QUALITY ASSURANCE APPLICATIONS FOR REMEDIATION OF PLUTONIUM CONTAMINATED SOIL

Kathleen S. Moroney
Johnston Atoll Plutonium Cleanup Project*
TMA/Eberline
Thermoanalytical, Inc.
5635 Jefferson N.E.
Albuquerque, NM 87109

ABSTRACT

This paper describes quality assurance applications for an environmental cleanup of coral soil matrix contaminated with low levels of transuranic elements, mainly plutonium and americium. The cleanup is being conducted by TMA/Eberline, as prime contractor to the Defense Nuclear Agency, on Johnston Atoll in the mid-Pacific. Radioactive material is sorted from uncontaminated coral using a unique system of segmented gates. Plant concentrates containing low levels of radioactive material will require eventual certification for disposal at an approved defense waste disposal site in accordance with established Waste Acceptance Criteria. Project QA requirements are specified in a QA Plan based on NQA-1. The QA plan is supported by approved standard operating procedures incorporating numerous QA elements.

INTRODUCTION

TMA/Eberline is conducting a radiologically contaminated coral cleanup project on Johnston Atoll (JA) as prime contractor to the Defense Nuclear Agency (DNA). This paper describes quality assurance applications for quality- and/or safety-affecting project activities.

JA is an unincorporated territory of the United States. It is located near the center of the North Pacific between the Hawaiian and Marshall Islands, approximately 1325 kilometers (825 miles) SSW of Honolulu. It is the only land area in 1.3 million square kilometers (approximately 800,000 square miles) of open ocean, and supports breeding of twelve species of seabirds. It was first protected as a Bird Refuge in 1926, and has been a military reservation since 1939. The lagoon supports diverse marine life, including green sea turtles, an endangered species. The atoll is now designated as the JA National Wildlife Refuge, one of a small group of remote protected habitats in the Pacific Ocean.

JA is comprised of four small islands, two of which are entirely human-made. The largest, Johnston Island (JI), is approximately 2.4 kilometers (1.5 miles) long and 0.8 kilometer (0.5 mile) wide, covering about 2 square kilometers. JI includes the main original land mass in the atoll, and has been extensively augmented by coral dredge-and-fill from the lagoon. The atoll was not historically inhabited until 1936, when the Navy began extensive reef blasting, dredging, landfilling, grading, and construction on the islands.(1) Current atoll population is approximately 1300 persons, including both military and civilian personnel.

In the late 1950's and 1960's, a series of high altitude atmospheric nuclear tests brought new activity and attention to JA. In 1962, a nuclear device-carrying Thor missile was intentionally destroyed on the launch pad during an aborted launch attempt. Radiological contamination was dispersed over the land area, and was especially concentrated in the area of the missile launch emplacement. Two additional aborts at high altitude occurred, but the main source of contamination was the launch pad accident. Radiological evaluations were subsequently performed and contaminated coral soil was relocated to a single controlled area. However, a significant portion of island land remained under radiological control.

In 1975, a scientific panel recommended comprehensive radiological remediation of the site. Identification and removal of radioactive material were begun on a small scale using manual methods, but large scale remediation was deferred. The JA Radiological Control Area (RCA) currently encloses 27 acres, and, for planning purposes, has been estimated to contain approximately 76,000 cubic meters (100,000 cubic yards) of coral soil matrix contaminated with low levels of transuranic elements, chiefly Plutonium-239 (Pu) and Americium-241 (Am).

PROJECT OBJECTIVE

The primary objective of the DNA's JA Soil Cleanup Project is to decontaminate the coral soil inside the RCA, and release it for unrestricted use.

Lagoon dredging operations have been curtailed in the JA National Wildlife Refuge due to environmental concerns. The atoll's coral reef is a fragile habitat, and is easily smothered by silty fines generated during dredging. Consequently, all material for construction or landfill must be conveyed to JA using expensive barge transportation. After decontamination, the soil from inside the RCA will become a valuable on-island resource. In addition, the land area of the RCA will become available for use to support future defense or environmentally related missions.

TMA/Eberline has extensively modified a former cleanup demonstration plant to facilitate the decontamination of approximately 76,000 cubic meters (100,000 cubic yards) of low level transuranic-contaminated coral soil remaining inside the RCA. The modified soil cleanup plant utilizes some existing items of conventional material-handling equipment found in "sand and gravel" operations. For example, a

* Operated by TMA/Eberline, ThermoAnalytical, Inc., for the Defense Nuclear Agency under contract No. DNA001-90-C-0119.

hammermill pulverizes larger pieces of coral, and motor-driven conveyor belts move soil through the plant. Radiation detectors are linked with microprocessors and computer software newly developed for the project. The new microprocessors and software identify radioactive material as it passes under detector arrays, track it through the system, and generate and archive data files.

Radioactive material is diverted from the flow of feed material through the plant using a new mechanical soil sorting system based on a unique segmented gate methodology. Principal mechanical areas of the modified soil cleanup plant include the soil preparation area, the detection and segmented gate soil sorting systems, a soil washing mechanism to remove distributed contamination in fractionated fines, and the control station. Clean material is stored in a segregated area inside the RCA pending release for use elsewhere on-island. Concentrated Pu- and Am-containing material that has been diverted by the plant is expected to be packaged and shipped to an approved defense waste disposal facility for disposal as low level waste (LLW).

