*DRAFT*

# WORK PLAN
## FOR
# TIME CRITICAL REMOVAL ACTION
## FORMER NAVAL STATION PUGET SOUND
## SEATTLE, WASHINGTON

CONTRACT NUMBER **N62470-08-D-1007**

**Prepared for:**
**U.S. Department of the Navy**
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315

**Prepared by:**
**Shaw Environmental and Infrastructure, Inc.**
12100 NE 195th Street
Bothell, Washington 98296

TASK ORDER FNZ4
SHAW PROJECT NO. 137165

JANUARY 2010

# Work Plan for

## Time Critical Removal Action
## Former Naval Station Puget Sound
## Seattle, Washington

# Signature Page

| | |
|---|---|
| Jim Langsted<br>Project Technical Manager | Date: |
| Chris Generous, L.G.<br>Project Manager | : Date |
| James A. Dunn, Jr., P.E<br>Program Manager | Date: |

# TABLE OF CONTENTS

## LIST OF FIGURES



## LIST OF TABLES



## LIST OF APPENDICES

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACM | asbestos-containing materials |
| ACP | Asbestos Competent Person |
| AEC | Atomic Energy Commission |
| AHERA | Asbestos Hazard Emergency Response Act |
| AM | Action Memorandum |
| APP | Accident Prevention Plan |
| Argus | Argus Pacific, Inc. |
| BRAC | Base Realignment and Closure |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CFR | Code of Federal Regulations |
| City | City of Seattle |
| TO | Task Order |
| $cm^2$ | square centimeters |
| decon | decontamination chamber |
| DoD | Department of Defense |
| DOH | Department of Health |
| dpm | disintegrations per minute |
| EBS | Environmental Baseline Survey |
| Ecology | Washington State Department of Ecology |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EM | Engineer Manual |
| EPA | Environmental Protection Agency |
| EPP | Environmental Protection Plan |
| f/cc | fibers per cubic centimeter of air |
| ft | feet |
| $ft^2$ | square feet |
| FSS | final status survey |
| H&S | health and safety |
| $H_o$ | null hypothesis |
| $H_a$ | alternative hypothesis |
| IR | Installation Restoration |
| LBP | lead-based paint |
| L&I | Washington State Department of Labor and Industries |
| m | meter |
| $m^2$ | square meters |
| mg | milligrams |
| MARSSIM | Multi-Agency Radiation Site Survey and Site Investigation Manual |
| NAS | Naval Air Station |
| NAVFAC NW | Naval Facilities Engineering Command Northwest |

| | |
|---|---|
| NAVSEA | Naval Sea Systems Command |
| NAVSTA PS | Naval Station Puget Sound |
| Navy | United States Department of the Navy |
| NCP | National Oil and Hazardous Substance Contingency Plan |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NOAA | National Oceanic and Atmospheric Administration |
| NORM | naturally occurring radioactive material |
| NRC | Nuclear Regulatory Commission |
| NTR | Navy Technical Representative |
| OSHA | Occupational Safety and Health Administration |
| pCi/g | picocuries per gram |
| PEL | permissible exposure limit |
| PM | Project Manager |
| PPE | personal protective equipment |
| PQOs | project quality objectives |
| PSCAA | Puget Sound Clean Air Authority |
| QA | quality assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| $^{226}Ra$ | Radium-226 |
| RCA | radiologically controlled area |
| ROC | Radionuclide of Concern |
| RCT | Radiological Control Technician |
| RPM | Remedial Project Manager |
| RPP | Radiation Protection Plan |
| RSO | Radiation Safety Officer |
| SAP | Sampling and Analysis Plan |
| Shaw | Shaw Environmental and Infrastructure, Inc. |
| SOPs | standard operating procedures |
| SOW | scope of work |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| SU | survey unit |
| TCRA | time critical removal action |
| TWA | time-weighted average |
| U.S. | United States |
| VAT | vinyl asbestos floor tile |
| WAC | Washington Administrative Code |
| WMP | Waste Management Plan |

# *Executive Summary*

This Work Plan has been prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) to support Radiological Surveys and Time Critical Removal Action (TCRA) at the Former Naval Station Puget Sound (NAVSTA PS). Shaw has been retained by the United States Department of the Navy (Navy) to conduct radiological surveys and removal actions in order to achieve unrestricted release of all potentially radiological impacted areas within the Former NAVSTA PS, in Seattle, Washington. A location map for Former NAVSTA PS identifying the approximate boundaries of the facility is shown in Figure 1.

During review of historical drawings as part of recent proposed renovations of Building 27, the City of Seattle (City) identified areas where radioactive materials may have been used or stored. The City conducted a radiation screening survey that identified areas in Building 27 where radiation dose appears to exceed background. The City also conducted screening surveys in near-by Building 2 and a pump house connected to the storm/sewer line system. The results of the screening level survey of Building 2 and the pump house were inconclusive. The City contacted the Navy regarding the potential need for action to address radiological contamination on the site. The radionuclide of concern (ROC) is radium-226 ($^{226}Ra$) based on historic use in Navy aircraft. The locations of Buildings 27 and 2 and the approximate areas of interest within the buildings are shown on Figure 2.

Activities that are currently proposed in support of this project include performing radiological screening and characterization surveys of impacted building materials including flooring, walls, ceiling, roofing materials, sewer and storm pipes, manholes, catch basins, and pump houses associated with former instrument rooms identified in Buildings 2 and 27. It is anticipated that floor tile and carpet will be removed within the former instrument shops of both buildings and it is assumed that asbestos-containing materials (ACM) and lead-based paints (LBP) will be present in these materials. It is also anticipated that the subflooring in the former Radium Room and the piping located in the room beneath the floor of the Radium Room will also require removal.

If upon completion of the work described above, it is determined that further surveying and/or removal action is required, an Engineering Evaluation/Cost Analysis (EE/CA) and Action Memorandum (AM) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) will be prepared to support a TCRA.

Final Status Survey (FSS) in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) will be performed at the conclusion of removal activities to document removal of radiological materials above established criteria.

# 1.0 INTRODUCTION

This Work Plan has been prepared to conduct radiological surveys and limited TCRA within identified areas of former NAVSTA PS in Seattle, Washington. Shaw has prepared this Work Plan under the United States (U.S.) Navy Contract Number N62470-08-D-1007, Task Order (TO) FNZ4. A location map for former NAVSTA PS identifying the approximate boundaries of the Site is shown as Figure 1.

## 1.1 NAVY OPERATIONAL HISTORY

Former NAVSTA PS is located approximately 6 miles northeast of downtown Seattle on the western shore of Lake Washington. Former NAVSTA PS was initially named Naval Air Station (NAS) Seattle at Sand Point. The facility was built in 1925 on land donated by King County and served as a Naval Air Reserve Training facility until December 7, 1941.

During World War 2, NAS Seattle supported air transport and ship outfitting personnel for the Alaskan and Western Pacific theaters of operation. Transport squadron personnel operated cargo flights to Alaska and the Aleutian Islands, supplying air stations such as Sitka, Kodiak, Dutch Harbor, Adak, and Attu. Outfitting personnel handled the preparation of escort carriers and seaplane tenders built in Tacoma and Vancouver, Washington prior to departure. In 1945, the peak of its activity, the facility supported more than 4,600 Navy/Marine Corps and civilian personnel. After the war, the facility was designated a Naval Reserve Air Station. From 1945 to 1970, the station maintained Naval Reserve squadrons for supplementing active duty forces, both continental U.S. and abroad. Aviation activities officially ceased on June 30, 1970, and NAS Seattle was decommissioned.

On July 1, 1970, NAS Seattle was redesignated Naval Support Activity, Seattle. Three years after the Navy stopped its air activities, the facility was divided into three parts. National Oceanic and Atmospheric Administration (NOAA) received 100 acres, including one third of the runways and 3,500 feet of waterfront. The City received the southeast portion including approximately one mile of waterfront that later became Magnuson Park in 1977. The Navy retained the rest. From 1970 until April 1982, the base provided logistic services such as supply, billeting, and administration to the 13th Naval District, Department of Defense (DoD) and other federal agencies. In April 1982, Naval Support Activity, Seattle was designated Naval Station, Seattle. In October 1986, it was designated NAVSTA PS as a result of the station's increasing support role in the Pacific fleet activities.

In June 1991, the Base Realignment and Closure (BRAC) Commission of the DoD announced the closure of former NAVSTA PS. In accordance with recommendations of the 1991 BRAC Commission, the Navy closed former NAVSTA PS in September 1995. A disestablishment ceremony was held on September 28, 1995, to commemorate the closing of the base.

Subsequent to closure, the Navy conducted environmental investigations and cleanup of portions of the facility. The condition of the property was described in the Environmental Baseline

Survey (EBS) report. The EBS describes the significant operations and existing conditions at specific buildings and areas at former NAVSTA PS that were addressed in past environmental investigations. The EBS identified areas with potential environmental concern where storage or release of hazardous substances had occurred. This document was used by the Navy to generate the Finding of Suitability to Transfer for the property. After completion of these actions as well as the appropriate National Environmental Policy Act actions, the Navy initiated transfer of the former NAVSTA PS property to several government agencies in accordance with the BRAC closure plan.

The Navy transferred portions of the facility to the City for recreational development. Due to a long history of use of the facility by the Navy, and because of the potential that the environmental investigations conducted did not identify all environmental hazards that pose a threat to human health and the environment, the transfer deed between the Navy and the City included an environmental covenant that allowed the City to seek action by the Navy to address contamination that was not identified in the EBS.

## 1.2 Radiological History

The EBS identified Buildings 2 and 27 as "Areas where only storage of hazardous substances or petroleum products has occurred (but no release, disposal, or migration from adjacent areas has occurred)." The transfer deed additionally included land use restrictions for Building 2 to address residual chemical contamination on the site. The EBS, however, did describe the potential for radiological contamination.

During planning of recent proposed renovations of Building 27, the City reviewed historical drawings and identified areas where radioactive materials may have been used or stored. Buildings 2 and 27 are both former aircraft hangers. Airplane maintenance and storage activities may have involved the use of self-luminescent radium paint for the maintenance and repair of aircraft instruments and parts. Based on known historical use the expected ROC is $^{226}Ra$.

Recent screening level radiation surveys were performed in April and May 2009 by Argus Pacific, Inc. (Argus) under contract with Seattle Parks and Recreation. The surveys were conducted within Building 27 and three pump houses (Pump House A, B, and 116) near Building 27 and in Building 2. The location of Building 2, Building 27, and each of the three pump houses is shown on Figure 2.

The Argus screening surveys identified two areas in Building 27 with radiation readings above background. No readings in Building 2 or the three pump houses were considered by Argus to be above background levels. The two locations were associated with a former sink drain pipe located in the former Radium Room on the second floor of Building 27. The pipe extends beneath the floor of the former Radium Room to the first floor of Building 27. The location of the Radium Room and the pipe running to the room beneath it is shown on Figure 3.

Based on the findings of the Argus screening surveys, the Navy requested that radiological surveys be conducted in the former instrument room (includes the former radium room) on the second floor and beneath the instrument room on the first floor in Building 27. The Navy has also requested that Shaw conduct radiation surveys in two former instrument rooms on the second floor of Building 2 and in three pump houses on the site. The work in Building 2 and at the two pump houses will be conducted even though the Argus screening survey results showed no radiological readings above background levels in those areas. The location of the instrument room within Building 2 is shown on Figure 4.

Due to the potential for the radiological contamination to flow along sewer and potentially storm lines, the Navy has also requested that radiological surveys are conducted along the gravity flow sewer line and pump house, the storm drain systems adjacent to Building 27, and the pump house associated with an inactive pressurized sewer line.

## 1.3 BUILDINGS AND STRUCTURES

### *1.3.1 Building 27*

Building 27 was originally constructed as a hangar for the Navy. Currently, Building 27 is vacant. At the south end of the building are two interior stories of storage, offices, and restrooms. The second floor is accessible by staircases. Site drawings dated 1943 indicate that an instrument shop on the second floor, including a Radium Room, may have been used for handling low-level radioactive materials. Drawings dated 1985 indicate that the building was subsequently renovated during which the Radium Room was reconfigured and renamed the S-1 Work Space. Figure 3 presents both the 1943 and 1985 room configurations. The first and second floors of Building 27 are currently unoccupied.

The S-1 Work Space (formerly the Radium Room) now contains a wall of mailboxes on the south wall. On the north wall, a sink has been removed, but the open drainpipe and capped water supply pipes are in place. A ventilation duct located in the ceiling has also been removed, but the approximately 2-foot-by-2-foot penetration is open to the ceiling space above (Figure 5). The floor is covered with 9-inch square floor tiles that, along with the mastic, are typically ACM.

The center portion of the building comprises the former hangar space. It has a concrete floor and steel framing. The center portion is currently not in use other than for isolated and random storage.

### *1.3.2 Building 2*

Building 2, located west of the NOAA facilities, formerly housed the Marine Corps Reserve motorpool and offices. The building, constructed in 1938, was an active air hangar until the NAS was decommissioned in 1970. Airplane maintenance and storage activities at Building 2 (also called Hangar 2) may have involved the use of self-luminescent radium paint for the maintenance and repair of aircraft instruments and parts.

The center part of Building 2 comprises the former hangar space. It has a concrete floor and steel framing and is currently used as a recreation facility. The northern portion of the building is utilized for storage, offices, and restrooms. There are unoccupied areas on the second floor of the building including two former Instrument Rooms. The second floor is accessible by staircases. As shown in Figure 4, one is shown on a 1939 drawing and one is shown on a 1941 drawing. There is also an area of interest located in the southeast corner of Building 2 (Figure 4). This area is a small room that currently contains a two-basin sink and a floor drain located in the center of the tile floor.

### ***1.3.3*** *Piping and Pump Houses*

Pump House 116 handles wastewater from Building 27. Historically, Pump House 116 discharged treated sanitary wastewater into Lake Washington. Pump House 116 is located on the shoreline nearest to Building 13 and the North Shore Recreation Area. It is a one-story building with a single sub-grade room that contains wastewater pumping systems and machinery. The machinery is accessible by a staircase from the ground-level landing. Currently, Pump House 116 pumps wastewater from the gravity flow sewer lines that run along the south and west sides of Building 27 to the city sewer system (Figure 5).

An inactive pressurized sewer line (Figure 5) runs from Pump House 117 located east of Building 27 across the south end of Building 27 and then northwest to Pump House 98 (inactive pump house at old sewage treatment plant).

The existing storm water system runs along the west side and under Building 27 and discharges into Lake Washington. A manhole (#136) located in the hangar area of Building 27 provided a potential point of contamination. The storm drain line runs from this point toward a manhole (#160) located in the current marina area. Three surface water catch basins are located along the west sides of Building 27. These provide additional points of potential contamination.

## **1.4** SCOPE OF WORK

The Navy scope of work (SOW) dated September 3, 2009 was provided for the development and implementation of a TCRA to survey, access, remove, and verify the removal of radiological materials at former NAVSTA PS. Based on this SOW the following tasks will be performed and are described in detail in subsequent sections of this Work Plan. The current schedule to complete these tasks is provided as Appendix F.

Impacted areas include: Radium Room, Instrument Shop, the room below the Radium Room and the roof areas surrounding instrument shop exhaust vents in Building 27; two Instrument Shops in Building 2; Pump Houses 116, 98, and 117; and storm drain and sewer lines.

*Table 1.4 Planned Sequential Work Activities*

| | |
|---|---|
| Scoping Survey | • Perform radiological scoping survey of impacted areas in Building 27 (Figure 6), Building 2 (Figure 7), associated roof vents, and Pump Houses. |
| Remove Exposed Sewer Piping | • Remove and containerize exposed piping located below the former Radium Room in Building 27 (associated with sink previously located in the former Radium Room). |
| Utility Locate/Dye Tracer | • To identify whether the removed section of pipe was connected to the gravity flow sewer line or the abandoned pressurized sewer line, a utility locate, dye tracer, or another appropriate method will be conducted. |
| Background Determination | • Conduct background radiological survey and sludge sampling to provide baseline data. |
| Sewer and Storm Line Sludge Sampling | • Collect sludge samples at gravity feed sewer manholes, storm line manholes and catch basins, valve pit, and pump houses 98 and 116. |
| Fire Training Maze Removal | • Remove fire training area from second floor of Building 27. |
| Clean Area | • Remove all furniture, debris, carpeting, and clean area with high-efficiency particulate air filtered vacuums. |
| Asbestos Abatement | • Remove, handle, and transport asbestos contaminated tile and subflooring material including fire training area within the impacted areas of Building 27 and Building 2. |
| Characterization Survey –impacted areas | • Perform radiological characterization survey of impacted areas in Building 27 (Figure 6) and Building 2 (Figure 7). |
| Remove contaminated subflooring | • Remove contaminated subflooring and walls. |
| FSS – subflooring | • Perform FSS on removal areas. |
| Remove roofing | • Remove roofing at identified sampling points (Section 5.1) with 10 foot proximity to former instrument room exhaust vents. |
| FSS – Roofing | • Perform characterization survey of impacted roofing. |
| Repair Roofing | • Repair and replace disturbed roofing. |
| Characterization Survey & Sampling – Storm & Sewer Lines | • Perform radiological sampling and survey of storm drain and sanitary sewer piping at accessible manholes and two pump houses (Figure 8). |
| Video Survey | • Conduct camera surveys of sewer and storm drain lines. |

| | |
|---|---|
| Powerwash and Jet Clean Storm & Sewer Lines | • If evidence of radiological contamination or significant sediment is detected during radiological survey or camera survey, power wash storm and sewer lines including drains and manholes. |
| FSS - Storm & Sewer Lines | • Perform FSS storm and sewer lines. |
| Power Wash Pump Houses | • Power wash pump houses. |
| FSS – Storm & Sewer lines | • Perform FSS Pump Houses. |
| EE/CA | • Prepare an EE/CA and AM on any areas identified for TCRA. |
| TCRA | • Conduct TCRA as necessary. |
| FSS – TCRA areas | • Conduct FSSs of TCRA areas in accordance with MARSSIM survey standards. |
| After Action Reports | • Prepare After Action Reports. |

## 1.5 SUPPORTING DOCUMENTS

As outlined in the Navy SOW dated September 3, 2009, Shaw was contracted to prepare a Work Plan in accordance with the requirements identified in the basic contract and the following five plans included as appendices. An Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP) was developed and submitted under separate cover.

Appendix A Quality Assurance Project Plan (QAPP)/Sampling and Analysis Plan (SAP) - This plan presents the methodology for radiological and chemical sampling and analysis as well as the quality assurance plan and procedures to complete the required SOW.

Appendix B Waste Management Plan (WMP) - This plan details procedures to handle, store, transport, and dispose of wastes generated during field activities.

Appendix C Radiation Protection Plan (RPP) - This plan provides guidance for identifying and protecting workers from radiological hazards during field activities.

Appendix D Environmental Protection Plan (EPP) - This plan defines abatement, control, and mitigation measures necessary to protect the environment while conducting field activities at the site.

Appendix E Program Quality Control (QC) Plan Addendum – This plan describes the QC actions that will be implemented during the construction activities at the site.

Appendix F Project Schedule to complete the tasks detailed in subsequent sections of this plan to accomplish the task order SOW.

Table 1.5 summarizes the key personnel and their roles in the development of the Work Plan and supporting documents.

