed the rate increase resulting from the USACE reduction in scope.

Lessons Learned:

- Remain flexible and realistic regarding agency's scope and schedules, and strive to keep communication lines between partner agencies open. One of the primary reasons the DOE was successful in completing this project was its ability to remain flexible and remain on track despite changes in partner agency scopes and schedules.
- Establish an official agreement between all agencies outlining scope, schedules, and responsibilities. The DOE should have insisted on an agreement between each agency's headquarters, detailing the responsibilities each agency would take on, and providing contingencies if scope should change.
- Remain cautious in making commitments until agreements are in place. Had the DOE remained cautious in making commitments regarding the base camp, many complications could have been avoided. Instead, the DOE overextended itself in its effort to cope with the changing schedules and scope of the other agencies.

Impacts Due To Accelerated Schedule

Three major challenges arose from the decision to accelerate the project schedule. First, the effort to gather data to begin field design had to be completed earlier than expected and the design had to be quickly completed and approved by the state. Second, the DOE had to reorganize its budget to secure funding to complete the project. And third, all necessary permits had to be obtained in a short period of time. All had to be completed a year earlier than planned. This was an extremely aggressive schedule to maintain, especially for such a remote and logistically challenging site.

At the time of the decision to accelerate the project virtually no data had been collected on the mud pits. An engineering field study, originally scheduled for August 2000, was rescheduled for June 2000 in order to complete the design in time. While the DOE had initially planned to coordinate with the USFWS to transport personnel to the island, the accelerated schedule necessitated the chartering of a private service, at a substantial cost to the DOE.

The design began in August 2000, as soon as the topographic surveys and sample analyses were completed. The design was submitted in draft form to the regulatory agency on November 30, 2000, for review, and to contractors for bidding purposes on December 3, 2000. The goal was to have the design approved by the State of Alaska and the USFWS as soon as possible, and to enter the field nine months later in May 2001. Because the contractors were bidding on a draft design, if the state regulators had any technically substantial comments on the design it would have to be modified and amendments to the design/bid packages sent to all bidders. This of course would have severely hampered an already tight schedule. As it was, the regulator had minor comments, which did not change the design. "Approved for Construction" drawings and specifications were issued to the contractor in March 2001.

Because the information to begin the design was not obtained until late in 2000, it was impossible to perform a sound budget estimate that year. As the design was being finalized in November 2000, it became evident that several additional regulatory drivers would need to be adhered to that would effect the cost of the project. For example, during the design phase, the regulatory agency notified the DOE that a synthetic cap system was required in lieu of the previously estimated earthen one. Also, the regulatory agency required screening and possible treatment of standing water prior to discharge instead of pumping the standing water directly to the ground surface. The project cost was not re-estimated until the entire design was completed in early spring 2001, at which time it became evident that the original funding would not be sufficient to complete the project. The DOE had to reorganize funding priorities to meet costs for the project.

The DOE also had to issue Requests for Proposals (RFPs) to potential base camp providers before the design was complete and the remediation contract awarded, in order to secure a contract for the 2001 construction period. This required the DOE to estimate the number of personnel and the amount of equipment and cargo necessary to complete the project. While this alone would not necessarily impact the cost of the project, the unexpected reduction in the USACE personnel did, as the base camp provider would only accept a guaranteed minimum number of personnel from each agency. With the reduction in USACE personnel, the DOE's estimate of personnel was approximately 20 percent over the actual number that ended up being on the island.

Several permits were needed in order to occupy the island during the construction season. Specifically, black water, gray water, and potable water systems had to be approved and permitted by ADEC prior to operation. The DOE was required to submit as-built photographs of the systems to ADEC to verify that they were constructed as shown in the permit application. While this requirement could have been met with the original schedule, the Navy’s announcement that they would be mobilizing to the island in May of 2001 instead of the originally scheduled June, made it necessary to obtain permit approval immediately, which was impossible to do. Temporary approval was obtained within days of mobilization to operate the small potable water treatment system pending permit issuance; however, the ADEC approval process of the gray water leachfield was a lengthy one. The camp was up and operational for approximately three weeks prior to gaining approval to dispose of gray water in the leachfield. Water generated from the showers and kitchen was stored in tanks and bladders pending approval. With great pressure from the DOE, as holding capacities were reaching 100 percent, the ADEC issued the permit to begin use of the leachfield.

A wastewater treatment permit was also needed to pump and treat the standing water from the mud pits. During the engineering field study of June 2000, water samples were taken and a treatability study completed to determine the water treatment method. Again, due to the accelerated schedule, the wastewater treatment plan was submitted to ADEC, but the DOE was unable to obtain the permit prior to mobilization. When the permit was issued, a condition to the permit was added stating that water could not be discharged to the surface with a turbidity greater than five NTUs, a requirement that would meet Federal Drinking Water Standards. This requirement hampered the treatment process, because although the system was set up on the island, it was not set up to meet a five NTU discharge requirement. The system was equipped with sand filters, which was not the optimum filter system for the discharge limit. Synthetic bag filters would have been the optimum choice had the discharge requirement been known prior to mobilization. Because of the extremely high costs associated with transporting a bag filter system to the island, the sand filter system was utilized, but had to be operated at a lower discharge volume and additional steps added to pretreat the water prior to passing it through the system. Technically, this added requirement by ADEC could have been considered a “changed condition” by the water treatment contractor and additional costs could have been incurred, but due to efficiencies in the pumping system itself, no additional costs were associated with this discharge requirement.