PROJECT QUALITY ASSURANCE REQUIREMENTS

The cleanup process must provide assurance that soil released from the soil cleanup plant as "clean" complies with established DNA cleanup guidelines based on EPA standards (2). Soil designated as radioactive waste must be properly characterized and certifiable for expected transport and disposal in accordance with established disposal site Waste Acceptance Criteria (WAC). The Department of Energy's (DOE's) WAC for the Nevada Test Site (NTS), NVO-325 (3), was selected as an example requirements document.

Since all approved defense waste disposal sites are under the regulatory authority of DOE, work must be consistent with applicable DOE Orders, including DOE 5820.2A, Radioactive Waste Management (4), as required by NVO-325 and other defense waste WACs; and DOE 5700.6B, Quality Assurance (5), as invoked by DOE 5820.2A. Department of Transportation (DOT) regulations will apply to the packaging and shipping of radioactive material. Department of Defense (DoD) Instructions apply to activities conducted by the contractor at JA under the direction of DNA.

QUALITY ASSURANCE APPLICATIONS

Quality Assurance (QA) is the planned system for assuring the reliability and acceptability of project items, services, activities, measurements, and products. The level and degree of project QA controls to be applied is governed by three primary considerations:

1. The criteria that must be satisfied so that LLW from the Soil Cleanup Plant can meet requirements for acceptance for disposal at an approved defense waste disposal facility;
2. The need to assure that "clean" soil meets the DNA-adopted criteria for release for unrestricted use based on EPA's guidance document; and,
3. DoD and DOE requirements to promulgate a site-specific QA Plan that describes and documents project QA controls for quality- and safety-affecting activities.

The Project QA Plan (QAP) was developed for DNA by TMA/Eberline, for application to quality- and/or safety-affecting activities to be conducted by both contractor and DNA staff. It consolidates applicable QA requirements and establishes the basis for a high degree of quality during performance of project activities. The QAP's structure and contents follow the format of ANSI/ASME NQA-1-1989 *(6), as specified* in DOE 5700.6B, and is based on those requirements. It also incorporates local DNA Instructions, on- and offsite operational requirements, and good radiological and industrial practices.

Stringent QA requirements are specified by DOE WACs for approved defense waste disposal facilities, with NVO-325 used as the primary example WAC. Therefore, the QAP contains the specific elements of NUREG 1293 (7), equivalent to the eighteen elements of NQA-1, applicable to a project Waste Certification Program Plan as required by NVO-325 and other WACs. Activities required to achieve an acceptable level of quality in on-site and laboratory waste assay and "clean" soil verification analyses (including Chain of Custody sample control) are specified in the QAP, and include essential elements from EPA-SW-846 (8), also required by NVO-325 and other WACs.

ELEMENTS OF QUALITY IN STANDARD OPERATING PROCEDURES

The primary means of quality achievement for the Project is the successful implementation of effective standard operating procedures (SOPs). An SOP is a written document that details and prescribes methods for performing defined routine or repetitive tasks. SOPs are commonly accepted in the nuclear industry and scientific community as an essential part of an effective QA program. They prescribe the way that tasks will be performed, and serve as formal documentation of the method used. Virtually all Federal agencies with regulatory authority for environmental or related programs mandate the comprehensive use of SOPs to accomplish tasks.(9) Although regulatory agencies do not specify organizational format for SOPs, procedures must be comprehensive and contain sufficient QA elements to assure that work is performed to acceptable standards of quality.

Guidance from sources that address QA elements for SOPs has been included in Project procedures. For example, the Environmental Protection Agency's Environmental Monitoring Systems Laboratory QA Plan lists procedural functions for which SOPs should be written, with "possible associated elements," and "documentation requirements."(10) T.L. Rucker's presentation at the annual meeting of the Health Physics Society in Albuquerque, New Mexico (June, 1989) discussed quality factors that could affect environmental monitoring for radioactivity.(11) In addition, a previous series of QA presentations by the author, including a paper presented at the annual meeting of the American Nuclear Society in Orlando, Florida (June, 1991) discusses QA elements in environmental radiation procedures.(12) A summary of information from these sources is shown in Tables I and II.

Table I lists procedural paragraph headings, and associated procedural elements to include under each heading. Paragraph headings can be selected according to the level of detail or documentation required. Table II links procedural functions with corresponding QA elements that may be considered for inclusion in SOPs, as applicable.