*Table 1.5*
*Responsibilities of Key Personnel*

| Name | Title/Role | Organizational Affiliation | Responsibility |
|---|---|---|---|
| Justin Peach | U.S. Navy Remedial Project Manager (RPM) | Navy | Manages governmental oversight of the project.<br>Manages project funding and scope.<br>Coordinates project documents review.<br>Primary contact and liaison with regulatory agencies.<br>Responsible for technical oversight of the project. |
| Nars Ancog | Navy Quality Assurance Officer (QAO) | Navy | Provides governmental oversight of the Shaw Quality Assurance (QA) Program.<br>Provides quality-related directives through Contracting Officer's Technical Representative.<br>Provides technical and administrative oversight of Shaw surveillance audit activities.<br>Reviews and approves the SAP prior to regulatory review or field implementation.<br>Acts as point-of-contact on all matters concerning QA and the client's Laboratory QA Program.<br>Authorized to suspend project execution if QA requirements are not adequately followed. |
| Chris Generous | Project Manager (PM) | Shaw | Manages oversight of the project for Shaw.<br>Point of contact for communication with the Navy RPM and Navy Contract Specialist.<br>Ensures that all requirements of project are attained in a manner consistent with Project Plans.<br>Oversees planning, execution, and conclusion of all project activities.<br>Manages project budgets and schedules. |
| Jim Langsted | Project Radiation Safety Officer (RSO) | Shaw | Oversees overall radiological operations and documentation for the project.<br>Acts at the technical lead for radiological data collection and analysis.<br>Ensures that the Project RSO have adequate training in sample collection and analytical methods.<br>Monitors the performance of on-site radiological laboratory.<br>Ensures that 10% of the samples are forwarded to the off-site QA laboratory for analysis.<br>Receives and reviews QA laboratory sample data to ensure data qualify objectives are met. |
| Rose Condit | Program Chemist | Shaw | Reviews and approves the SAP.<br>Guides the selection of subcontract analytical laboratories.<br>Conducts field and laboratory audits.<br>Serves as a point-of-contact for the Navy QAO.<br>Develops corrective action as required.<br>Serves as a technical advisor to the project. |
| Jim Langsted | Project Technical Manager | Shaw | Develops Work Plans to address project SOW.<br>Prepares Work Plan variances, if necessary.<br>Manages technical project elements.<br>Reports to PM. |

| Name | Title/Role | Organizational Affiliation | Responsibility |
|---|---|---|---|
| Steve Crupi | Project Chemist | Shaw | Develops the project quality objectives (PQOs) and prepares the SAP.<br>Selects qualified subcontract laboratories.<br>Implements chemical data QC procedures and audits field performance.<br>Reviews laboratory data prior to use.<br>Performs validation of laboratory data.<br>Reviews data validation report.<br>Prepares the appropriate sections of the report summarizing the project sampling activities. |
| Pat Moore | Project QC Manager | Shaw | *Develops the project QC objectives and prepares the QC Plan.*<br>*Administers the QC Plan.*<br>*Manages QC documentation and QC deliverables.*<br>*Lists definable features of work.*<br>*Conducts inspections (preparatory, initial, follow-up, completions*). |
| Pat Moore | Site Safety and Health Officer (SSHO) | Shaw | Develops and administers the SSHP.<br>Manages personnel and environmental monitoring.<br>Coordinates preparation of Job Safety Analyses.<br>Selects appropriate personal protective equipment (PPE) and facilitates daily safety meetings.<br>Reviews essential health and safety (H&S) requirements with on-site personnel. |
| Field Technician/ Scientist | Field Technician (sampling) | Shaw | Ensures that field QC samples are collected as specified in the SAP.<br>Completes field documentation and implements field corrective actions as required.<br>Must have Occupational Safety and Health Administration (OSHA) 40-hour Certification and 8-hour OSHA Refresher Certification. |

# **2.0** *REGULATORY AUTHORITY PROGRAMS AND STAKEHOLDERS*

The following sections discuss the current regulatory agencies that oversee former NAVSTA PS. Each organization has distinct responsibilities and by agreement, federal agencies do not share jurisdiction over a site. While the work will be conducted as an independent action and may enter into the Voluntary Cleanup Program with the Washington State Department of Ecology (Ecology), the procedures for the work have been established to meet the requirements of the CERCLA and NCP.

## **2.1** UNITED STATES NUCLEAR REGULATORY COMMISSION

The Nuclear Regulatory Commission (NRC) is the federal regulatory authority for use of source, special nuclear and byproduct material as defined in Title 10 of the Code of Federal Regulations (CFR). The Navy holds an NRC Master Materials License to cover use of NRC-licensed radioactive material by the Navy and Marine Corps.

Licensed radioactive material is either under the jurisdiction of the NRC or an Agreement State depending on the physical location and use of the radioactive material. Washington is one of 37 Agreement States that have entered into Agreements with the NRC.

An area of exclusive Federal jurisdiction is an area over which the Federal government exercises legal control without interference from jurisdiction and administration of State law. The creation of an area of exclusive Federal jurisdiction occurs as a result of State consent at the time the Federal government acquires control over the land. The determination of whether a Federal enclave is an area of exclusive federal jurisdiction must be made on a case-by-case basis since the status of such land is subject to change.

Since the former NAVSTA PS facilities where radioactive material was used are now within the property owned by the City and Washington is one of the Agreement States with the NRC, radiological jurisdiction is expected to be with the State of Washington with oversight provided by Washington State Department of Health (DOH) - Office of Radiation Protection. Oversight from the U.S. Environmental Protection Agency (EPA) or Ecology is not anticipated.

### **2.1.1** *Installation Restoration Program*

The Navy established the Installation Restoration (IR) Program to implement the requirements of Defense Environmental Restoration Program and CERCLA. The IR Program identifies, investigates, and cleans up or controls releases of hazardous substances and reduces risk to human health and the environment from past waste disposal operations and hazardous materials spills on Navy and Marine Corps property in a cost-effective manner. The IR Program is managed by the Naval Facilities Engineering Command Northwest (NAVFAC NW). Navy Radiological Affairs Support Office provides technical expertise to NAVFAC NW for general radioactive material issues associated with IR sites.

### 2.1.2 *Washington Department Of Health*

The WASHINGTON STATE DOH regulates the public health of the state and their Office of Radiation Protection implements the Washington Agreement State Radioactive Material Licensing Program. At former NAVSTA PS, WASHINGTON STATE DOH will provide regulatory oversight of the radiological release of buildings with contamination that do not have pathways to the environment.

### 2.1.3 *Puget Sound Clean Air Authority*

The Puget Sound Clean Air Authority (PSCAA) guidelines and requirements will be followed during asbestos abatement. The qualified contractor will provide the required notification of the abatement work to PSCAA prior to conducting the work. A notification fee is also required.

### 2.1.4 *City Of Seattle and Local Community*

The City is the current owner of Building 27 and Building 2 at former NAVSTA PS. The City and the local community are active in the regulatory process. The City has indicated that they will lead public relations activities related to this project.

### 2.1.5 *Current Contractors*

The Navy has an NRC Master Materials License that covers residual radioactive material at former NAVSTA PS. It is Navy policy that any contractor performing such work must maintain independent NRC license authority.

Contractors performing current radiological work at former NAVSTA PS involving licensable quantities of radioactive material must have an NRC or a Washington Agreement State license for remediation, packaging, and transportation of any resultant waste. Since former NAVSTA PS is no longer a federal property, any contractor performing radiological work under a Washington Agreement State license must file for reciprocity with the NRC before doing work at former NAVSTA PS. All contractors performing radiological work at former NAVSTA PS must prepare site work plans delineating proposed work efforts and safety measures.

# *3.0 ASBESTOS AND LEAD-BASED PAINT ABATEMENT*

According to the EBS (EBS, January 16, 1996) ACM and LBP may be present in both Building 27 and Building 2. This section outlines the field activities related to the performance of ACM and/or LBP abatement operations relative to the subsequent radiological surveys and TCRA.

Building 27 is assumed to have ACM in the form of vinyl asbestos floor tile (VAT) and associated mastic in the radium room and instrument shop area. Asbestos-containing roofing materials may also be involved if the radium room exhaust vent is to be removed. Building 2 is assumed to have VAT and associated mastic in the instrument shop area (Figures 3 and 4).

Since the potential exists for the disturbance of ACM and/or LBP, these materials will be safely abated by qualified subcontractors prior to disturbance and/or demolition. The work will require coordination with the Project RSO in order to provide the necessary radiological monitoring as outlined in the RPP provided in Appendix C.

## **3.1** APPLICABLE DEFINITIONS

**Asbestos Hazard Emergency Response Act (AHERA) Building Inspector** means a person who has successfully completed the training requirements for a building inspector established by the EPA Asbestos Model Accreditation Plan; Interim Final Rule (40 CFR Part 763, Appendix C) and whose certification is current.

**Asbestos** means the asbestiform varieties of actinolite, amosite, tremolite, chrysotile, crocidolite, or anthophyllite.

**ACM** means any material containing more than one percent (1%) asbestos as determined using the method specified in EPA regulations Appendix E, Subpart E, 40 CFR Part 763, Section 1, Polarized Light Microscopy.

**Asbestos Survey** means a written report describing an inspection using the procedures contained in EPA regulations (40 CFR 763.86) to determine whether materials or structures to be worked on, renovated, removed, or demolished contain asbestos.

**Friable ACM** means ACM that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure or by the forces expected to act upon the material in the course of demolition, renovation, or disposal. Such materials include, but are not limited to, thermal system insulation, surfacing material, and cement asbestos products.

**Homogeneous Area** means an area of material that is uniform in color and texture.

**LBP** means paint or other surface coatings that, by definition, contain lead in excess of 1.0 milligrams per square centimeters (mg/cm$^2$) or 0.5 percent (0.5%) by weight.

**Surfacing Material** means material that is sprayed-on, troweled-on, or otherwise applied to surfaces including, but not limited to, acoustical plaster on ceilings, paints, fireproofing materials on structural members, or other materials on surfaces for decorative purposes.

**Suspect ACM** means material that has historically contained asbestos including but not limited to, surfacing material, thermal system insulation, roofing material, fire barriers, gaskets, flooring material, and cement siding.

**Thermal System Insulation** means material applied to pipes, fittings, boilers, tanks, ducts, or other structural components to prevent heat loss or gain.

## 3.2 APPLICABLE REGULATIONS

If the potential exists for the disturbance of ACM and/or LBP these materials will be safely abated by qualified workers prior to disturbance and/or demolition according to the following regulations.

- EPA, AHERA, 40 CFR 763, Subpart E;
- PSCAA, Regulation III, Article 4: Asbestos Control Standards;
- ASTM E 2308-05 – Standard Guide for Limited Asbestos Screens of Buildings;
- Washington State Department of Labor and Industries (L&I), Asbestos Regulations (Washington Administrative Code [WAC] 296-65 & 296-62-077);

Toxic Substances Control Act Section 403 – Residential Lead Hazard Standards.

## 3.3 ASBESTOS ABATEMENT ACTIVITIES

The following sections provide details for the asbestos abatement activities.

### *3.3.1 Asbestos Competent Person Responsibilities*

An Asbestos Competent Person (ACP) will provide oversight and direction of any asbestos abatement activities. The ACP will be capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, and will have the authority to take prompt corrective measures to eliminate them.

The ACP will be trained in all aspects of asbestos removal and handling, including: abatement, installation, removal and handling, the contents of this Work Plan, the identification of asbestos, and removal procedures. Such training will be obtained in a comprehensive course for supervisors, such as a course conducted by an EPA or Washington State-approved training provider. The ACP will maintain current Washington State Asbestos Supervisor certifications and shall carry their certification cards on their persons while on the project site.

The ACP will be responsible for supervising or performing the following duties:

- Enforce the provisions of this Work Plan;
- Set up the regulated area, enclosure, or other containment;

- Ensure the integrity of the enclosure or containment by on-site inspection and smoke test;
- Set up procedures to control entry and exit from the enclosure and/or area;
- Ensure all air monitoring required by this Work Plan is conducted properly and as needed;
- Ensure that employees working within the enclosure and/or using glove bags wear protective clothing and respirators as required by this Work Plan;
- Ensure, through on-site supervision, that employees set up and remove engineering controls, use work practices and PPE in compliance with all requirements;
- Ensure that employees use the hygiene facilities and observe the decontamination procedures required by this Work Plan; and
- Ensure that proper notification requirements to the Local Air Pollution Control Agency have been met.

### ***3.3.2*** *Asbestos Workers*

All asbestos workers will be bearers of current Asbestos Worker certificates and will carry their worker certification card on their person while on the project site.

### ***3.3.3*** *Asbestos-Containing Material Pre-Abatement Inspections*

Abatement work will not start until all parties understand the SOW and the following items have been addressed:

- Shaw and the Navy Technical Representative (NTR) have inspected the work area to make sure that the pre-abatement work can begin;
- Abatement contractor personnel have received project-specific radiation awareness training and training on implementation of project-specific radiological controls;
- Permission has been received from Shaw and the NTR to commence pre-abatement work;
- All pre-abatement submissions, notifications, postings and permits have been provided and are satisfactory to Shaw and the NTR;
- Enclosure systems have been constructed and tested prior to ACM removal;
- Negative pressure ventilation systems, if used, are functioning adequately and are vented to the outside of the building;
- All equipment for abatement, cleanup and disposal are on hand;
- All worker and supervisor training (and certification) are completed; and
- All of the above are documented within the daily log kept by the site supervisor.

#### **3.3.4** *Asbestos-Containing Material Active Abatement Inspections*

The abatement contractor's ACP will perform daily inspections to ensure the integrity of the enclosures and/or regulated areas and that engineering controls are functioning properly.

If Shaw or the NTR desires, they have the right to inspect the work during abatement. When entering a containment or regulated area all respiratory regulations and rules are in affect and will have to be obeyed by all parties. Inspections may include the following:

- Confirm the contractor(s) are following applicable federal and state ACM abatement regulations.
- Verify that asbestos abatement supervisors and workers are current in their certifications;
- Verify that the asbestos abatement contractor has provided written notification of any proposed asbestos abatement project to PSCAA prior to work commencing;
- Observe that the asbestos abatement contractor is following proper AHERA/PSCAA/L&I asbestos abatement work practices and procedures, such as negative pressure enclosures and other fiber release prevention measures, and notifying the NTR of any observed discrepancies;
- Observe that the asbestos abatement contractor is properly labeling, storing and shipping asbestos-containing wastes for disposal at a licensed Treatment, Storage and Disposal Facility or properly licensed landfill of the NTR's designation, and notifying the NTR of any observed discrepancies; and
- Verify that the asbestos abatement contractor has met final air clearance sampling and documentation requirements.

#### **3.3.5** *Asbestos-Containing Material Post Abatement Inspections*

The abatement contractor, Shaw and/or the NTR will visually inspect the work areas for remaining visible residue. Following satisfactory results from clearance air monitoring and visual inspections and with written permission of the NTR, the barriers and/or enclosures will be removed.

Clearance air monitoring will be performed by a third-party that is not monetarily involved with completion of this project.

#### **3.3.6** *Site Security*

The work area will be restricted only to authorized, trained and protected personnel. These may include the abatement contractor's employees, employees of Subcontractors, Shaw, the NTR, state and local inspectors and other designated individuals. A list of authorized personnel will be established by Shaw prior to job start and posted as directed by the NTR.

Entry into the work area by unauthorized individuals will be reported immediately by the abatement contractor to Shaw and the NTR.

A logbook will be maintained in the clean-room area of the worker decontamination system. Everyone who enters the work area must record name, affiliation, time in and time out for each entry.

#### ***3.3.7*** *Work Area Preparation*

Work areas will be inspected by the abatement contractor's site supervisor, Shaw and/or the NTR for agreement on pre-abatement conditions.

Caution signs meeting the specifications and all codes and regulations will be posted at locations, and approaches to locations, where airborne concentrations of asbestos exceed or can reasonably be expected to exceed, the Permissible Exposure Limit (PEL). Signs will be posted at a distance sufficiently far from the work area to permit an employee to read the sign and take the necessary protection measures to avoid exposure. Additional signs may need to be posted following construction of workplace enclosure barriers.

Caution signs will include the following:

**DANGER**
**ASBESTOS**
**CANCER AND LUNG DISEASE HAZARD**
**AUTHORIZED PERSONNEL ONLY**
**RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA**

Shut down and lock out of electric power to work areas will be performed where feasible. Conduits in the abatement area may remain energized, requiring sealing and protection. Safe installation (including ground faulting) of temporary power sources and equipment will be assured by complying with applicable electrical code requirements for temporary electrical systems. All conduits and junction boxes will be sealed against amended water.

All intake and exhaust vents in the work area will be sealed with tape and 6-mil polyethylene plastic. Also all seams in system components that pass through the work area will be sealed. All conduit joints, junction boxes, motor connections, motors, conveyors, control panels, lights, and associated equipment in the work areas will be protected from amended water by plastic, or locked out and power turned off.

#### ***3.3.8*** *Personal Protective Requirements*

Disposable clothing including head, foot and full body protection will be provided in sufficient quantities and adequate sizes for all workers and authorized visitors.

Hard hats, protective eyewear, gloves, rubber boots, or other footwear will be provided as required for workers and authorized visitors. Safety shoes may be required for some activities.

All respiratory fit-testing will be conducted according to applicable regulations. A copy of the fit-testing records of workers and supervisors will be kept onsite during abatement activities.

For each employee wearing respirators, the abatement contractor will perform either quantitative or qualitative fit-tests at the time of initial fitting and at least every six months thereafter. Fit tests will be conducted according to applicable regulations.

### *3.3.9 Medical Monitoring*

The abatement contractor is responsible for providing medical monitoring to all abatement contractor employees that are required to perform work in regulated areas. All medical monitoring will be conducted by or under the supervision of a licensed physician in accordance with applicable regulations.

Medical monitoring will be provided before assignment to a regulated area and annually thereafter during the employment of the worker by the abatement contractor. Medical monitoring will include, as a minimum, a complete physical examination of all systems with special emphasis on the pulmonary, cardiovascular, and gastrointestinal systems, a chest x-ray, pulmonary function test, completion of a medical questionnaire in accordance with applicable regulations, and any additional tests deemed appropriate by the examining physician.

The abatement contractor shall provide a copy of the physician's written opinion to the affected employee as soon as possible but no later than thirty-days from its receipt by the contractor.

### *3.3.10 Air Monitoring*

Air sampling will be performed by the abatement contractor and all samples will be analyzed by a third party laboratory. Workers shall not be exposed to an airborne concentration of asbestos in excess of the PEL of 0.1 fibers per cubic centimeter of air (f/cc) as an 8-hour time-weighted average (TWA). No worker shall be exposed to an airborne concentration of asbestos in excess of 1.0 f/cc of air averaged over a sampling period of 30-minutes.

Pre-abatement air samples will be taken in all areas to establish background conditions. Daily personal and area air sampling will be conducted throughout the abatement project.

Personal samples will be obtained in employee breathing zones in order to determine employee peak (30 minutes) and 8-hour TWA exposure. Representative personal air samples will be collected in each work area, on every shift in each job classification (type of work performed). A minimum of 25 percent (25%) of the work force will be monitored for airborne asbestos exposure during each work shift.

Area air samples will be collected for asbestos analysis inside and outside the work area to confirm the adequacy of work procedures to prevent the uncontrolled spread of asbestos fibers. Inside work area air samples will be obtained at a rate of at least one sample per work area, depending on the site conditions. Asbestos air samples outside of the work area will be collected at the entrance to the decontamination chamber (decon) or work area, at the negative air machine. Exhaust decon asbestos air samples will be collected every other day. Final clearance asbestos air samples will be taken prior to removal of work area containment. All air monitoring will be conducted in compliance with applicable regulations.

Air sample data will be recorded by the abatement contractor on Shaw-approved forms and transmitted to Shaw within 24 hours of receipt of the laboratory results. Air monitoring results will be transmitted by Shaw to the NTR within 24 hours of receipt of the sampling results. Fiber concentrations that exceed the exposure limits noted above will be reported verbally as soon as received by the abatement contractor. All asbestos sampling results will be compared with criteria detailed in Table 3-3

Within five working days after completion of the exposure assessment, Shaw will notify each Shaw employee or subcontractor (other than abatement contractor employees) in writing of the monitoring results, including corrective actions to be taken if the exposure was found to be at or above the PEL in accordance with WAC 296-62 and Shaw H&S Procedure HS104 – Employee Notification of Industrial Hygiene Monitoring Results (Shaw, 2009). A copy of HS104 is provided in Appendix D of the SSHP. The abatement contractor is responsible for notification to their employees or subcontractors.