During the engineering field study in June 2000, DOE anticipated excavating test pits in strategic locations throughout the island to locate potential soil borrow sources to use. However, the USFWS requested no intrusive activities be completed in areas not previously disturbed. This meant that only existing borrow areas could be utilized for material. During the course of the remediation, the source of suitable material for the Drill Site D remediation became exhausted and a new area had to be found. DOE worked closely with the USFWS to locate another area in the vicinity of Drill Site D that could be utilized for a soil borrow source. A USFWS site representative inspected the new area, reviewed DOE’s excavation plans and approved the use of the new area without any delay time for the earthwork contractor.

Lessons Learned:

- Closely review a project's critical path prior to making agreements that may alter project costs and schedule. Although the DOE had established a critical path for the project, additional attention to the amount of risk it was taking on by partnering with the Navy and USACE could have prevented some of the challenges that arose in project planning and implementation. The cost savings associated with sharing the base camp, although initially appealing, may not have justified accelerating the schedule due to the challenges and costs of accelerating other work to meet project requirements.
- Schedule sufficient time for initial site characterizations. A more aggressive field study, including more test trenches, would have aided the DOE in the design phase.
- Obtain all necessary permits and regulatory approvals prior to mobilization. It would have been impossible for the DOE to delay mobilization for the Amchitka project due to the tremendous cost and schedule constraints associated with a barge deployment of this magnitude, but on a more conventional project it may be advantageous and cost effective to delay the mobilization until all regulatory hurdles are completed.
- Have proper equipment on hand to meet necessary and potential needs. The selection of equipment and supplies for the Amchitka project was well planned and more than adequate for work that was planned. Because of this, the DOE avoided additional costs by not having to replace equipment or ship additional equipment to the island.

Anticipating Risk and Construction Costs

It is very difficult to accurately estimate the cost impact of risk associated with a particular project, especially one located on a remote, uninhabited island. Even so, during future life-cycle baseline planning, every attempt should be made to address potential risk and allocate some risk contingency funds to minimize associated impact. Risks and associated costs should be efficiently communicated from the DOE contractor to DOE management, in order to obtain appropriate contingencies to deal with the prospect of inflated costs and the potential impact to the project baseline schedule.

An underestimated risk impact on the Amchitka project caused budgeting difficulty for the DOE. Upon review of the contractor pricing proposals it was evident that the pricing was inflated due to the unusually high risk associated with the project. The state of the economy in Alaska had an impact on pricing as well. With construction booming in the state, contractors were not willing to assume a lot of the risk, which was reflected in the pricing. The high likelihood of weather delays, coupled with transportation costs to deliver cargo to the island in the event of equipment breakdown caused pricing to be higher than anticipated.

Lessons Learned:

- Complete and utilize a risk analysis at project startup to determine how much risk should be taken on, and the potential effect of these risks on cost. While the DOE was successful in allocating some of the risk associated with construction costs to its contractors, additional attention to the risk analysis could have improved the budget estimates.

Weather

The weather on the island had a detrimental effect on the project. During the month of July it rained 21 out of the 31 days with a dense fog. A 50-foot visibility range was often the norm rather than the exception. The transport of personnel, equipment, and supplies was dependent on visibility, and flights had to be scheduled or delayed according to the weather. Construction work was also weather dependent, with activities such as dewatering pits, stabilizing drilling mud, and earthmoving activities being slowed during periods of precipitation. The ability to work on various sites on the island assisted the DOE in keeping on schedule, as work could be moved to a different location if weather became adverse.

Lessons Learned:

- Remain as flexible as possible when arranging flight schedules. The DOE had to be cautious in committing to flight schedules of personnel, supplies, and equipment in order to keep flight costs down.
- Contingency plans should be in place in anticipation of weather delays. The DOE and its contractors were successful in anticipating potential delays of remediation work and had sufficient contingency plans in place to deal with setbacks caused by weather.
- Factor in sufficient crew replacements in order to keep moral positive and personnel productive. The DOE made efforts to provide for the recreational needs of personnel and rotate individuals off the island for rest and relaxation. To improve upon this, the effects of work in a remote environment and lack of sunlight on the well being of workers could have been addressed in the Site Specific Health and Safety Plan or at tailgate meetings.

SUMMARY

In the summer of 2001, a joint agency effort became a reality with the DOE and other government agencies partnering to conduct environmental restoration activities on Amchitka Island, Alaska. The DOE met a variety of challenges and obstacles in the process of completing the remediation efforts on Amchitka. These challenges and obstacles have provided valuable lessons to the DOE that will be useful in planning and implementing future remediation activities.

Several activities remain before the DOE or the State of Alaska can officially agree that the surface remediation of Amchitka has been completed. DOE activities planned for fiscal 2002 are designed to complete the surface site closure process and obtain a Record of Decision for closure from the State of Alaska.

LIST OF ACRONYMS

ADEC – Alaska Department of Environmental Conservation
A/PIA – Aleutian/Pribilof Islands Association
DoD – U.S. Department of Defense
DOE – U.S. Department of Energy
DRO – diesel-range organics
EPA – U.S. Environmental Protection Agency
NTU – Nephelometric Turbidity Units
USACE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service

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DOE/NV—791