TABLE I

Standard Operating Procedure Format

Procedural Paragraph Heading	Asociated Elements
1.0 Purpose	Reason for SOP.
2.0 Applicability	Discussion of when SOP will be used and its scope.
3.0 Definitions	Explanation of technical terms.
4.0 References	List of pertinent requirements,directives, or standards.
5.0 Discussion	Summary of the method, analysis, procedure, or principle; including analytical limitations or interferences.
6.0 Responsibility	Delegation of assignments or specific duties of all personnel assigned to task, including note of any special training,
7.0 Equipment	Calibration requirements and procedures. List of materials, forms, scientific apparatus, tools, model numbers, chemicals and reagents. Specially noted safety equipment.
8.0 Procedure	Step-by-step "walkthrough" of the task that clearly differentiates between required and recommended actions, and corresponding documentation. QA and quality control steps, system checks, critical points, signoffs, notification requirements. Highlighted Safety Warnings
9.0 Records and Reports	Description of subject and format of record, distribution, storage location, how long to retain, who will have authorized access.
(Rucker, 1989 and Moroney, 1989)	

Not all of the procedural paragraph headings of Table I are necessarily used for all project SOPs. Some topics may be combined under one paragraph heading to clarify connected concepts or requirements for greater ease of use of the procedure in performing a task. However, an attempt has been made to include all applicable QA elements in corresponding procedural functions. Commitment to quality on the project is based on the concept that satisfactory achievement of project goals depends on successful selection and application of effective QA methods to project tasks.

SUMMARY

JA is a remote Pacific atoll, designated as a National Wildlife Refuge, and administered by DNA. Technical and contractual management authority for a project to decontaminate approximately 76,000 cubic meters of coral soil contaminated with low levels of Pu and Am extends directly from DNA to TMA/Eberline, the on-site contractor. After decontamination using a unique segmented gate methodology, clean soil will be released for unrestricted use elsewhere on-island. Waste concentrate, containing low levels of Pu and Am, will be packaged for shipment to an approved defense waste disposal site. Project QA requirements stem from multiple sources. The most stringent QA requirements are specified or incorporated by the WACs for approved defense waste disposal sites. The NTS WAC is used as an example document.

Project QA requirements are specified in a QAP based on the eighteen elements of NQA-1. Approved written procedures prescribe and document the methods used to accomplish project tasks that are quality- and/or safety-affecting. SOPs incorporate numerous QA elements to ensure that project activities, measurements, services, and products achieve planned reliability and acceptability. Project commitment to quality is based on the concept that satisfactory achievement of project goals depends on successful selection and application of effective QA methods.

BIBLIOGRAPHY

AMERSON, A.B., and Shelton, P.C., The Natural History of Johnston Atoll - Central Pacific Ocean, Smithsonian Institution Atoll Research Bulletin No. 192, December, 1976

TABLE II

Procedural Functions with Quality Assurance Elements

Procedural Function	Quality Assurance Elements
Purpose	Documentation to be produced; measurements, tests, and evaluations to be performed.
Applicability/Scope	Analysis or maintenance of physical system to be performed.
Definitions	List of technical and QA terms.
References	QA standards, operator's manuals, required standards or criteria
Discussion	Sensitivity, range, detection limits, safety precautions, bias, precision, accuracy, interferences.
Responsibility	Corrective actions, notifications, training, certifications, oversight functions.
Equipment	Controlled laboratory notebooks, apparatus, model numbers, manuals, reference tables, and maintenance specifications; QA controlled reagents or other items, including storage and handling requirements.
Procedure	Blanks, control and spiked samples, methods, checkpoints, signoffs, approvals, QA documentation, notifications, and calibration methods; sample storage, collection, marking, labeling and handling; data reduction, verification, and validation; corrective action, safety precautions, method, caveats, preparation, schedules, formulae and calculations. Safety Precautions and Emergency Response
Records and Reports	Forms, notebooks, dates, approvals, storage, maintenance.
(EMSL-LV, 1987 and Moroney, 1989)	

Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment, EPA 520/4-77-016, U.S. Environmental Protection Agency, Revised 1988.

Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements, NVO-325, U.S. Department of Energy, October, 1988.

DOE Order 5820.2A, Radioactive Waste Management, U.S. Department of Energy, September, 1988.

DOE Order 5700.6B, Quality Assurance, U.S.Department of Energy, September, 1986.

ANSI/ASME NQA-1-1989, Quality Assurance Program for Nuclear Facilities, American Society of Mechanical Engineers, 1989.

Quality Assurance Guidance for Low Level Radioactive Waste Disposal Facilities, NUREG-1293, U.S. Nuclear Regulatory Commission.

Test Methods for Evaluating Solid Waste, EPA-SW-846, U.S. Environmental Protection Agency.

MORONEY, KATHLEEN S., "Assuring Quality Measurements of Environmental Radioactivity," paper presented at the Canadian Radiation Protection Association Conference, St. John, New Brunswick, June 1990.

Environmental Monitoring Systems Laboratory (EMSL-LV) Quality Assurance Program Plan, EPA/600/x-87/241, U.S. Environmental Protection Agency, 1987.

RUCKER, THOMAS L., "Quality in Analytical Procedures for Radiological Environmental Monitoring," paper presented at the Annual Meeting of the Health Physics Society, Albuquerque, New Mexico, 1989.

MORONEY, KATHLEEN S., "Quality Assurance Elements in Environmental Restoration Procedures at Mixed Waste Sites," Transactions of the American Nuclear Society, Volume 63, June, 1991.