*Table 3.3.Asbestos Criteria, Former Naval Base Puget Sound*

| Contaminant | Permissible Exposure Limit | Exhaust Limit | Final Clearance Limit |
|---|---|---|---|
| Asbestos | 0.1 f/cc 8-hr TWA<br>1.0 f/cc 30-min peak | 0.2 f/cc 8-hr TWA<br>1.0 f/cc 30-min peak | 0.01 f/cc<br>Surface Visible Dust - absent |

### ***3.3.11*** *Radiological Monitoring Of Asbestos Waste*

Radiological monitoring of asbestos waste will be performed by the project Radiological Control Technician (RCT). Bags of waste will be monitored for the presence of $^{226}Ra$ using a sodium iodide scintillation detector. Periodic swipe samples will be taken and analyzed to determine removable contamination levels. These measurements will be used to determine if the waste can be free released, or must be handled as radiologically contaminated.

### ***3.3.12*** *Waste Transportation, Storage And Disposal*

All asbestos waste will be transported in an enclosed container to a licensed asbestos disposal facility. Workers transporting waste will follow respiratory protection regulatory requirements concerning respiratory requirements for transporting asbestos waste. Packaged waste shall not be dragged or otherwise damaged during transport. All waste will be lifted and carried, or transported in wheeled carts, when moved from one area to another. Packaged wastes will be placed, not thrown or dropped, into vehicles, storage areas and the landfill.

Any asbestos wastes that are not taken to a landfill will be stored in a secure, lockable area. Signage in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) will be posted at the storage area and on vehicles used to transport asbestos containing waste material during loading and unloading. When asbestos waste in the storage area is taken to the landfill, it will be transported in accordance with all applicable federal, state and local regulations. An asbestos waste shipment record will be completed in accordance with the requirements in NESHAP Section 61.150.

The workers conducting the work activity will fill out the waste tracking form. Once it is completed and the waste is stored or taken to a landfill, the form will be turned in, and maintained for closeout submittals. The management of asbestos waste at the site will be completed in accordance with the WMP provided in Appendix B.

## **3.4** LEAD-BASED PAINT ABATEMENT ACTIVITIES

The LBP abatement activities are anticipated to be strictly limited to areas that may be disturbed during remedial actions, such as the removal of LBP from surfaces of piping where cutting or other hot work is to take place.

Prior to removal, project RCTs will perform surveys to determine the radiological status. If the location is determined to be above free release levels the waste resulting from lead abatement activities will be treated as radiologically contaminated. Removal of LBP from piping materials and other surfaces prior to hot work will be conducted using a LBP-removal product, such as Peel-Away® ST-1 steel-surface paint remover. Removed LBP shall be handled as a lead-contaminated waste and disposed of in accordance with local regulations and the WMP provided in Appendix B.

If bulk materials need to be removed they shall be handled using wet methods to prevent airborne lead dust production and shall be disposed of as lead-contaminated waste.

# *4.0 RADIOLOGICAL WORK PROCESS*

This section discusses the technical approach and execution of radiological screening and materials disposition for work to be performed at the former NAVSTA PS, providing specific guidance for the completion of the work scope. This section describes the performance of work under the safety controls described in the RPP provided in Appendix C.

The work will consist of radiological survey of various structural materials and piping; determination of radiological contamination status; and removal, handling, and packaging of the contaminated materials. Materials may include floor tile, subflooring, wallboard and paneling, roofing material, and piping.

## **4.1** RADIOLOGICAL SURVEYS AND REMOVAL

The ROC known or suspected within former NAVSTA PS as covered under this CTO is $^{226}$Ra. Radiological contamination could potentially be encountered in and on surfaces of building materials, in drain pipes and/or in manholes and catch basins associated with sewer and storm drain lines.

The SOW presented in this Work Plan includes radiological surveys of building surfaces (floors, walls, ceilings, roofing), storm drains, sanitary sewers, manholes, catch basins, and associated pump houses. Radiological surveys will be conducted before, during and after asbestos and LBP abatement activities. The SOW also includes removal of materials contaminated above identified radiological thresholds. The field implementation of the radiological SOW is detailed in Section 5.0 of this Work Plan.

## **4.2** CURRENT RADIOLOGICAL INVESTIGATIONS

A screening level radiological investigation was previously performed at the request of the Seattle Parks and Recreation (Argus, 2009a and Argus, 2009b). There are no current radiological investigations in progress.

## **4.3** CURRENT AND FUTURE LAND USAGE AT FORMER NAVSTA PS

The City has leased several of the original buildings to public and private organizations to support the redevelopment as recreational facilities. Upon completion of radiological surveys, removal actions, and necessary remediation activities, the facilities will be released for unrestricted use by any future tenants.

## **4.4** ACCESS CONTROL

Shaw will establish a temporary office in each building when conducting work in that area. Building 27 will also be utilized when conducting work on the storm drains and pump houses. Fencing will be installed around all work areas to create a Controlled Area. Access to asbestos and LBP work areas will be additionally controlled as indicated in this Work Plan. Radiologically Controlled Areas (RCAs) and Access Control Points will be established and posted within the Controlled Area based on radiological conditions and planned work activities. Additional levels of radiological control will be established as necessary. The RPP in Appendix C provides definitions of these radiological areas and the associated postings. Access to the worksite will be limited to project personnel engaged in the surveys and removal activities. Visitors, including regulatory agency personnel granted access to an RCA, will be briefed in accordance with the RPP requirements and escorted while in the area.

### **4.5** OFFICE SPACE AND RESTROOM FACILITIES

Offices and restroom facilities will be located near the work site. Restrooms are available within Buildings 2 and 27.

### **4.6** ELECTRICAL POWER

Electrical power is available in Building 2 and Building 27. Portable gasoline generators may be required when work is conducted at the Pump Houses and sewer and storm drain locations.

### **4.7** RADIONUCLIDE CLEANUP GOALS

Release cleanup criteria for the project's ROC, $^{226}$Ra, are listed in Table 4.7. If soil, equipment, or building materials exceed these criteria they will be removed, segregated, characterized, and packaged for disposal. If other radionuclides are encountered, additional release criteria will be similarly established and submitted to NAVFAC NW for approval.

Any equipment or materials that are contaminated in excess of these criteria and cannot be decontaminated, shall be packaged and placed in a secured location designated as a Radiological Materials Storage Area within Shaw's project yard in Building 27. This area will be access controlled and posted in accordance with Shaw's license requirements and procedures which include barricades, authorized access, controlled egress (personnel and material), and radiological warning signs. The equipment and materials will be maintained under an appropriate radioactive materials license until arrangements can be made by the Navy to properly dispose of the material.

*Table 4.7 Release Criteria*

| Radionuclide | Radiation | Equipment and Building Material Surfaces[a,b] (disintegrations per minute[dpm]/100 cm$^2$) | | | Soil and Sediment[c] (picocuries per gram [pCi/g]) |
|---|---|---|---|---|---|
| | | Average (dpm/100 cm$^2$) | Maximum (dpm/100 cm$^2$) | Removable (dpm/100 cm$^2$) | |
| $^{226}$Ra | alpha, gamma | 100 | 300 | 20 | Greater than mean statistical background level plus 3 standard deviations[d] |

*a These limits are based on Atomic Energy Commission (AEC) Regulatory Guide 1.86.*
*b Pipe geometry may make surface contamination measurements difficult, requiring professional interpretation.*
*c This limit is based on the SOW for this CTO (Revised 03 September 2009).*
*d Refer to the QAPP/SAP provided in Appendix A for the determination method for this value.*

## 4.8 SURVEY TYPES

Listed below in Table 4.8 are the types of surveys that may be performed at former NAVSTA PS.

70

*Table 4.8 Survey Types for Each Project Activity*

| Project Location ⇨ / Project Activity ⇩ | Building 27 | | | | | | | Building 2 | | Storm Drain System | | | Gravity Flow Sewer System | | | Former Pressurized Sewer Line | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ra Room | Instrument Shop | Exposed Sewer Line | Room Below Sewer Line | Hanger Area | Exhaust Vents & Ceiling | Roof | Instrument Shop | Exhaust Vent & Ceiling | Manholes | Pipes | Catch Basins | Manholes | Pipes | Pump House 116 | Pump House 117 | Valve Pit | Line | Pump House 98 |
| Scoping Survey[a] | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Remove Exposed Sewer Line | | | PAEW | PAEW | | | | | | | | | | | | | | | |
| Conduct Utility Locate/Dye Test | | | | PAE | | | | | | | | | | | | | | | |
| Background Determination[b] | B | B | | B | B | B | B | B | B | B | B | B | B | B | B | | | B | B |
| Storm and Sewer Line Sludge Sampling | | | | | | | | | | PAE | | PAE | PAE | | PAE | | PAE | | PAE |
| Fire Training Maze Removal | | PAEW | | | | | | | | | | | | | | | | | |
| Clean Area | PAE | PAE | | PAE | PAE | | | PAE | | | | | | | | | | | |
| Asbestos Abatement | PAEW | PAEW | | | | PAEW | | PAEW | PAEW | | | | | | | | | | |
| Remove Roofing | | | | | | | PAEW | | | | | | | | | | | | |
| Characterization Survey[c] / FSS – Impacted Areas | C1/3 | C2/3 | | C1/3 | C2/3 | C2/3 | C2 | C2/3 | C2/3 | | | | | | | | | | |
| Remove Contaminated Subflooring | RPAE | | | | | | | | | | | | | | | | | | |
| FSS – Subflooring | F1/3 | | | | | | | | | | | | | | | | | | |

| Project Location ⇨ / Project Activity ⇩ | Building 27 | | | | | | | Building 2 | | Storm Drain System | | | Gravity Flow Sewer System | | | Former Pressurized Sewer Line | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ra Room | Instrument Shop | Exposed Sewer Line | Room Below Sewer Line | Hanger Area | Exhaust Vents & Ceiling | Roof | Instrument Shop | Exhaust Vent & Ceiling | Manholes | Pipes | Catch Basins | Manholes | Pipes | Pump House 116 | Pump House 117 | Valve Pit | Line | Pump House 98 |
| Characterization Survey – Storm & Sewer Lines | | | | | | | | | | C1 | C1 | C1 | C1 | C1 | C1 | C2 | C1 | C1 | C1 |
| Video Survey | | | | | | | | | | PE | PE | PE | PE | PE | PE | PE | PE | PE | PE |
| Sewer Jet Storm & Sewer Lines | | | | | | | | | | PE | PE | PE | PE | PE | PE | PE | PE | PE | PE |
| Power Wash Pump Houses | | | | | | | | | | | | | | | PE | | | | |
| FSS – Storm & Sewer Lines | | | | | | | | | | C1 | C1 | C1 | C1 | C1 | C1 | C2 | C1 | C1 | C1 |

*S = scoping survey (Section 4.8.2)*
*C = characterization survey (Section 4.8.3)*
*R = remedial action support survey (Section 4.8.4)*
*F = FSS (Sections 4.8.5)*
*P = personnel survey (Section 4.8.6)*
*A = air sampling*
*E = equipment or sample release survey (Section 4.8.7)*
*W = waste characterization measurement*
*B = background – reference area survey (Section 4.8.1)*

*a Initial scoping surveys performed by Argus.*
*b Measurements and samples taken at (non-impacted) location with same type of material.*
*c Numbers indicate survey unit classification (Class 1, 2, or 3 – See Sections 4.9.1, 4.9.2, or 4.9.3, respectively) for floor/walls and ceilings. Characterization surveys initially taken with same protocol as FSS to meet that need if possible.*

#### **4.8.1** *Reference (Background) Area Survey*

The ROC, $^{226}$Ra, is a naturally occurring radioactive material (NORM). It and other NORM radionuclides are present in many materials and contribute to the measured count rate and laboratory analysis results. Background is subtracted from field measurements and is a basis for the soil and sludge release criteria shown in Table 4.7. To quantify the background, a reference area is selected. A reference area is a geographical area or structure from which representative radioactivity measurements are collected for comparison with measurements performed in an impacted area. A reference area should have similar physical, chemical, radiological, and biological characteristics as the impacted area(s) being investigated, and should not be identified as impacted by any previous surveys. All on-site and off-site areas selected for reference will be approved by the Program RSO. The same survey methods and equipment that will be used for conducting a survey in an impacted area will be used for the background area survey. Reference area data will normally be provided to the RCT prior to the start of a survey.

#### **4.8.2** *Scoping Survey*

Scoping surveys provide site-specific information based on limited measurements. Scoping surveys are to be conducted with guidance from the MARSSIM (DoD et al., 2000) Section 5.2 and will consist of judgment-based measurements (biased) based on any historical data and professional experience. Sufficient information will be collected to identify situations that require immediate radiological attention or to support development of other project activities.

The primary objectives of scoping surveys are to:

- Perform a preliminary contamination assessment,
- Identify radionuclide contaminants,
- Assess radionuclide ratios,
- Assess general levels and extent of radionuclide contamination,
- Support classification of impacted areas,
- Evaluate whether the survey strategy can be optimized for use in the characterization or FSSs.

The measurements performed by Argus in March and April 2009 provide scoping surveys information as indicated in MARSSIM Section 2.4.3. Shaw will perform additional scoping surveys to characterize other worksite locations for this project.

#### **4.8.3** *Characterization Survey*

The characterization survey is the most comprehensive of the survey types and generates the most data. This includes preparing a reference grid, systematic as well as judgment measurements, and surveys of different media (e.g., surface soils, interior and exterior surfaces of buildings). The decision as to which media will be surveyed is a site-specific decision addressed during the execution of the characterization survey.

Characterization surveys are planned based on historical data, MARSSIM guidance, and scoping survey results. The surveys will be conducted on a fine enough grid to meet MARSSIM requirements for FSSs. If contamination levels are recorded above the criteria listed in Table 4-7, the locations will be identified for remediation. The characterization survey design will be reevaluated based on these findings. If no contamination above the contamination criteria is identified, then the data collected will provide the information necessary to evaluate the final contamination status for that area.

The primary objectives of characterization surveys are to:

- Assess the nature and extent of contamination, if present.
- Collect data to support evaluation of remedial alternatives and technologies.
- Evaluate whether the survey strategy can be optimized for use in the FSS.
- Provide input to the FSS design.

### 4.8.4 *Remedial Action Support Survey*

Remedial action support surveys are performed to assess the effectiveness of the remedial action while remediation is being conducted, and to guide the cleanup in a real-time mode. The primary objectives of remedial action support surveys are to:

- Support remediation activities,
- Assess when an area is ready for the FSS,
- Provide site-specific information used for planning the FSS.

### 4.8.5 *Final Status Survey*

The FSS provides data to demonstrate that radiological parameters satisfy the established guideline values and conditions for radiological release. Data from other surveys conducted during the course of site investigations at former NAVSTA PS (such as scoping, characterization, and remedial action support surveys) can provide valuable information for planning an FSS. If radiological parameters are satisfied during the characterization surveys then they will serve as the FSS.

The objective of each FSS is to demonstrate that the identified residual radioactivity levels are below the release criterion for each survey unit (SU), including building walls, floors, and ceilings, storm lines and drains, sanitary sewer pipes, and pump houses. The FSS provides data to demonstrate that all radiological parameters satisfy the established guideline values and conditions. In demonstrating that this objective is met, statistical testing is performed on the data. In this case, the null hypothesis ($H_o$) tested is that residual contamination exceeds the release criterion and the alternative hypothesis ($H_a$) is that residual contamination meets the release criterion.

The primary objectives of FSSs are to:

- Verify classification.
- Demonstrate that the potential dose or risk from residual contamination is below the release criteria.
- Demonstrate that the potential dose or risk from small areas of elevated activity is below the release criteria.

#### **4.8.6** *Personnel Surveys*

Personnel surveys are used to ensure that individuals leaving a radiological area are free of contamination.

#### **4.8.7** *Equipment And Material Surveys*

Before being put into service or leaving a radiological work area, equipment and/or material will be surveyed in an area of low background to ensure that the equipment and materials release criteria are not exceeded, using appropriate standard operating procedures (SOPs):

- Equipment and/or materials considered for service in a radiological work area at former NAVSTA PS that exceed the release criteria will be returned to the supplier for replacement or decontamination prior to use under this TO.
- Outgoing equipment and/or materials that do not meet the release criteria will be decontaminated before leaving the radiological work area or stored for disposal.

#### **4.8.8** *Truck Surveys*

Surveys will be performed on vehicles transporting non-radiologically-impacted materials that are entering or leaving the RCAs. The surveys will be performed to protect against the inadvertent receipt or shipment of materials exhibiting elevated radiation levels. Surveys will be accomplished in accordance with specifications similar to those used at disposal facilities, or manually surveyed using portable survey equipment, and will be operated per SOPs.

### **4.9** SURVEY AREA CLASSIFICATION

Areas that have no reasonable potential for radiological contamination are classified as non-impacted areas. Review of historical records and surveys performed by Argus have identified some areas at former NAVSTA PS that have been classified as impacted. Based on available information, each impacted area will be given a classification. Any area not specifically identified as impacted is classified as non-impacted. Impacted areas are divided into one of three classifications as described below.

#### **4.9.1** *Class 1 Areas*

Class 1 areas have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above project release criteria (Table 4.7). Examples of Class 1 areas include:

- Site areas previously subjected to remedial actions,
- Locations where leaks or spills are known to have occurred,
- Former burial or disposal sites,
- Waste storage sites,
- Areas designated as such in previous historical assessments.

Based on the above criteria, Class 1 areas at the former NAVSTA PS are the Radium Room floor and the floor under the exposed sewer line within the work space (welding shop) beneath the Radium Room as shown on Figure 6.

#### **4.9.2** *Class 2 Areas*

Class 2 areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the project release criteria (Table 4.7). Examples of areas that might be classified as Class 2 for the FSS include:

- Locations where radioactive materials were present in an unsealed form,
- Potentially contaminated transport routes,
- Areas downwind from stack release points,
- Upper walls and ceilings of buildings or rooms subjected to airborne radioactivity,
- Areas handling low concentrations of radioactive materials,
- Areas designated as such in previous historical assessments,
- Buffer areas on the perimeter of Class 1 areas.

Based on these criteria, Class 2 areas are the Building 27 Instrument Room floor, a strip of Building 27 hanger floor immediately outside the welding shop, as shown on Figure 6; and the two Instrument Room floors in Building 2 as shown on Figure 7. The manholes and pipes for the storm drain and gravity flow sewer system, the former pressurized sewer line, and Pump Houses 116 and 98 are Class 2 areas. The roof in proximity (10 foot radius) to the exhaust vents from the Radium Room and the Building 27 Instrument Shop is a Class 2 area as well.

#### **4.9.3** *Class 3 Areas*

Class 3 areas are not expected to contain residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the project release criteria, based on site operating history. Examples of areas that might be classified as Class 3 include:

- Buffer zones around Class 1 or Class 2 areas.
- Areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.
- Areas designated as such in previous historical assessments.

The areas identified as Class 3 areas are the Radium Room walls and ceilings, the instrument shops walls and ceilings (Building 27 and Building 2), the walls and ceiling of the welding shop, and the wall of the hanger area immediately opposite the welding shop.

### **4.10** SURVEY GRID DETERMINATION

A reference coordinate system will be laid out for each SU. A triangular grid system will be used for the survey areas. The length, L, of a side of the triangular grid is determined by the total number of samples or measurements to be collected. The length of the triangle will determine the distance between survey data points. The length or spacing of the grids will be calculated for each of the SUs using the following equation that was obtained from MARSSIM:

$$L = \sqrt{\frac{A}{0.866 * n}}$$

where:

| | | |
|---|---|---|
| $L$ | = | length of triangular grids [meters (m) or feet (ft)] |
| $A$ | = | surface area of the SU square m ($m^2$) or square ft ($ft^2$) |
| $n$ | = | statistically calculated number of samples[1] |

### **4.11** SURVEY UNIT

The work described herein will be performed within the impacted areas (as identified in Section 1.3 of this Work Plan at former NAVSTA PS. In accordance with MARSSIM guidelines, all impacted areas are initially assumed to be Class 1. Class 1 areas require the highest level of survey effort because they are known to have contaminant concentrations above the project release criteria, or the contaminant concentrations are unknown. Information indicating the potential or known contaminant concentration is less than the project release level can be used to support re-classification of an area or SU as Class 2 or Class 3.

[1] … n is determined for a FSS design based on the PQOs identified for the site (MARSSIM, Section 5.5.2.2), to demonstrate that the residual radioactivity in each SU satisfies the defined project release criteria. This survey design is applied while performing characterization surveys on this project, to facilitate the use of this data for final status determination where possible.

SUs should be limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. The suggested areas for SUs are summarized in the following table.

*Table 4.11 Structure Survey Unit Areas*

| Classification | Suggested Area |
|---|---|
| Class 1 | Up to 100 square meters ($m^2$) |
| Class 2 | 100 to 1000 $m^2$ |
| Class 3 | No limit |

Building surface SUs will encompass sections not to exceed those shown in Table 4.11. A minimum of 18 discrete surveillance points shall be spaced using the triangular grid pattern described in Section 4.10.

## 4.12 STATISTICAL TESTS

The Wilcoxon Rank Sum test will be used to evaluate data from the FSSs (DOD, 2000, Section 8.4.1). To determine data needs for this test, the acceptable probabilities of making Type I decision errors and Type II decision errors have been established in the SAP. The number of data points to be collected in each SU can be determined from this calculation.

# 5.0 *FIELD IMPLEMENTATION OF RADIOLOGICAL WORK*

This section outlines the field implementation of radiological work processes for removing the contaminated drain piping, floor, and other potentially contaminated materials and for performing surveys in accordance with the SOW. Details of the work processes are provided in the QAPP/SAP provided in Appendix A.

A suitable area for onsite materials and equipment storage areas and soil drum stockpile staging areas will be set up in Building 27. The specific locations will be approved by and coordinated with the NTR.

One or more RCAs will be established as necessary around work areas. Radiological screening will be required when personnel and equipment enter and exit the RCA and when moving between work areas. Work performed in or near roadways will be coordinated with the task-related Site Supervisor, local tenants, and other site users to develop appropriate traffic control plans and road closures as needed for site personnel safety. Field survey and abatement activities will be monitored at all times by an RCT providing H&S coverage.

## 5.1 SURVEY OF BUILDING SURFACES – FLOORS, WALLS, CEILINGS, AND ROOF

Initial scoping surveys for gross alpha and gross beta will be performed throughout the impacted areas using a 2-channel alpha/beta survey meter or a gamma scintillation detector. These surveys in accordance with Section 4.8.2 and will provide information for worker protection as well as identification and characterization of any additional impacted areas. Only Building 27 is expected to have sufficient contamination to require removal. This is currently assumed to be limited to the Radium Room (now named “S-1”).

Following the scoping survey, the interiors of impacted areas will be vacuumed and the furniture removed. A background survey in selected reference areas will be required prior to performing additional surveys. In Building 27, an approximate 50-foot section of potentially radiologically contaminated pipe (associated with the sink in the Radium Room) will be removed prior to performing a characterization survey. This pipe section will be handled in accordance with local, state, and federal requirements. To identify whether the removed section of pipe was connected to the gravity flow sewer line or the abandoned pressurized sewer line, a utility locate, dye tracer, or another appropriate method will be conducted. The sewer line will be capped to prevent leakage.

In the three identified instrument rooms, the flooring (tile and mastic) will be removed by an asbestos abatement contractor. This material will be radiologically surveyed and if contamination is detected above project cleanup levels, the material will be handled as low-level radioactive waste with an asbestos component and will be transferred to a radiological waste/asbestos disposal contractor. The WMP provided in Appendix B discusses the management of waste at the site.

Upon removal of the main floor surface (tiles and mastic), a characterization survey will be performed on the subfloor in accordance with MARSSIM standards. The floor surface will be monitored using a gas-flow proportional floor monitor. Walls and ceilings will be monitored using hand-held alpha/beta survey instrumentation.

In addition, the roof of Building 27 (south end) at identified sampling points (MARSSIM Class 2 survey location determination (Section 4.9.2)) will be removed and a characterization survey will be performed (Figure 8). Upon completion of the survey, assuming no contamination is identified, the roofing will be replaced and repaired by a qualified contractor with oversight from Shaw. If contamination is found, it may be necessary to remove additional roofing to complete remediation and the FSS. Any changes in scope and approach will be documented and approved by the Navy prior to implementation.

## 5.2 SURVEYS OF STORM DRAIN AND SANITARY SEWER PIPELINES

In situ storm piping characterization surveys will be performed in catch basins on the sides of the facility, as well as storm drain lines within and exiting the building to the north. Surveys will also be performed in the manholes of the gravity flow sewer system (currently active). The pressurized line (inactive) does not contain manholes therefore surveys will only be conducted both ends (Pump House 117 and Pump House 98 or the nearby valve pit).

The surveys at these locations will consist of sampling sediment or sludge present in the manholes, as well as those pipe sections which are accessible by hand. Surface contamination monitoring will be performed using a hand-held 2-channel alpha/beta survey instrument. If no sludge is present, swipe samples will be collected and surface contamination monitoring will be performed on interior pipe surfaces to identify the presence of surface contamination. Swipe samples will be analyzed onsite using a dual channel sample counter for gross alpha and gross beta contamination. The release criteria for material and equipment can be found in Table 5.2.

*Table 5.2 Release Criteria for Materials and Equipment*

| Radionuclide | Radiation type | Removable[a] (dpm/100 $cm^2$) | Total[a] (dpm/100 $cm^2$) |
|---|---|---|---|
| $^{226}Ra$ | alpha | 20 | 100 |

*a These limits are for the release of equipment and materials and are based on Regulatory Guide 1.86 (AEC, 1974).*

### 5.2.1 *Sewer and Storm Drain Pipelines*

The following sections will be surveyed using the above methods.

- The gravity flow sewer system, currently in use, approximately from Manhole 225 to Building 116, which also serves as a pump station (Figure 8). This section of pipeline will need to be blocked and bypassed prior to radiological surveying. Pipeline by-pass is outlined in the EPP provided in Appendix D. Shaw intends to wait until the pipe section dries, or survey those areas which readily drain. This is to allow proper readings which would otherwise be masked by the presence of water.

- The pressurized sewer line will be accessed at both ends (Pump House 117 and Pump House 98 or the nearby valve pit) and surveyed.
- Each of the accessible manholes associated with the storm drain line including the catch basins on the sides of Building 27 and Manhole 137 will be surveyed, as well as the pipe section from Manhole 136 (in Building 27) to Manhole 160, which is the last manhole before the lake outfall.

### 5.2.2 *Sludge Sampling*

Soil, sediment, or sludge that is encountered during the course of the manhole and sewer/storm drain piping surveys will be scanned and sampled in accordance with the procedures set forth in the QAPP/SAP provided in Appendix A.

### 5.2.3 *Camera Surveys*

At the completion of the survey and sampling within the manholes, catch basins, and accessible portions of the storm and sewer lines, the entire length of the storm and sewer piping will be camera surveyed. The intent of the camera survey is to provide visual evidence and documentation of interior pipe integrity and determine if significant sediment deposits are present within the piping. The camera survey will be conducted by a qualified contractor in the storm line from Manhole 136 to Manhole 160, in the gravity feed sewer line from Manhole 225 to Building 116, and in the pressurized line from Pump House 117 to Pump House 98 or the nearby valve pit. The pipelines will be blocked and bypassed as necessary to complete the camera surveys.

### 5.2.4 *Pump House Powerwashing and Line Jetting*

Depending on the findings of the radiological surveys, sampling, and camera survey, powerwashing of the pump houses and/or jetting of the storm and/or sewer lines may be conducted. The decision by the Navy to perform these activities will be based on whether surveys or sediment/sludge sampling indicate the presence of radiological contamination in excess of project release criteria and if visual inspection and the camera surveys indicate significant sediment is present that could be removed through power washing and/or jetting of the lines.

Powerwashing and jetting will be conducted by qualified contractors with oversight provided by Shaw. All wastes (water/sediment) generated during these activities will be contained and stored in DOT-approved containers as outlined in the WMP provided in Appendix B and the appropriate precautions will be taken to assure that a release of these wastes to the environment during performance of the work or transport and/or transfer of wastes on-site does not occur as outlined in the EPP provided in Appendix D.

## **5.3** DEMOBILIZATION

Upon completion of the scope of field work in each of the survey areas, associated radiological survey and supporting equipment will be removed. Each radiological work area will be turned over to the Navy in safe and secure radiological status and as required by NRC license conditions. No radioactive material other than exempt quantity radioactive check sources will remain in the possession of Shaw. The demobilization activities and timeframe will be addressed through ongoing discussions with the Navy, and the Navy will concur on turnover before Shaw exits the site.

# *6.0 PROJECT DOCUMENTATION*

Reports will be completed to document the survey results and any TCRAs taken.

## 6.1 RADIOLOGICAL SURVEY REPORTS

Survey documentation will be provided in:

- Radiological Survey Report - Background and Building 27.
- Radiological Survey Report - Building 2 and drain lines.

Sufficient data and information will be provided to enable an independent evaluation of the results. Much of the information will be available from other documents; to the extent practicable, this report will be a stand-alone document with minimum information incorporated by reference. The results of the scoping survey will be documented to provide additional information for characterization surveys and the radiological status of the site. The results will include the general extent of contamination (*e.g.*, activity levels and area of contamination detected).

Documentation of characterization surveys will provide a record of the radiological status of the site. Sufficient information to characterize the extent of contamination will be provided to support reasonable approaches or alternatives to site decontamination. The remedial action support surveys will provide data indicating an area has been successfully remediated. Information identifying areas of elevated activity that existed prior to remediation will be useful for planning FSSs. Documentation of the FSS will provide a record of the radiological status of each SU, relative to the established site release criteria.

## 6.2 AFTER ACTION REPORTS

Shaw will prepare After Action Reports for:

- Building 27,
- Building 2,
- Sewer/Storm Drain and Pump Houses.

These reports will document the implementation and completion of any cleanup and FSSs and will document that the cleanup objectives have been met. The reports will address all requirements under WAC 173-340 for reports of independent cleanups and will be formally reviewed and approved by the Navy.

# *7.0 REFERENCES*

Argus Pacific, 2009a, *Radiation Screening, Building 27, Former Sand Point Naval Facility, Seattle, Washington*, April 30.

Argus Pacific, 2009b, *Radiation Screening, Building 2 and Pump Houses, Former Sand Point Naval Facility, Seattle, Washington*, May 28.

Naval Sea Systems Command (NAVSEA), 2004, *Historical Radiological Assessment, History of the Use of General Radioactive Materials 1939 - 2003*.

U.S. 101st Congress, 1990, *Pollution Prevention Act of 1990, Public Law 101-508, Washington, DC*, November 6.

U.S. Army Corps of Engineers, 2008, *Engineer Manual (EM 385-1-1) Safety and Health Requirements Manual*, September 15.

U.S. Department of Defense, Department of Energy, Nuclear Regulatory Commission, and U.S. Environmental Protection Agency, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) *NUREG-1575*, August.

URS Consultants, Inc. 1996, Environmental Baseline Survey, Naval Station Puget Sound (NAVSTA PS), Seattle Washington, CTO 0104, January.

Washington State Department of Health, *WAC Title 246*, *Titles 246-220 through 246-254*. <http://apps.leg.wa.gov/wac/default.aspx?cite=246>.

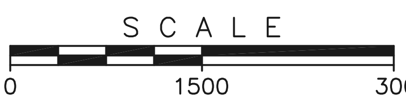
# FIGURES

XREF Files: IMAGE Files: sanpoint site.jpg
SITE LOC.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-F1.dwg Layout: 8.5X11-L User: maria.portacio Jan 12, 2010 - 5:04pm

| OFFICE | DRAWN BY | | CHECKED BY | | APPROVED BY | | DRAWING NUMBER | BT-131833-F1 |
|---|---|---|---|---|---|---|---|---|
| BOTHELL | MPortacio | 10/2009 | CG | 01/10 | | | | |



SCALE: 1"=2 MILES


SOURCE: 2009 GOOGLE-MAP DATA @ 2009 TELE ATLAS


Shaw®
Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766

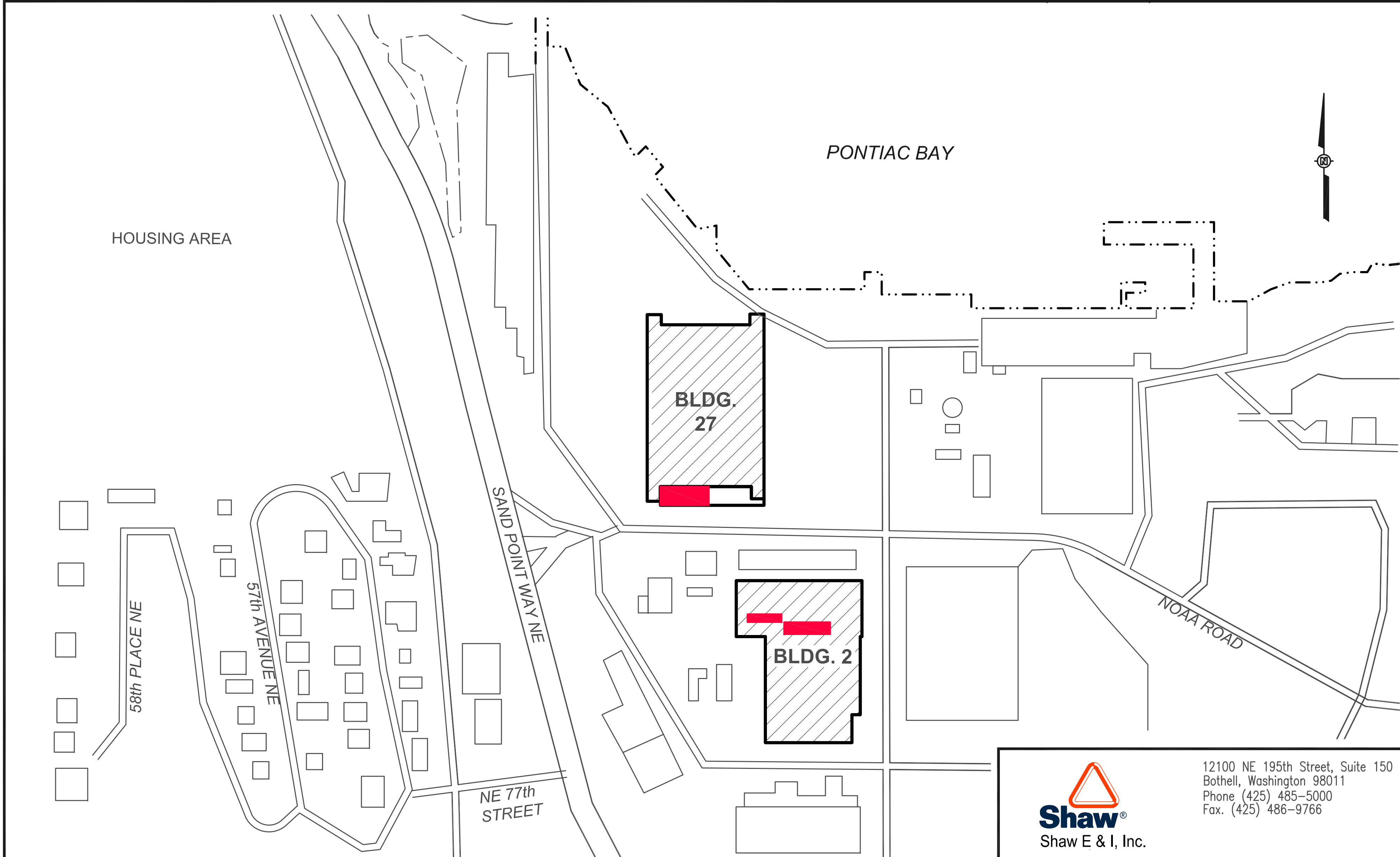

FIGURE 1

## SITE LOCATION MAP

FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON

XREF Files: IMAGE Files: sanpoint site.jpg
SITE LOC.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-F2.dwg Layout: 8.5X11-L User: maria.portacio Jan 12, 2010 - 5:02pm

| OFFICE | DRAWN BY | | CHECKED BY | | APPROVED BY | | DRAWING NUMBER | BT-131833-F2 |
|---|---|---|---|---|---|---|---|---|
| BOTHELL | MPortacio | 10/2009 | CG | 01/10 | CG | 01/10 | | |





Shaw®
Shaw E & I, Inc.

12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766


SCALE

0 600 1200 FEET

**LEGEND:**

APPROXIMATE LOCATIONS OF INVESTIGATIONS

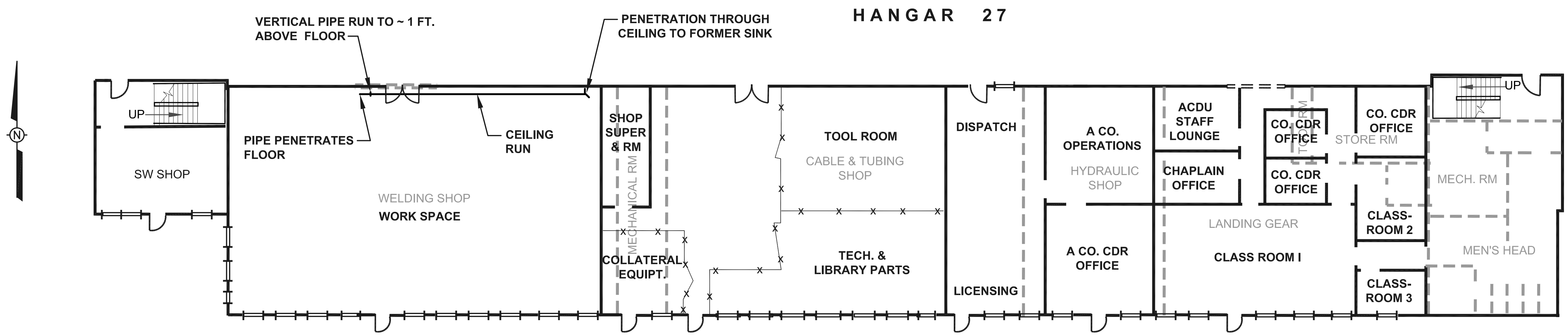
SOURCE: 2009 GOOGLE-MAP DATA @ 2009 TELE ATLAS

FIGURE 2

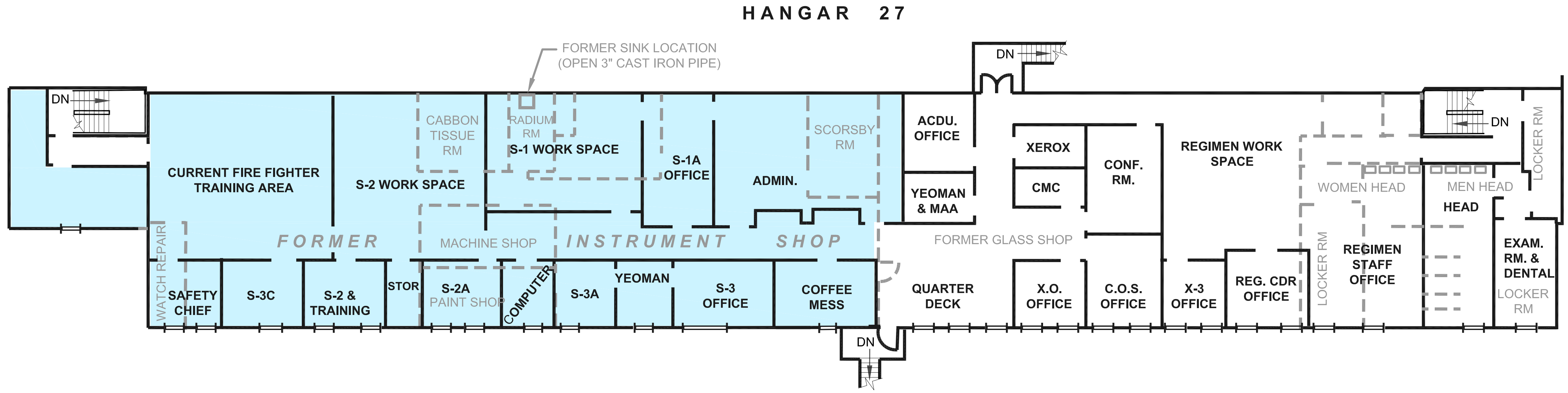
**LOCATION OF BLDG. 27 & BLDG. 2**

FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON

| OFFICE | DRAWN BY | CHECKED BY | APPROVED BY | DRAWING NUMBER |
| --- | --- | --- | --- | --- |
| BOTHELL | MPortacio 10/2009 | CG 01/10 | CG 01/10 | BT-137165-BLDG-F3 |




FIRST FLOOR PLAN




SECOND FLOOR PLAN

LEGEND:

- OUTLINE OF BUILDING (1943)
- OUTLINE OF BUILDING (1985)
- FORMER INSTRUMENT SHOP AREA

SCALE

0 20 40 FEET

SOURCE: US NAVAL STATION, SEATTLE WASHINGTON
BUILDING 27 PLAN - 1985 (DRAWING #54151)
1943 (DRAWING #54080)


Shaw® Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766

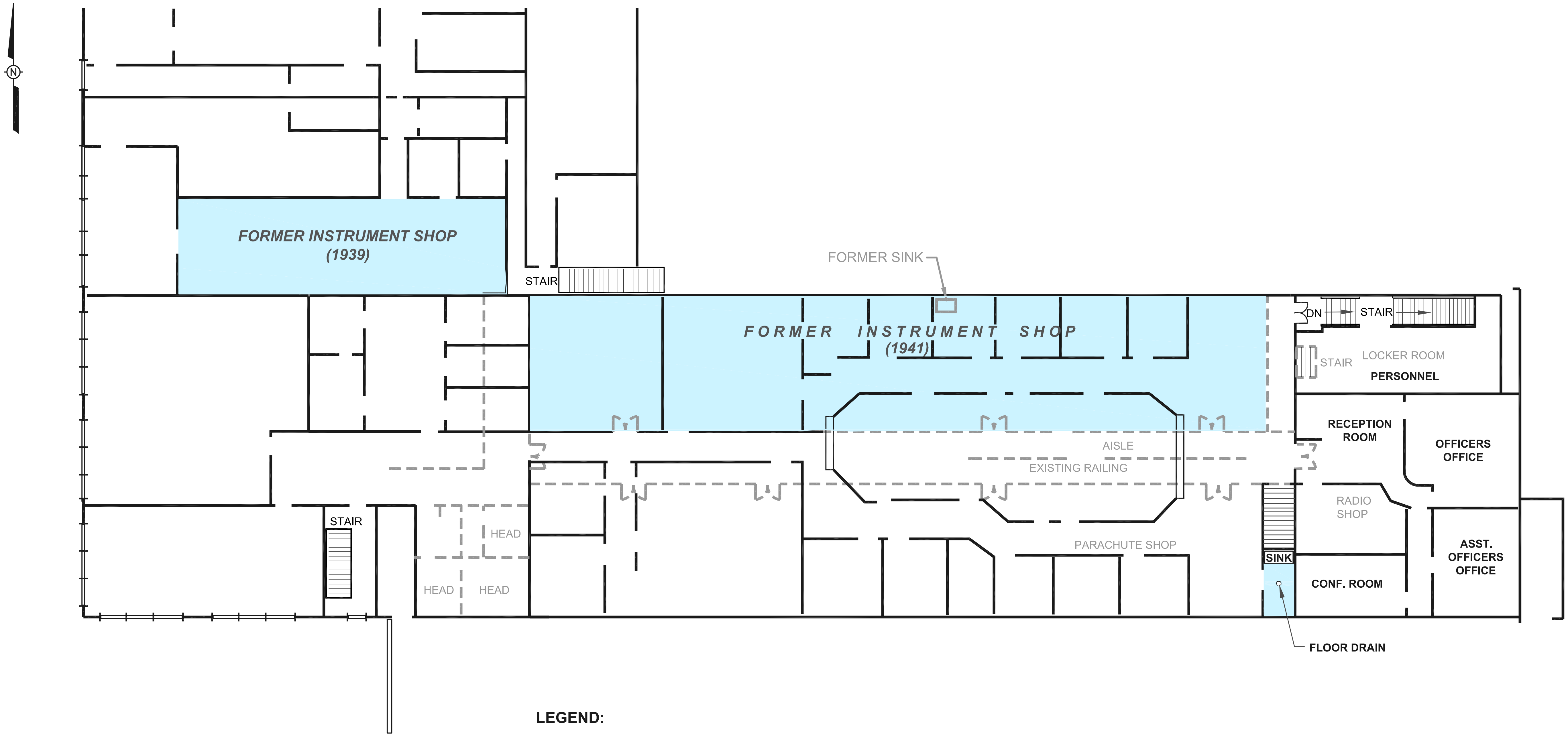

FIGURE 3

**FLOOR PLAN OF BLDG. 27**

FORMER NAVAL STATION — PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON


XREF Files: IMAGE Files: 2835_001_Page_1.jpg BLDG27-1943.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-BLDG-F3.dwg Layout: FIGURE User: maria.portacio Jan 12, 2010 - 5:00pm

| OFFICE | DRAWN BY | CHECKED BY | APPROVED BY | DRAWING NUMBER |
|---|---|---|---|---|
| BOTHELL | MPortacio 10/2009 | CG 01/10 | CG 01/10 | BT-137165-BLDG-F4 |




**LEGEND:**

- - - - OUTLINE OF BUILDING (1941)

—— OUTLINE OF BUILDING (1986)

FORMER INSTRUMENT SHOPS

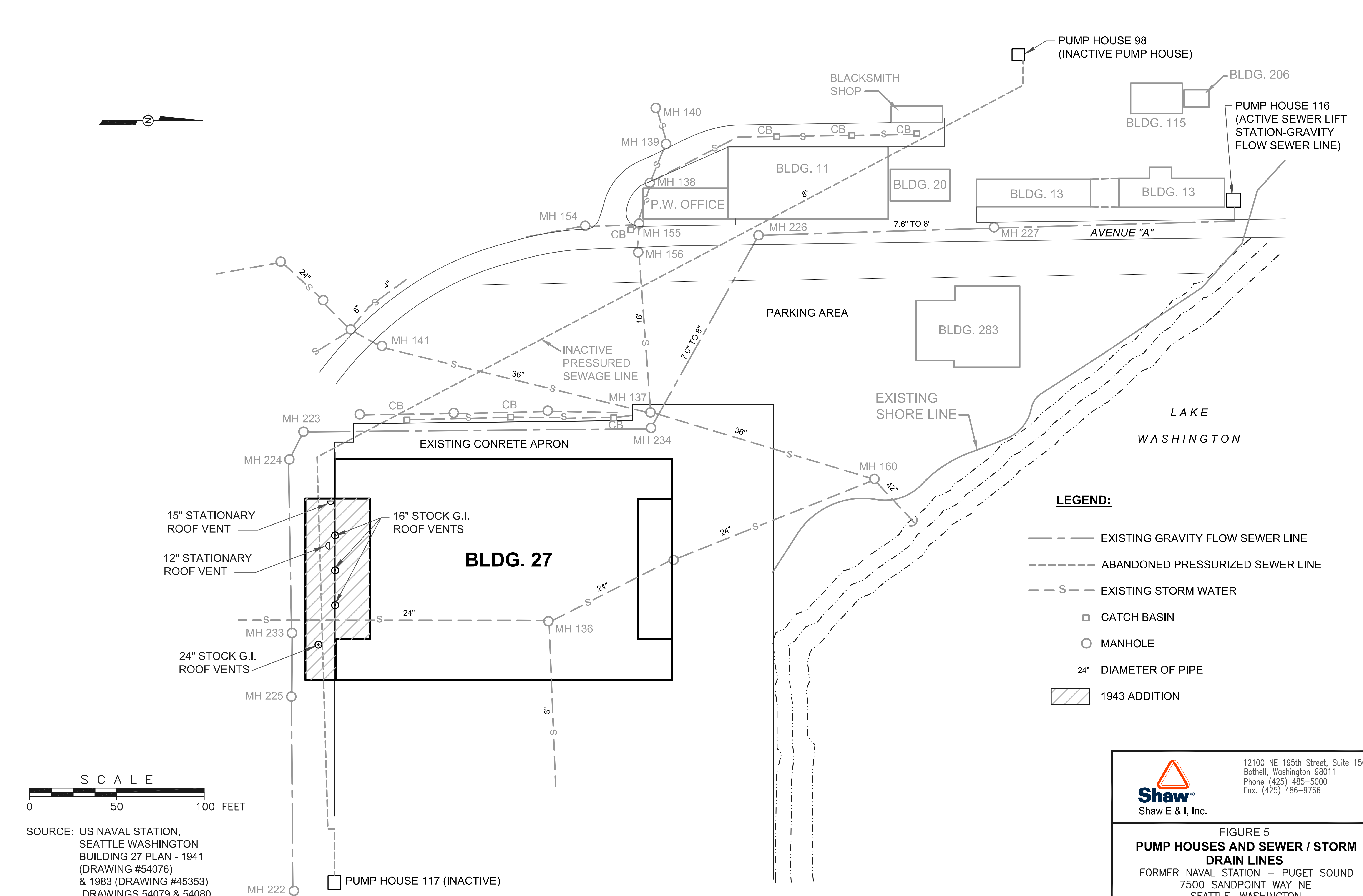
SCALE

0 20 40 FEET

SOURCE: US NAVAL STATION, SEATTLE WASHINGTON
BUILDING 2 PLAN - 1986 (DRAWING #50263)
1941 (DRAWING #50106)
1939 (DRAWING #50030)


Shaw®
Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766


FIGURE 4
**FLOOR PLAN OF BLDG. 2**
**(SECOND FLOOR)**
FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON




SOURCE: US NAVAL STATION, SEATTLE WASHINGTON
BUILDING 27 PLAN - 1941 (DRAWING #54076)
& 1983 (DRAWING #45353)
DRAWINGS 54079 & 54080

Shaw®
Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766

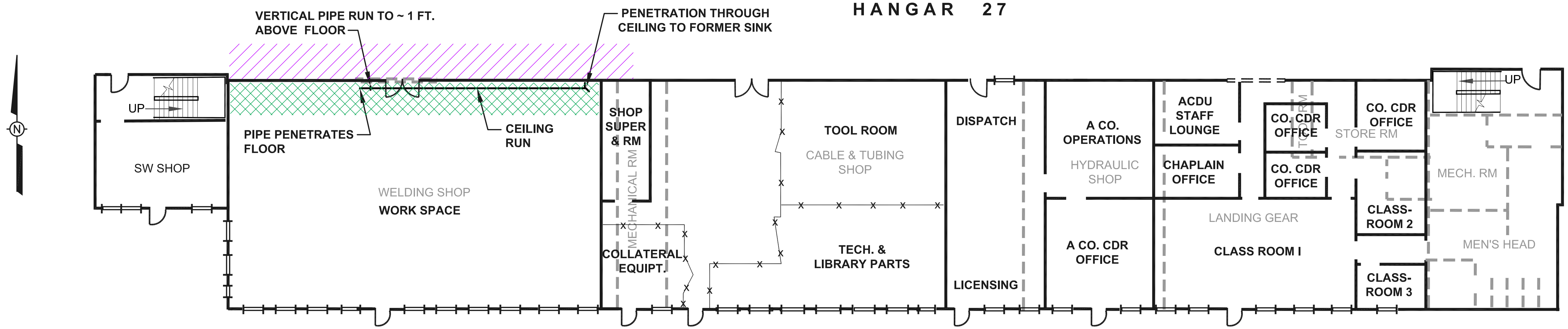
FIGURE 5
**PUMP HOUSES AND SEWER / STORM DRAIN LINES**
FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON

| OFFICE | DRAWN BY | CHECKED BY | APPROVED BY | DRAWING NUMBER |
|---|---|---|---|---|
| BOTHELL | MPortacio 10/2009 | CG 01/10 | CG 01/10 | BT-137165-BLDG-F5 |

XREF Files: IMAGE Files: 2835_001_Page_1.jpg 54076.tif BLDG27-1943.jpg ss_Page_2.jpg ss_Page_3.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-BLDG-F5.dwg Layout: FIGURE User: maria.portacio Jan 12, 2010 – 5:30pm

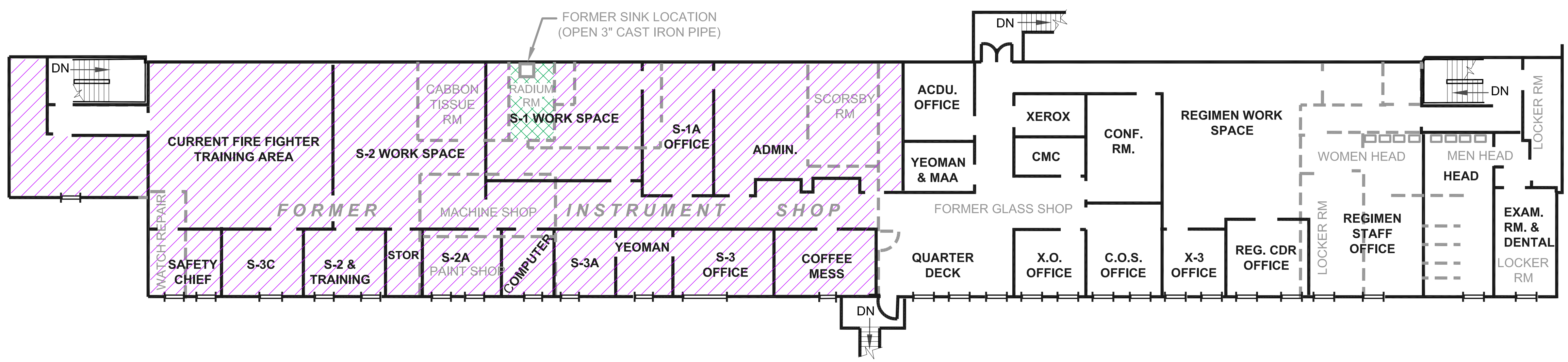
| OFFICE | DRAWN BY | CHECKED BY | APPROVED BY | DRAWING NUMBER |
|---|---|---|---|---|
| BOTHELL | MPortacio 10/2009 | CG 01/10 | CG 01/10 | BT-137165-B27-F7 |

## HANGAR 27




## FIRST FLOOR PLAN

## HANGAR 27




## SECOND FLOOR PLAN

SCALE

0 20 40 FEET

**LEGEND:**

OUTLINE OF BUILDING (1943)

OUTLINE OF BUILDING (1985)

**SURVEYS**

CLASS 1 (FLOOR) / CLASS 3 (WALLS)

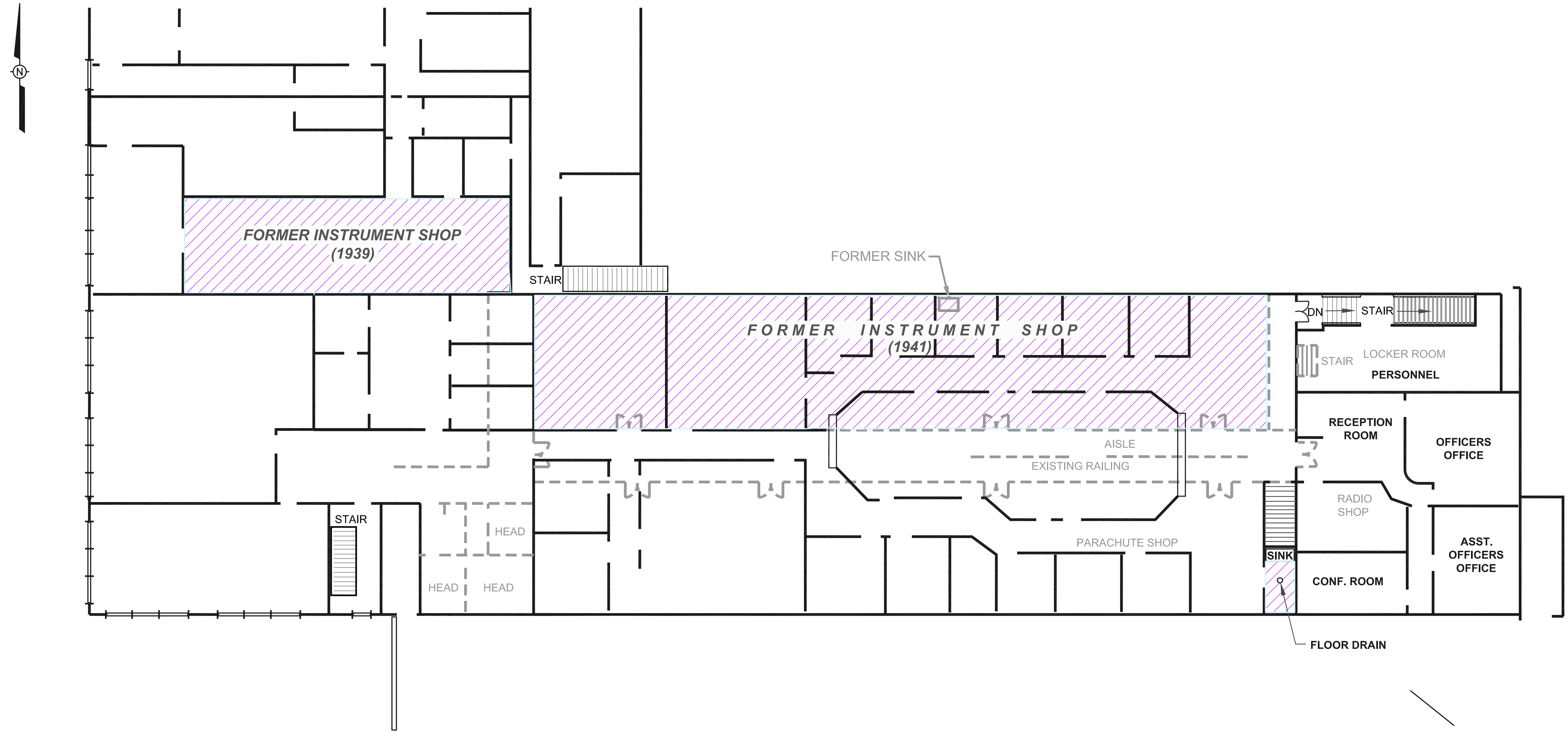
CLASS 2 (FLOOR) / CLASS 3 (WALLS)

SOURCE: US NAVAL STATION, SEATTLE WASHINGTON
BUILDING 27 PLAN - 1985 (DRAWING #54151)
1943 (DRAWING #54080)


Shaw®
Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766


FIGURE 6
**PROPOSED RADIOLOGICAL SURVEY**
**BLDG. 27**
FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON

XREF Files: IMAGE Files: 2835_001_Page_1.jpg BLDG27-1943.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-B27-F7.dwg Layout: FIGURE User: maria.portacio Jan 12, 2010 - 4:44pm




**LEGEND:**

- - - - OUTLINE OF BUILDING (1941)

—— OUTLINE OF BUILDING (1986)

**SURVEYS**

CLASS 2 (FLOOR) / CLASS 3 (WALLS)

SCALE

0 20 40 FEET

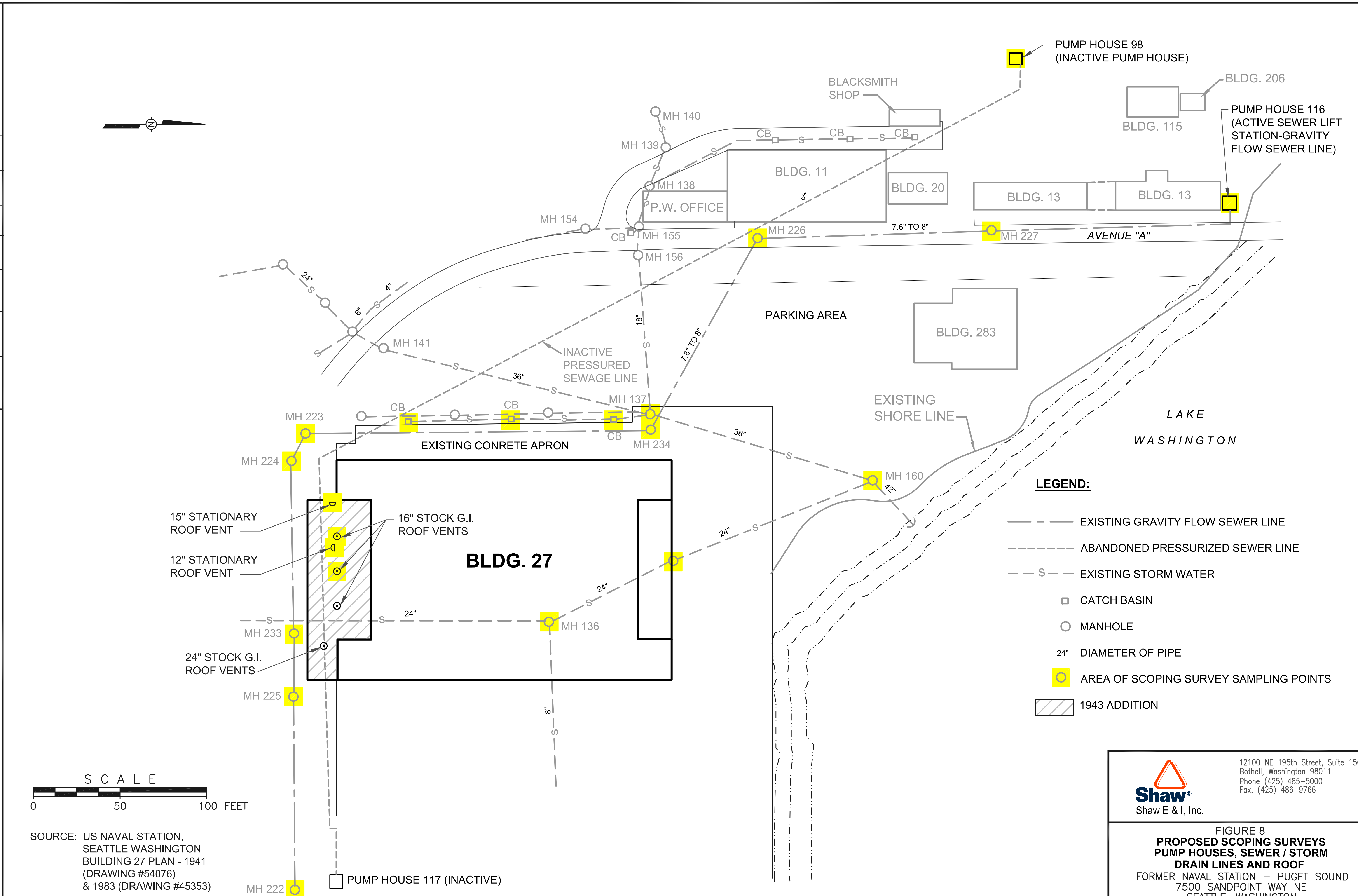
SOURCE: US NAVAL STATION, SEATTLE WASHINGTON
BUILDING 2 PLAN - 1986 (DRAWING #50263)
1941 (DRAWING #50106)
1939 (DRAWING #50030)

| OFFICE | DRAWN BY | CHECKED BY | APPROVED BY | DRAWING NUMBER |
|---|---|---|---|---|
| BOTHELL | MPortacio 10/2009 | CG 01/10 | CG 01/10 | BT-137165-B2-F7 |

XREF Files: IMAGE Files: 50106.tif 50172.tif bldg2-1986.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-B2-F7.dwg Layout: 11X17-L User: maria.portacio Jan 12, 2010 - 5:13pm


Shaw® Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766


FIGURE 7
**PROPOSED RADIOLOGICAL SURVEY**
**BLDG. 2 (SECOND FLOOR)**
FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON




SOURCE: US NAVAL STATION, SEATTLE WASHINGTON BUILDING 27 PLAN - 1941 (DRAWING #54076) & 1983 (DRAWING #45353)

| OFFICE | DRAWN BY | | CHECKED BY | | APPROVED BY | | DRAWING NUMBER |
|---|---|---|---|---|---|---|---|
| BOTHELL | MPortacio | 10/2009 | CG | 12/09 | CG | 12/09 | BT-137165-B27-F8 |

XREF Files: IMAGE Files: 2835_001_Page_1.jpg 54076.tif BLDG27-1943.jpg ss_Page_2.jpg ss_Page_3.jpg
File: N:\Project\draft\USNavy\Sandpoint TCRA\Drawings\BT-131833-B27-F8.dwg Layout: FIGURE User: maria.portacio Jan 12, 2010 - 5:39pm

Shaw®
Shaw E & I, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766

FIGURE 8
**PROPOSED SCOPING SURVEYS**
**PUMP HOUSES, SEWER / STORM DRAIN LINES AND ROOF**
FORMER NAVAL STATION – PUGET SOUND
7500 SANDPOINT WAY NE
SEATTLE, WASHINGTON

# APPENDIX A

## *QUALITY ASSURANCE PROJECT PLAN/SAMPLING AND ANALYSIS PLAN*

*DRAFT*

# QUALITY ASSURANCE PROJECT PLAN/ SAMPLING AND ANALYSIS PLAN

## TIME CRITICAL REMOVAL ACTION
## FORMER NAVAL STATION PUGET SOUND
## SEATTLE, WASHINGTON

CONTRACT NUMBER N62470-08-D-1007

**Prepared for:**

**U.S. Department of the Navy**
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315

**Prepared by:**
**Shaw Environmental and Infrastructure, Inc.**
12100 NE 195th Street
Bothell, Washington 98296

TASK ORDER FNZ4
SHAW PROJECT NO. 137165

JANUARY 2010

# QAPP Worksheet #1 – Title and Approval Page

Draft
Time Critical Removal Action at Former Naval Station Puget Sound
Former Naval Station Puget Sound, Seattle, Washington
Quality Assurance Project Plan (QAPP)/Sampling and Analysis Plan (SAP)
January 2010

Prepared for:

U.S. Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315

Prepared by:
Shaw Environmental and Infrastructure, Inc.
12100 NE 195th Street, Suite 150
Bothell, WA 98011-5763
425-485-5000

Prepared under:
Environmental Contract N62470-08-D-1007
Contract Task Order FNZ4

Review Signatures: ________________________ Date: ________________________
Christopher Generous
Shaw Environmental and Infrastructure, Inc.
Project Manager

Review Signatures:________________________ Date________________________
Rose Conduit
Shaw Environmental and Infrastructure, Inc.
Program Chemist

Approval Signatures: ________________________ Date: ________________________
Laurie Lowman
United States Navy Radiological Affairs Support Office

Approval Signatures: ________________________ Date: ________________________
Nars Ancog
United States Navy Quality Assurance Officer

# EXECUTIVE SUMMARY

This Quality Assurance (QA) Project Plan (QAPP)/Sampling and Analysis Plan (SAP) has been prepared by Shaw Environmental and Infrastructure, Inc. (Shaw) to support the Time Critical Removal Action (TCRA) at the Former Naval Station Puget Sound (NAVSTA PS). This QAPP/SAP, which includes worksheets and supporting documentation, was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans* (United States [U.S.] Environmental Protection Agency [EPA], 2005).

For this project Shaw will conduct radiological surveys and remediation in order to achieve unrestricted release of all potentially radiological impacted areas within the Former NAVSTA PS, in Seattle, Washington. A location map for Former NAVSTA PS identifying the approximate boundaries of the facility is shown in Figure 1.

During review of historical drawings as part of recent proposed renovations of Building 27, the City of Seattle (City) identified areas where radioactive materials may have been used or stored. The City conducted a radiation screening survey that identified areas in Building 27 where the radiation dose appears to exceed background. The City also conducted screening surveys in near-by Building 2 and a pump house connected to the storm/sewer line system. The results of the screening level survey of Building 2 and the pump house were inconclusive. The City contacted the U.S. Department of the Navy (Navy), regarding the potential need for action to address radiological contamination on the site. The radionuclide of concern (ROC) is radium-226 ($^{226}Ra$) based on historic use in Navy aircraft. The locations of Buildings 27 and 2 and the approximate areas of interest within the buildings are shown on Figure 2.

Activities that are planned in support of this project are summarized as follows:

- Perform radiological screening and characterization surveys of potentially impacted building sections to identify contamination above radiological criteria and verify the absence of radioactive materials in all other potentially impacted areas.
- Access and perform radiological screening on potentially impacted storm drain (SD) and sewer lines.
- Develop an Engineering Evaluation/Cost Analysis (EE/CA) and Action Memorandum in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan.
- Perform TCRA as identified in the approved Action Memorandum, providing remedial action support surveys to adequately protect workers, the public, and the environment.
- Perform the Final Status Survey (FSS) in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) as necessary to document removal of all radiological materials and the absence of any radiological materials above criteria.

The following QAPP/SAP provides project details, and the concurrence by Navy Radiological Affairs Support Office (RASO) of the final version of this document must be obtained prior to implementation.

## QAPP Worksheets

# Acronyms

| | |
|---|---|
| % | percent |
| α/β/γ | alpha/beta/gamma |
| BRAC | Base Realignment and Closure |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| City | City of Seattle |
| cm | centimeter |
| CoC | chain of custody |
| DCGL | derived concentration guideline level |
| DoD | United States Department of Defense |
| dpm | disintegrations per minute |
| DQA | data quality assessment |
| DQI | data quality indicator |
| ft | feet |
| EE/CA | Engineering Evaluation and Cost Analysis |
| EBS | Environmental Baseline Survey |
| EDD | electronic data deliverable |
| EPA | Environmental Protection Agency |
| FSS | final status survey |
| H&S | health and safety |
| $H_0$ | null hypothesis |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| LCD | laboratory control duplicate |
| LCS | laboratory control sample |
| m | meter |
| MARSSIM | Multi-Agency Site Survey Investigation Manual |
| MDA | minimum detected amount |
| MDL | method detection limit |
| MS | matrix spike (generally in association with MSD) |
| MSD | matrix spike duplicate |
| NAS | Naval Air Station |
| NAVFAC | Naval Facilities Engineering Command |
| NAVSTA PS | Former Naval Station Puget Sound |
| Navy | Department of the Navy |
| NOAA | National Oceanic and Atmospheric Administration |
| NRC | Nuclear Regulatory Commission |
| NTR | Navy Technical Representative |
| NW | Northwest |
| OSHA | Occupational Safety and Health Administration |
| pCi/g | picocuries per gram |
| pCi/L | picocuries per liter |
| PM | Project Manager |
| POC | point of contact |

# Acronyms (Continued)

| | |
|---|---|
| PQO | project quality objectives |
| QA | quality assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| QL | quantitation limit |
| QSM | Quality Systems Manual |
| $^{226}Ra$ | radium-226 |
| RASO | Radiological Affairs Support Office |
| RCT | radiological control technician |
| ROC | radionuclide of concern |
| RPD | relative percent difference |
| RPM | Remedial Project Manager |
| RSO | Radiation Safety Officer |
| RW | radiation worker |
| SAP | Sampling and Analysis Plan |
| SD | storm drain |
| Shaw | Shaw Environmental and Infrastructure, Inc. |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| SOP | standard operating procedure |
| SU | survey unit |
| SW | Southwest |
| TA | TestAmerica Laboratory, Saint Louis |
| TBD | to be determined |
| TCRA | time-critical removal action |
| TSA | Technical Systems Audit |
| UFP | Uniform Federal Policy |
| U.S. | United States |
| WMP | Waste Management Plan |

2

## QAPP Worksheet #2 – SAP Identifying Information

| | |
|---|---|
| Site Name/Number: | Former Naval Station Puget Sound (NAVSTA PS) |
| Contractor Name: | Shaw Environmental and Infrastructure, Inc. (Shaw) |
| Contract Number: | N62470-08-D-1007, |
| Contract Title: | Remedial Action Contract V NAVFAC Atlantic |
| Work Assignment Number (optional): | Contract Task Order FZN4 |

1. This SAP was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (U.S. EPA, 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (EPA, 2001), with additional guidance from:
    - *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (U.S. Department of Defense [DoD], 2000)
    - *Quality Systems Manual for Environmental Laboratories, Version 4.1 Final* (DoD, 2009)
    - *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4* (EPA, 2006)
    - *Environmental Work Instruction 1 – Chemical Data Validation* (Naval Facilities Engineering Command [NAVFAC], Southwest [SW], 2001)
    - *Environmental Work Instruction 2 – Review, Approval Revision, and Amendment of SAPs* (NAVFAC SW, 2006)
    - *Environmental Work Instruction EVR.4 – Implementing and Maintaining the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record and Compendium at NAVFAC Southwest* (NAVFAC SW, 2007)
    - *Environmental Work Instruction EVR.6 – Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW, 2005).
2. Identify regulatory program: CERCLA/Model Toxics Control Act.
3. This is a project-specific QAPP/SAP.
4. List dates of scoping sessions that were held:
    - Initial site walk and discussions on July 14, 2009
    - Site walk and investigation on September 1, 2009
    - Scoping meeting on September 2, 2009.
5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

| Title | Date |
|---|---|
| *None* | |

## QAPP Worksheet #2 – SAP Identifying Information (continued)



6. List organizational partners (stakeholders) and connection with lead organization:
   Example for project-specific SAPs:

| |
|---|
| EPA, Region 10 |
| Seattle Parks & Recreation |
| Washington Division of Environmental Health, Office of Radiation Protection |
| |

7. Lead organization: NAVFAC Northwest (NW)

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

| |
|---|
| None |

| UFP-QAPP Worksheet # | Required Information | Crosswalk to Related Information |
|---|---|---|
| A. Project Management | | |
| *Documentation* | | |
| 1 | Title and Approval Page | Worksheet # 1 |
| 2 | Table of Contents; SAP Identifying Information | Worksheet # 2 |
| 3 | Distribution List | Worksheet # 3 |
| 4 | Project Personnel Sign-Off Sheet | Worksheet # 4 |
| *Project Organization* | | |
| 5 | Project Organizational Chart | Worksheet # 5 |
| 6 | Communication Pathways | Worksheet # 6 |
| 7 | Personnel Responsibilities and Qualifications Table | Worksheet # 7 |
| 8 | Special Personnel Training Requirements Table | Worksheet # 8 |
| *Project Planning/ Problem Definition* | | |
| 9 | Project Planning Session Documentation (including Data Needs tables); Project Scoping Session Participants Sheet | Worksheet # 9 |
| 10 | Problem Definition, Site History, and Background. Site Maps | Section 10.1 |
| 11 | Site-Specific Project Quality Objectives (PQOs) | Worksheet # 11 |
| 12 | Measurement Performance Criteria Table | Worksheet # 12 |
| 13 | Sources of Secondary Data and Information<br>Secondary Data Criteria and Limitations Table | No secondary data used for this project |
| 14 | Summary of Project Tasks | Sections 14.1 – 14.7 |
| 15 | Reference Limits and Evaluation Table | Worksheet # 15a, 15b, 15c |
| 16 | Project Schedule/Timeline Table | Worksheet # 16 |

## QAPP Worksheet #2 – SAP Identifying Information (continued)



| UFP-QAPP Worksheet # | Required Information | Crosswalk to Related Information |
|---|---|---|
| B. Measurement Data Acquisition | | |
| *Sampling Tasks* | | |
| 17 | Sampling Design and Rationale | Sections 17.1 – 17.3 |
| 18 | Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table; Sample Location Map(s) | Worksheet # 18 |
| 19 | Analytical Methods/SOP Requirements Table | Worksheet # 19 |
| 20 | Field Quality Control (QC) Sample Summary Table | Worksheet # 20 |
| 21 | Project Sampling SOP References Table Sampling SOPs | Worksheet # 21 |
| 22 | Field Equipment Calibration, Maintenance, Testing, Inspection Table | Worksheet # 22 |
| *Analytical Tasks* | | |
| 23 | Analytical SOPs; Analytical SOP References Table | Worksheet # 23 |
| 24 | Analytical Instrument Calibration Table | Worksheet # 24 |
| 25 | Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table | Worksheet # 25 |
| *Sample Collection* | | |
| 26 | Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal ;Sample Handling Flow Diagram | Worksheet # 26 |
| 27 | Sample Custody Requirements, Procedures/SOPs Sample Container Identification; Example Chain-of-Custody (CoC) Form | Sections 27.1 – 27.6 |
| *Quality Control Samples* | | |
| 28 | QC Samples Table<br>Screening/Confirmatory Analysis Decision Tree | 28a, b, c |
| *Data Management Tasks* | | |
| 29 | Project Documents and Records Table | Worksheet # 29 |
| 30 | Analytical Services Table; Analytical and Data Management SOPs | Worksheet # 30 |
| C. Assessment Oversight | | |
| 31 | Planned Project Assessments Table; Audit Checklists | Worksheet # 31 |
| 32 | Assessment Findings and Corrective Action Responses Table | Worksheet # 32 |
| 33 | QA Management Reports Table | Worksheet # 33 |
| D. Data Review | | |
| 34 | Verification (Step I) Process Table | Worksheet # 34 |
| 35 | Validation (Steps IIa and IIb) Process Table | Worksheet # 35 |
| 36 | Validation (Steps IIa and IIb) Summary Table | Worksheet # 36 |
| 37 | Usability Assessment | Sections 37.1 – 37.3 |

# 1 SAP Worksheet #3 – Distribution List

| Name of SAP Recipients | Title/Role | Organization | Telephone Number (Optional) | E-mail Address or Mailing Address |
|---|---|---|---|---|
| Justin Peach | Navy Remedial Project Manager (RPM) | NAVFAC NW | (360) 396-0082 | justin.peach@navy.mil<br>NAVFAC Northwest<br>1101 Tautog Circle, Suite 203<br>Silverdale, WA 98315 |
| Nars Ancog | Navy Quality Assurance Officer (QAO) | NAVFAC SW | (619) 532-3048 | narciso.ancog@navy.mil<br>NAVFAC SW<br>Building 127, 1220 Pacific Highway<br>San Diego, CA 92132-5190 |
| Brian Cullen | Navy Technical Representative (NTR) | NAVFAC NW | (360) 396-0083 | brian.cullen@navy.mil<br>NAVFAC Northwest<br>1101 Tautog Circle, Suite 203<br>Silverdale, WA, 98315 |
| Debra McBaugh | DOHS Project Manager (PM) | Washington State, Department of Health, Division of Environmental Health, Office of Radiation Protection | (360) 236-3251 | Washington State Department of Health<br>Office of Radiation Protection<br>P.O. Box 47827<br>Olympia, Washington 98504-7827 |
| Marrell Livesay | Seattle Parks and Recreation Environmental Analyst Planning & Development | Seattle Parks & Recreation | (206) 684-7133 | Seattle Parks and Recreation<br>100 Dexter Ave N<br>Seattle, WA 98109 |
| Rose Condit | Shaw Program Chemist | Shaw | (925) 288-2151 | rose.condit@shawgrp.com<br>4005 Port Chicago Highway<br>Concord, CA 94520 |
| Chris Generous | Shaw Program Manager | Shaw | (425) 402-3208 | christopher.generous@shawgrp.com<br>12100 NE 195th, Suite 150<br>Bothell, WA 98011 |

| Name of SAP Recipients | Title/Role | Organization | Telephone Number (Optional) | E-mail Address or Mailing Address |
|---|---|---|---|---|
| Pat Moore | Shaw Site Safety and Health Officer (SSHO)/Project QC Manager<br>(maintains field copy of SAP) | Shaw | (425) 402-3222 | pat.moore@shawgrp.com<br>12100 NE 195th, Suite 150<br>Bothell, WA 98011 |
| Steve Crupi | Shaw Project Chemist<br>(maintains field copy of SAP) | Shaw | (907) 249-6312 | steve.crupi@shawgrp.com<br>2000 West International Airport Road<br>Anchorage, AK 99502 |

## QAPP Worksheet #4 – Project Personnel Sign-Off Sheet

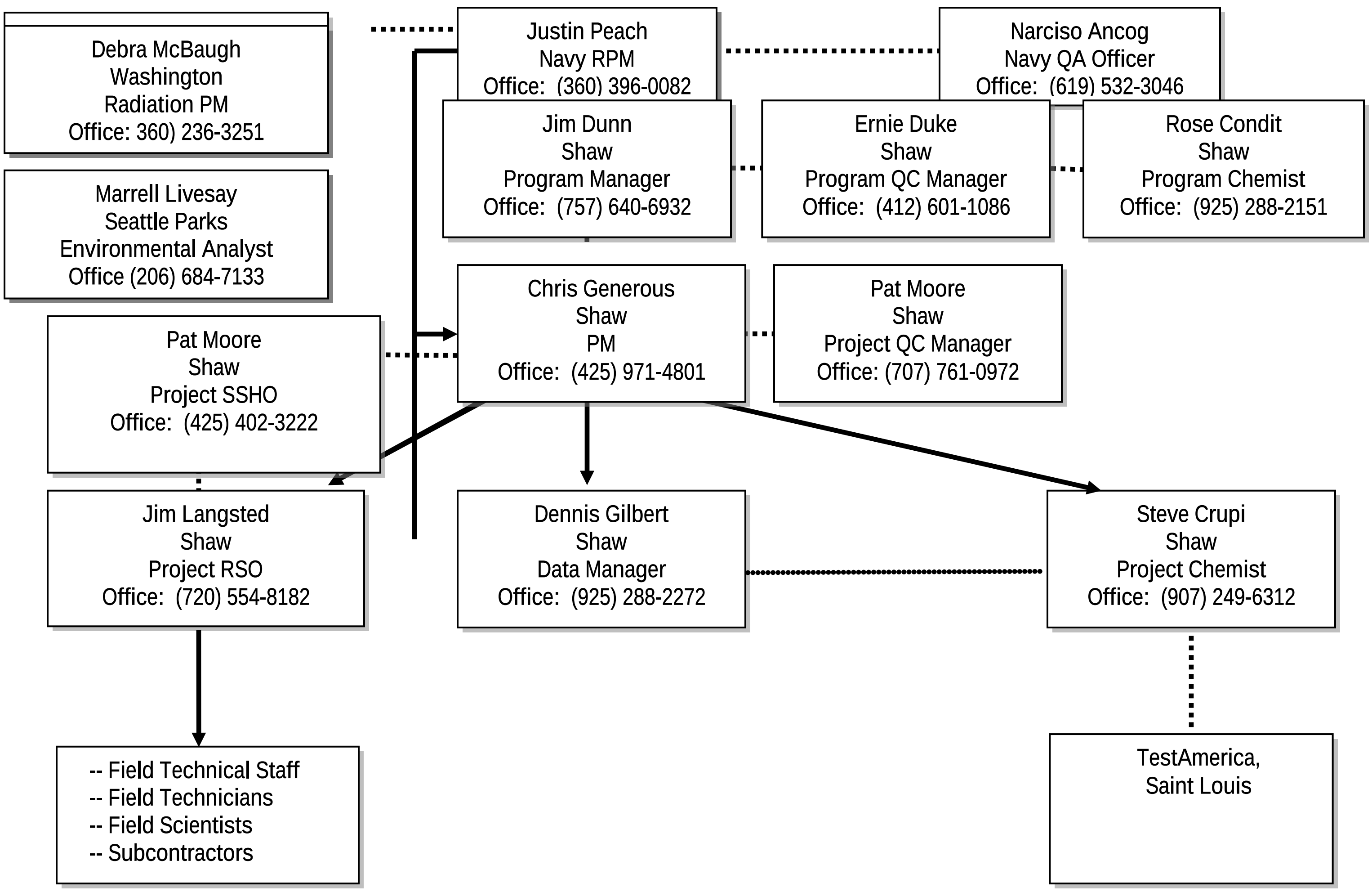
The Project Personnel Sign-Off Sheet will be used to document all key project personnel performing site work have read the applicable sections of the SAP and will perform the sampling and analysis tasks as described.

| Name | Organization/Title/Role | Signature/Email Receipt | Date SAP Read |
|---|---|---|---|
| Steve Crupi | Shaw, Project Chemist | | |
| Pat Moore | Shaw, Project QC Manager | | |
| Chris Generous | Shaw, PM | | |
| Jim Langsted | Shaw, Project Radiation Safety Officer (RSO) | | |
| TBD[1] | TestAmerica Laboratory, Saint Louis (TA) | | |
| TBD[1] | Data validation company | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

*1. TBD (to be determined) denotes person not yet assigned. TBD will be updated in the Final SAP.*

## SAP Worksheet #5 – Project Organization Chart

All lines of responsibility (solid lines) and lines of communication (dotted lines) are provided.



# SAP Worksheet #6 – Communication Pathways

| Communication Drivers | Responsible Affiliation | Name | Telephone Number and/or email | Procedure |
|---|---|---|---|---|
| Point of Contact (POC) with Navy RPM | Shaw Program Manager | Chris Generous | (425) 402-3208 | All materials and information about the project will be forwarded to RPM by PM. |
| SAP Changes in the Field | Shaw Project Chemist or Program Chemist | Steve Crupi<br>Rose Condit | (907) 249-6312<br>(925) 288-2151 | The Project Chemist is responsible for documenting field changes related to sampling and for informing or seeking approval from the Program Chemist or Navy QAO. The Project Chemist is also responsible for generating SAP amendments as necessary for approval by the Navy QAO. The Project Chemist oversees the documentation, notification and corrective actions associated with data collection issues. Due to the potential impact field changes and SAP amendments may have on the project, the Project Chemist is to be notified of such issues within 24 hours. |
| Construction or Sampling Quality Issues | Project QC Manager, Program Chemist or Program QC Manager | Pat Moore<br>Rose Condit<br>Ernie Duke | (425) 402-3222<br>(925) 288-2151<br>(412) 601-1086 | In general, the Project Chemist is the POC for sampling and chemistry issues and the Project QC Manager is the POC for other quality issues. If quality issues are not resolved at the project level (in consultation with the PM, site supervisor, technical lead, etc.), then the issue will be elevated to the Program QC Manager or the Program Chemist. The Program QC Manager or Program Chemist will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project QC Manager or Project Chemist oversees the documentation, notification and corrective actions associated with the QA issue in writing. |
| Health and Safety (H&S) Issues | SSHO | Pat Moore | (425) 402-3222 | The Project SSHO is the POC for H&S issues. If H&S issues are not resolved at the project level (in consultation with the PM, Site Supervisor, Technical Lead, etc.), then the issue will be elevated to the Program SSHO. The Program SSHO or designee will seek additional guidance or approval from the Navy SSHO, if necessary. Upon resolution, the Project SSHO oversees the documentation, notification, and corrective actions associated with the issue in writing. Due to the potential seriousness of H&S issues, the SSHO is to be notified of H&S issues immediately. |

## SAP Worksheet #6 – Communication Pathways (Continued)

| Communication Drivers | Responsible Affiliation | Name | Telephone Number and/or email | Procedure |
|---|---|---|---|---|
| Sample Collection Issues | Shaw Project Chemist or Program Chemist | Steve Crupi<br>Rose Condit | (907) 249-6312<br>(925) 288-2151 | The Project Chemist is the POC for sampling and chemistry issues. If sampling issues are not resolved at the project level (in consultation with the PM, Site Supervisor, Technical Lead, Geologist, etc.), then the issue will be elevated to the Program Chemist or Program QC Manager. The Program Chemist or Program QC Manager will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the QA issue in writing. Due to the potential impact sampling issues may have on the project, the Project Chemist is to be notified of sampling issues within 24 hours. |
| Laboratory Reporting or Data Quality Issues | Shaw Project Chemist/ Data Manager | Steve Crupi | (425) 971-6312 | The Project Chemist is the POC for laboratory issues. The Data Manager is the POC for electronic data deliverables (EDDs). If laboratory issues are not resolved with the Project Chemist or Data Manager, then the issue will be elevated to the Program Chemist. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the laboratory issue in writing. |
| Field Activity Issues | Shaw Technical Manager or Program Manager | Jim Langsted or Chris Generous | (720) 554-8187<br>(425) 971-4801 | The Technical Manager is the POC for all project site activities such as scheduling, staffing, subcontractors, field work, etc. The Technical Manager, in consultation with the PM and Navy RPM, if necessary, will resolve all project site issues. Upon resolution, the Site Supervisor oversees the documentation, notification, and corrective actions associated with site issues in writing. Due to the lower probability of site issues impacting the project significantly, the Site Superintendent is to be notified of site issues within 72 hours. |

# SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table

| Name | Title/Role | Organizational Affiliation | Responsibility |
|---|---|---|---|
| Justin Peach | Navy RPM | Navy | Manages governmental oversight of the project<br>Manages project funding and scope<br>Coordinates project documents review<br>Primary contact and liaison with regulatory agencies<br>Responsible for technical oversight of the project |
| Nars Ancog | Navy QAO | Navy | Provides governmental oversight of the Shaw QA Program<br>Provides quality-related directives through Contracting Officer's Technical Representative<br>Provides technical and administrative oversight of Shaw surveillance audit activities<br>Reviews and approves the SAP prior to regulatory review or field implementation<br>Acts as point-of-contact on all matters concerning QA and the client's Laboratory QA Program<br>Authorized to suspend project execution if QA requirements are not adequately followed |
| Chris Generous | Program Manager | Shaw | Manages oversight of the project for Shaw<br>POC for communication with the Navy RPM and Navy Contracts<br>Ensures that all requirements of the project contract are attained consistent with project plans<br>Oversees planning, execution, and conclusion of all project activities<br>Manages project budgets and schedules |
| Jim Langsted | Project RSO | Shaw | Oversees overall radiological operations and documentation for the project<br>Acts at the technical lead for radiological data collection and analysis<br>Ensures that the project personnel have adequate training in radiological protection and controls<br>Monitors the performance of radiological measurement process<br>Receives and reviews radioanalytical laboratory sample data to ensure data quality objectives are met |
| Rose Condit | Program Chemist | Shaw | Reviews and approves the SAP<br>Guides the selection of subcontract analytical laboratories<br>Conducts field and laboratory audits<br>Serves as a POC for the Navy QAO<br>Develops corrective action as required<br>Serves as a technical advisor to the project |
| Jim Langsted | Technical Manager | Shaw | Develops Work Plans to address the project scope of work<br>Prepares Work Plan variances, if necessary<br>Manages technical project elements<br>Reports to PM |

## SAP Worksheet #7 – Personnel Responsibilities and Qualifications Table (Continued)

| Name | Title/Role | Organizational Affiliation | Responsibility |
|---|---|---|---|
| Steve Crupi | Project Chemist | Shaw | Develops the PQOs and prepares the SAP<br>Selects qualified subcontract laboratories<br>Implements chemical data QC procedures and audits field performance<br>Reviews laboratory data prior to use<br>Performs validation of laboratory data<br>Reviews data validation report<br>Prepares the appropriate sections of the report summarizing the project sampling activities |
| Pat Moore | Project QC Manager | Shaw | Develops the project QC objectives and prepares the QCPlan<br>Administers the QC Plan<br>Manages QC documentation and QC deliverables<br>Lists definable features of work<br>Conducts inspections (preparatory, initial, follow-up, completions) |
| Pat Moore | SSHO | Shaw | Develops and administers the Site Safety and Health Plan (SSHP)<br>Manages personnel and environmental monitoring<br>Coordinates preparation of Job Safety Analyses<br>Selects appropriate personal protective equipment and facilitates daily safety meetings<br>Reviews essential H&S requirements with on-site personnel |
| Field Technician/ Scientist | Field Technician (sampling) | Shaw | Performs all sampling in accordance with the approved SAP<br>Ensures that field QC samples are collected as specified in the SAP<br>Completes field documentation and implements field corrective actions as required<br>Must have Occupational Safety and Health Administration (OSHA) 40-hour Certification and 8-hour OSHA Refresher Certification |

# QAPP Worksheet #8 – Special Personnel Training Requirements Table

Routine Training Requirements: All field personnel will be required to have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard Protection training, continued 8-hour HAZWOPER, and submit to medical surveillance, as required by OSHA. The Shaw SSHO will be responsible for ensuring that training and/or certification is met and that qualified personnel are performing the work.

| Project Function | Specialized Training - Description of Course | Training Provider | Training Date | Personnel / Groups Receiving Training | Personnel Titles / Organizational Affiliation | Location of Training Records and Certificates |
|---|---|---|---|---|---|---|
| PM | Radiation Worker (RW)[1] – classroom | Project RSO | Pre-mob | Permanent site | Shaw Project RSO | Project files |
| Project RSO | RW[2] - classroom, & practical | Project RSO | Pre-mob | Hands-on work | Shaw Project RSO | Project files |
| | Project-specific procedures | SSHO | Pre-work | Use procedures | Shaw Project Chemist | |
| SSHO | RW – classroom | Project RSO | Pre-mob | Permanent site | Shaw Project RSO | Project files |
| | Project-specific procedures | Project Chemist | Pre-work | Use procedures | Shaw Project Chemist | |
| Radiological Control Technician (RCT), Senior | RW - classroom, & practical | Project RSO | Pre-work | Hands-on work | Shaw RSO | Project files |
| | Project-specific procedures | Project Chemist | Pre-work | Use procedures | Shaw Project Chemist | |
| | Project-specific procedures | Project RSO | Pre-work | Radiation control work | Shaw Project RSO | |
| RCT, Junior | Project-specific procedures | Project RSO | Pre-work | Hands-on work | Shaw Project RSO | Project files |
| | Project-specific procedures | Project Chemist | Pre-work | Use procedures | Shaw Project Chemist | |
| | RCT practical factors | Project RSO | Pre-work | Radiation control work | Shaw Project RSO | |
| Laborer | RW - classroom, & practical | Project RSO | Pre-work | Hands-on work | Shaw Project RSO | Project files |
| | Project-specific procedures | Project Chemist | Pre-work | Use procedures | Shaw Project Chemist | |
| Project Chemist | RW - classroom, & practical | Project RSO | Pre-mob | Hands-on work | Shaw Project RSO | Project files |
| | Project-specific procedures | Project Chemist | Pre-work | Use procedures | Shaw Project Chemist | |
| Field Technician/ | RW - classroom, & practical | Project RSO | Pre-work | Hands-on work | Shaw Project RSO | Project files |

| Project Function | Specialized Training - Description of Course | Training Provider | Training Date | Personnel / Groups Receiving Training | Personnel Titles / Organizational Affiliation | Location of Training Records and Certificates |
|---|---|---|---|---|---|---|
| Field Scientist | Project-specific procedures | Project Chemist | Pre-work | Use procedures | Shaw Project Chemist | |
| Office Support | Project familiarity | PM | Pre-work | Project support | Shaw PM | Project files |
| Community Relations Specialist | Project familiarity | PM | Pre-work | Project support | Shaw PM | Project files |
| Asbestos abatement subcontractor | RW - classroom, & practical | Project RSO | Pre-work | Hands-on work | Shaw Project RSO | Project files |
| Roofing subcontractor | RW - classroom, & practical | Project RSO | Pre-work | Hands-on work | Shaw Project RSO | Project files |
| Video pipe inspection subcontractor | RW - classroom, & practical | Project RSO | Pre-work | Hands-on work | Shaw Project RSO | Project files |
| Site visitors | Project familiarity | Project RSO | Pre- visit[3] | Project support | Project RSO | Project files |

[1] RW training
[2] Will teach RW course
[3] For unescorted visit

# SAP Worksheet #9a – Project Scoping Session Participants Sheet

| | |
|---|---|
| Project Name: Time Critical Removal Action at Former Naval Station Puget Sound<br>Projected Date(s) of Sampling: Spring 2010 | Site Name: Sand Point |
| Project Manager: Chris Generous | Site Location: Seattle, WA |
| Date of Session: July 14, 2009 (Site Walk) | |

Scoping Session Purpose: Initial Site Walk for Former NAVSTA PS – Radiological Surveys and TCRA

| Name | Title | Affiliation | Phone # | E-mail Address | Project Role |
|---|---|---|---|---|---|
| Justin Peach | RPM | NAVFAC NW | (360) 396-0082 | justin.peach@navy.mil | RPM |
| Dina Ginn | Former RPM | NAVFAC NW | (360) 396-0016 | dina.ginn@navy.mil | Former RPM |
| Chris Generous | PM | Shaw | (425) 402-3208 | christopher.generous@shawgrp.com | PM |
| MaryAnn Hough | Contracting Specialist | NAVFAC SW | (619) 532-0791 | maryann.hough@navy.mil | Contracting Specialist |
| John Hamm | Radiological Program Manager | Shaw | (505) 259-1232 | john.hamm@shawgrp.com | Program Technical Lead/Project RSO |
| Jarvis Jensen | | RASO | (757) 887-4483 | jarvis.jensen@navy.mil | |
| Matt Slack | | RASO | (757) 887-4692 | | |
| Jodi Sinclair | Senior Environmental Analyst | Seattle Parks and Recreation | (206) 684-7292 | Jodi.Sinclair@Seattle.Gov | |
| Kevin Bergsrud | Senior Planning and Development Specialist | Seattle Parks and Recreation | (206) 684-5831 | Kevin.Bergsrud@Seattle.Gov | |
| Marrell Livesay | Environmental Analyst | Seattle Parks and Recreation | (206) 684-7133 | Marrell.Livesay@Seattle.Gov | |
| Comments/Decisions: | Radiological contamination observed | | | | |
| Action Items/ Decisions | Prepare project approach/cost estimate | | | | |

# 1 QAPP Worksheet #9b – Project Scoping Session Participants Sheet

| | |
|---|---|
| Project Name: Time Critical Removal Action at Former Naval Station Puget Sound<br>Projected Date(s) of Sampling: Spring 2010 | Site Name: Buildings 2 and 27 |
| Project Manager: Chris Generous | Site Location: Former NAVSTA PS, Seattle, Washington |
| Date of Session: September 2, 2009 (Site Walk) | |
| Scoping Session Purpose: Follow-up Site Walk for Survey and Sampling | |

| Name | Title | Affiliation | Phone # | E-mail Address | Project Role |
|---|---|---|---|---|---|
| Justin Peach | RPM | NAVFAC NW | (360) 396-0082 | justin.peach@navy.mil | RPM |
| Chris Generous | PM | Shaw | (425) 402-3208 | christopher.generous@shawgrp.com | PM |
| Jim Langsted | Project RSO | Shaw | (720) 554-8182 | jim.langsted@shawgrp.com | Radiation Controls Manager |
| Pat Moore | SSHO/Project QC Manager | Shaw | (425) 402-3222 | pat.moore@shawgrp.com | Technical Lead |
| Kevin Bergsrud | Senior Planning and Development Specialist | Partnerships Unit Seattle Parks & Recreation | (206) 684-5831 | kevin.bergsrud@seattle.gov | Organization Contact |
| Comments/Decisions: | • Second instrument shop in Building 2<br>• Pump House 117, Pump House 98, and valve pit are part of former pressurized sewer line system<br>• Perform a dye test to determine if exposed sewer line flows in gravity flow sewer system | | | | |
| Action Items/ Decisions | Revise project approach/cost estimate | | | | |

# SAP Worksheet #9c – Project Scoping Session Participants Sheet

| | |
|---|---|
| Project Name: Time Critical Removal Action at Former Naval Station Puget Sound | Site Name: Sand Point |
| Projected Date(s) of Sampling: Spring 2010 | |
| Project Manager: Chris Generous | Site Location: Seattle, WA |
| Date of Session: September 3, 2009 (Meeting in Silverdale) | |

Scoping Session Purpose: Cost Negotiations meeting for Former NAVSTA PS – Radiological Surveys and TCRA

| Name | Title | Affiliation | Phone # | E-mail Address | Project Role |
|---|---|---|---|---|---|
| Dina Ginn | NTR | NAVFAC NW | (360) 396-0016 | dina.ginn@navy.mil | NTR |
| Justin Peach | RPM | NAVFAC NW | (360) 396-0082 | justin.peach@navy.mil | RPM |
| Chris Generous | PM | Shaw | (425) 402-3208 | christopher.generous@shawgrp.com | PM |
| Jim Langsted | Technical Lead/Project RSO | Shaw | (720) 554-8182 | jim.langsted@shawgrp.com | Technical Lead |
| MaryAnn Hough | Contracting Specialist | NAVFAC SW | (619) 532-0791 | maryann.hough@navy.mil | Contracting Specialist |
| Jim Dunn | Program Manager | Shaw | (757) 640-6932 | james.dunn@shawgrp.com | Program Manager |
| Comments/Decisions: | Further Scope Definition/Cost Estimating | | | | |
| Action Items/ Decisions | Finalize and negotiate cost estimate | | | | |

# QAPP Worksheet #10 – Problem Definition

The planning team consists of the representatives of the Navy and Shaw with input from the City of Seattle Park Department. The Navy is the lead federal agency for the direction of the site activities and the prime decision maker.

Due to previous activities, NAVSTA PS contains potentially radiologically impacted areas. The ROC is $^{226}$Ra. Shaw will perform characterization surveys, remediation, remedial action support surveys and FSSs at potentially radiologically impacted sites at NAVSTA PS. The objectives of this contract task order are to conduct characterization surveys, TCRA, and FSS to address radiological contamination identified in building materials, and associated sewer and SD lines for Building 27 and for Building 2 and the storm/sewer pump house.

## 10.1 CONCEPTUAL SITE MODEL

### 10.1.1 NAVSTA PS Background

Former NAVSTA PS is located approximately 6 miles northeast of downtown Seattle on the western shore of Lake Washington. Former NAVSTA PS was initially named Naval Air Station (NAS) Seattle at Sand Point. The facility was built in 1925 on land donated by King County and served as a Naval Air Reserve Training facility until December 7, 1941.

During World War 2, NAS Seattle supported air transport and ship outfitting personnel for the Alaskan and Western Pacific theaters of operation. Transport squadron personnel operated cargo flights to Alaska and the Aleutian Islands, supplying air stations such as Sitka, Kodiak, Dutch Harbor, Adak, and Attu. Outfitting personnel handled the preparation of escort carriers and seaplane tenders built in Tacoma and Vancouver, Washington prior to departure. In 1945, the peak of its activity, the facility supported more than 4,600 Navy/Marine Corps and civilian personnel. After the war, the facility was designated a Naval Reserve Air Station. From 1945 to 1970, the station maintained Naval Reserve squadrons for supplementing active duty forces, both continental U.S. and abroad. Aviation activities officially ceased on June 30, 1970, and NAS Seattle was decommissioned.

On July 1, 1970, NAS Seattle was redesignated Naval Support Activity, Seattle. Three years after the Navy stopped its air activities, the facility was divided into three parts. National Oceanic and Atmospheric Administration (NOAA) received 100 acres, including one third of the runways and 3,500 feet of waterfront. The City received the southeast portion including approximately one mile of waterfront that later became Magnuson Park in 1977. The Navy retained the rest. From 1970 until April 1982, the base provided logistic services such as supply, billeting, and administration to the 13th Naval District, DoD and other federal agencies. In April 1982, Naval Support Activity, Seattle was designated Naval Station, Seattle. In October 1986, it was designated NAVSTA PS as a result of the station's increasing support role in the Pacific fleet activities.

In June 1991, the Base Realignment and Closure (BRAC) Commission of the DoD announced the closure of former NAVSTA PS. In accordance with recommendations of the 1991 BRAC Commission, the Navy closed former NAVSTA PS in September 1995. A disestablishment ceremony was held on September 28, 1995, to commemorate the closing of the base.

Subsequent to closure, the Navy conducted environmental investigations and cleanup of portions of the facility. The condition of the property was described in the Environmental Baseline Survey (EBS) report. The EBS describes the significant operations and existing conditions at specific buildings and areas at former NAVSTA PS that were addressed in past environmental investigations. The EBS identified areas with potential environmental concern where storage or release of hazardous substances had occurred. This document was used by the Navy to generate the Finding of Suitability to Transfer for the property. After completion of these actions as well as the appropriate National Environmental Policy Act actions, the Navy initiated transfer of the former NAVSTA PS property to several government agencies in accordance with the BRAC closure plan.

The Navy transferred portions of the facility to the City for recreational development. Due to a long history of use of the facility by the Navy, and because of the potential that the environmental investigations conducted did not identify all environmental hazards that pose a threat to human health and the environment, the transfer deed between the Navy and the City included an environmental covenant that allowed the City to seek action by the Navy to address contamination that was not identified in the EBS.

### 10.1.2 Building 27

Building 27 was originally constructed as a hangar for the Navy. Currently, Building 27 is vacant. At the south end of the building are two interior stories of storage, offices, and restrooms. The second floor is accessible by staircases. Site drawings dated 1943 indicate that an instrument shop on the second floor, including a Radium Room, may have been used for handling low-level radioactive materials. Drawings dated 1985 indicate that the building was subsequently renovated during which the Radium Room was reconfigured and renamed the S-1 Work Space. Figure 3 presents both the 1943 and 1985 room configurations. The first and second floors of Building 27 are currently unoccupied.

The S-1 Work Space (formerly the Radium Room) now contains a wall of mailboxes on the south wall. On the north wall, a sink has been removed, but the open drainpipe and capped water supply pipes are in place. A ventilation duct located in the ceiling has also been removed, but the approximately 2-foot-by-2-foot penetration is open to the ceiling space above (Figure 3). The floor is covered with 9-inch square floor tiles that, along with the mastic, are typically asbestos-containing material.

The center portion of the building comprises the former hangar space. It has a concrete floor and steel framing. The center portion is currently not in use other than for isolated and random storage.

#### 10.1.3 Building 2

Building 2, located west of the NOAA facilities, formerly housed the Marine Corps Reserve motorpool and offices. The building, constructed in 1938, was an active air hangar until the NAS was decommissioned in 1970. Airplane maintenance and storage activities at Building 2 (also called Hangar 2) may have involved the use of self-luminescent radium paint for the maintenance and repair of aircraft instruments and parts.

The center part of Building 2 comprises the former hangar space. It has a concrete floor and steel framing and is currently used as a recreation facility. The northern portion of the building is utilized for storage, offices, and restrooms. There are unoccupied areas on the second floor of the building including two former Instrument Rooms. The second floor is accessible by staircases. Figure 4 outlines the floor plan of the building, as documented in 1941 and 1986. There is also an area of interest located in the southeast corner of Building 2 (Figure 4). This area is a small room that currently contains a two-basin sink and a floor drain located in the center of the tile floor

#### 10.1.4 Sanitary Sewer System

Pump House 116 handles sewage wastewater from the gravity flow sewer line present south and west of Building 27 (see Figure 5 of the Work Plan). Historically, Pump House 116 discharged wastewater into Lake Washington. Pump House 116 is located on the shoreline nearest to Building 11 and the North Shore Recreation Area. It is a one-story building with a single sub-grade room that contains wastewater systems and machinery. The machinery is accessible by a staircase from the ground-level landing. Currently, Pump House 116 pumps wastewater to the city sewer system.

#### 10.1.5 Abandoned Pressurized Sewer Line

The inactive pressurized sewer line runs from Pump House 117, which is east of Building 27, west to the western side of Building 27, and then northwest to Pump House 98 (inactive pump house at old sewerage treatment plant). The radiological survey for this line will also be conducted in three phases, with potentially the inclusion of power washing of the pump houses.

#### 10.1.6 Storm Water Drainage System

The existing storm water system runs next to and under Building 27 and discharges into Lake Washington. A manhole (#136) located in the hanger area of Building 27 provided a potential point of contamination. The SD line runs from this point toward a manhole (#160) located in the current marina area. Three surface water catch basins are also located along the west side of Building 27. These along with manhole 137 provide additional points of potential contamination.

#### 10.1.7 Time Critical Removal Actions

The proposed radiological surveys and TCRAs for Building 27, Building 2, and the sewer and storm lines and pump houses are presented on Figures 6, 7, and 8 of the Work Plan. The Work Plan provides the details of the work to be performed including this QAPP/SAP, as well as the Waste Management Plan

(WMP), Accident Prevention Plan and SSHP, Radiation Protection Plan, Environmental Protection Plan, and Program Quality Control Plan Addendum.

# 1 QAPP Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements

<table>
<tr><td>Step 1</td><td>Define the problem that necessitates the study.</td></tr>
<tr><td colspan="2">Historical drawings of NAVSTA PS Buildings 2 and 27 indicate areas where aircraft instruments were serviced. One area is labeled “Radium Room,” consistent with the use of $^{226}Ra$ containing self-luminescent paint during this period. Radiological measurements performed on behalf of the facility owner indicate elevated exposure rates in a sink drain associated with the Radium Room. Sewer lines and associated Pump Houses, and SD lines associated with this area are potentially impacted. Significant remodeling has occurred subsequent to radium operations.<br><br>Shaw will implement basic radiation survey protocols in potentially radiologically impacted areas to achieve unrestricted release.</td></tr>
<tr><td>Step 2</td><td>Identify the Goal of the Study</td></tr>
<tr><td colspan="2">The goal of the sampling activities are to survey and sample the following locations to identify radiological contamination in excess of identified threshold values:<br><br>• Existing floors and walls<br>• Overhead ceilings and exhaust vents<br>• Roofing in proximity to suspect exhaust vents<br>• Sub-flooring in suspect areas<br>• Accessible sewer and SD lines, manholes, and catch basins to identify radiological contamination in excess of identified threshold values<br>• Video inspection of sewer and SD lines to identify pipe breaks and significant sludge buildup<br>• Remove materials in excess of identified threshold values and perform FSSs sufficient to allow free release for unrestricted use</td></tr>
<tr><td>Step 3</td><td>Identify Information Inputs</td></tr>
<tr><td colspan="2">• Background measurements in non-potentially impacted areas of materials similar to those evaluated in potentially impacted areas<br>• Scoping Surveys taken to initially identify radiological contamination<br>• Characterization Surveys performed in detail appropriate for contamination potential, to identify contamination or to verify absence of contamination in excess of identified thresholds. These surveys will be performed in sufficient detail to provide FSS data if contamination in excess of identified thresholds is not identified.<br>• Remedial Action Support Surveys taken to guide remediation of any areas identified in excess of identified thresholds<br>• FSS performed in remediated areas to verify cleanup to levels below identified thresholds<br><br>Measurements will include:<br>• Radiochemical analysis at offsite analytical laboratory<br>• Scanning surveys of surfaces for Total alpha/beta/gamma (α/β/γ)<br>• Stationary counts of surfaces for Total α/β/γ<br>• Swipe surveys for Removable α/β/γ<br>• Video inspection.</td></tr>
</table>

## QAPP Worksheet #11 – Project Quality Objectives/Systematic Planning Process Statements (Continued)

| Step 4 | Define the Boundaries of the Study |
|---|---|
| The potentially radiologically impacted areas to be evaluated under this project are described below:<br>• Existing sewer line associated with previous sink located in Radium Room<br>• Local concrete floors immediately below Radium Room sink sewer line and in hanger area adjacent to sewer line wall<br>• B27 Instrument Shop including identified Radium Room<br>• SD lines, manholes, and catch basins associated with B27<br>• Gravity flow sewer lines and associated pump houses, manholes, and the pump house associated with B27<br>• Abandoned pressurized sewer line from B27 to vault located at site of old sewer treatment plant<br>• B2 Instrument Shop areas (two identified areas) | |
| Step 5 | Develop the Analytic Approach |
| • If the survey results demonstrate compliance with the release criteria, then the results shall be documented in the final FSS report.<br>• If the survey results do not demonstrate compliance with the release criteria, then additional assessment and/or remediation are necessary | |
| Step 6 | Specify Performance or Acceptance Criteria |
| To limit uncertainty in obtained environmental data, criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and minimum detectable limits for the ROC have been developed. Measurement errors will be controlled by using appropriate sampling and analytical methods and following established SOPs. MARSSIM guidelines will be used and a 95% confidence level for detecting radioactivity above the release levels will be assumed with Type I and II errors limited to 5%. | |
| Step 7 | Plan the Design for Obtaining Data |
| The survey design specified for use in the Work Plan (Radiological Work Process) was developed to perform radiological FSS based on MARSSIM guidelines. Specific details regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected and investigation levels are discussed in the Work Plan. | |

## QAPP Worksheet #12a – Measurement Performance Criteria Table – Field QC Samples

| | |
|---|---|
| Matrix | Sludge |
| Analytical Group[1] | Radiochemical Analysis[4] |
| Concentration Level | All |

| Sampling Procedure[5] | Analytical Method/SOP[3] | Frequency | Data Quality Indicators (DQIs) | Measurement Performance Criteria | QC Sample and/or Activity Used to Assess Measurement Performance | QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A) |
|---|---|---|---|---|---|---|
| SOP-12 | Lab Procedure[6] | 1 per 20 samples | Precision | Relative percent difference (RPD)≤20% for both above minimum detected amount (MDA) | Field Duplicate | S |
| | | 1 per analytical batch of ≤20 samples | Accuracy | TBD[7] | Method Spike | A |
| | | 1 per 20 samples or one per day | Accuracy/Bias | <MDA | Field Blank | S |
| | | One per sampling event | Accuracy/Bias | <MDA | Equipment Rinse Blank | S |
| | | One per shipping batch | Accuracy/Bias | <MDA | Trip Blank | S |
| | | One per analytical batch of ≤20 samples | Precision | Established by lab QA program; approved by Shaw | Laboratory Duplicate | A |
| | | One per analytical batch of ≤20 samples | Accuracy/Bias | <MDA | Laboratory Blank | A |

4 Radiochemical Analysis refers to analytical laboratory analysis of sludge samples for $^{226}$Ra concentration
5 Reference number from QAPP Worksheet #21
6 Reference number from QAPP Worksheet #23
7 TBD denotes lab will provide. Will be updated in Final QAPP/SAP

## QAPP Worksheet #12b – Measurement Performance Criteria Table – Field QC Samples

| | |
|---|---|
| Matrix | Surface |
| Analytical Group[1] | Removable α/β/γ[8] |
| Concentration Level | All |

| Sampling Procedure[9] | Analytical Method/SOP | Frequency | DQIs | Measurement Performance Criteria | QC Sample and/or Activity Used to Assess Measurement Performance | QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A) |
|---|---|---|---|---|---|---|
| SOP-18 | SOP-18 | 1 per 20 samples | Precision | RPD≤20% for both above MDA | Field Duplicate | S |
| | | 1 per 20 samples or 1 per day | Accuracy/Bias | <MDA | Field Blank | S |

[8] Removable α/β/γ refers to smear samples taken on potentially contaminated surfaces to determine the quantity of contamination that can be removed from the surface. These samples are analyzed onsite in a counter capable of separately detecting alpha emissions and combined beta/gamma emissions
[9] Reference number from QAPP Worksheet #21

## QAPP Worksheet #12c – Measurement Performance Criteria Table – Field QC Samples

| | |
|---|---|
| Matrix | Surface |
| Analytical Group[1] | Total α/β/γ[10] |
| Concentration Level | All |

| Sampling Procedure[11] | Analytical Method/SOP[3] | Frequency | DQIs | Measurement Performance Criteria | QC Sample and/or Activity Used to Assess Measurement Performance | QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A) |
|---|---|---|---|---|---|---|
| SOP-18 | SOP-18 | 1 per 20 measurement | Precision | RPD≤20% for both above MDA | Field Duplicate | S |
| | | Background performed 1 per 20 measurements (minimum 1 per day) | Accuracy/Bias | <MDA | Field Blank (Background) | S |

[10] Total α/β/γ refers to stationary measurements taken on a potentially contaminated surface to determine the quantity of fixed + removable contamination on the surface. These measurements are taken using a survey meter capable of separately measuring alpha emissions and beta/gamma emissions
[11] Reference number from QAPP Worksheet #21

## QAPP Worksheet #12d – Measurement Performance Criteria Table – Field QC Samples

| | |
|---|---|
| Matrix | Surface |
| Analytical Group[1] | Floor Monitor α/β/γ[12] |
| Concentration Level | All |

| Sampling Procedure[13] | Analytical Method/SOP[3] | Frequency | DQIs | Measurement Performance Criteria | QC Sample and/or Activity Used to Assess Measurement Performance | QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A) |
|---|---|---|---|---|---|---|
| SOP-20 | SOP-20 | 5% of floor monitored | Precision | RPD≤20% for both above MDA | Field Duplicate | S |
| | | Background location 1 per 5% of floor monitored or 1 per day | Accuracy/Bias | <MDA | Field Blank | S |

[12] Floor Monitor α/β/γ refers to measurements taken with a scanning (rolling) monitor capable of measuring total (fixed + removable) contamination on the floor surface. This monitor separately measures alpha emissions and beta/gamma emissions
[13] Reference number from QAPP Worksheet #21

## QAPP Worksheet #13 – Secondary Data Criteria and Limitations Table

| Secondary Data | Data Source (originating organization, report title and date) | Data Generator(s) (originating organization, data types, data generation / collection dates) | How Data Will Be Used | Limitations on Data Use |
|---|---|---|---|---|
| No Secondary Data for this Project | | | | |

# QAPP Worksheet #14 – Summary of Project Tasks

## 14.1 SCOPE OF WORK

One area within Building 27 and two areas within Building 2 are considered potentially radiologically impacted. Other designated potentially radiologically impacted areas at NAVSTA PS include portions of the SD system, portions of the gravity flow sewer system, and portions of the abandoned pressurized sewer system.

The work activities that will be performed in potentially radiologically impacted areas include those in the following table:

| | |
|---|---|
| Scoping Survey | Perform radiological scoping survey of impacted areas in Building 27, Building 2, associated roof vents, and Pump Houses. |
| Remove Exposed Sewer Piping | Remove and containerize exposed piping located below the former Radium Room in Building 27 (associated with sink previously located in the former Radium Room). |
| Utility Locate/Dye Tracer | To identify whether the removed section of pipe was connected to the gravity flow sewer line or the abandoned pressurized sewer line, a utility locate, dye tracer, or another appropriate method will be conducted. |
| Background Determination | Conduct background radiological survey and sludge sampling to provide baseline data. |
| Sewer and Storm Line Sludge Sampling | Collect sludge samples at gravity feed sewer manholes, storm line manholes and catch basins, valve pit, and pump houses 98 and 116. |
| Fire Training Maze Removal | Remove fire training area from second floor of Building 27. |
| Clean Area | Remove all furniture, debris, carpeting, and clean area with high efficiency particulate air filtered vacuums. |
| Asbestos Abatement | Remove, handle, and transport asbestos contaminated tile and subflooring material including fire training area within the impacted areas of Building 27 and Building 2. |
| Characterization Survey –impacted areas | Perform radiological characterization survey of impacted areas in Building 27 and Building 2. |
| Remove contaminated subflooring | Remove contaminated subflooring and walls. |
| FSS – subflooring | Perform FSS on removal areas. |
| Remove roofing | Remove roofing at identified sampling points for sampling between and beneath. |
| FSS – Roofing | Perform characterization survey of impacted roofing. |

| | |
|---|---|
| Repair Roofing | Repair and replace disturbed roofing. |
| Characterization Survey & Sampling – Storm & Sewer Lines | Perform radiological sampling and survey of SD and sanitary sewer piping at accessible manholes and two pump houses. |
| Video Survey | Conduct camera surveys of sewer and SD lines. |
| Power wash and Jet Clean Storm & Sewer Lines | If evidence of radiological contamination or significant sediment is detected during radiological survey or camera survey, power wash storm and sewer lines including drains and manholes. |
| FSS - Storm & Sewer Lines | Perform FSS storm and sewer lines. |
| Power Wash Pump Houses | Power wash pump houses. |
| FSS – Storm & Sewer lines | Perform FSS of the pump houses. |
| EE/CA | Prepare an EE/CA and Action Memorandum on any areas identified for TCRA. |
| TCRA | Conduct TCRA as necessary. |
| FSS – TCRA areas | Conduct FSSs of TCRA areas in accordance with MARSSIM survey standards. |
| After Action Reports | Prepare After Action Reports. |

## 14.2 SAMPLE COLLECTION METHODS AND PROCEDURES

The following sections describe the sampling methods and procedures that will be used for this project depending on the media being sampled. Soil samples may be collected from SD or sanitary sewer trenches or from off-site borrow sources.

### 14.2.1 Sludge Sampling

Site-specific sludge sampling method is TBD.

### 14.2.2 Water Sampling

Sampling of Aqueous Liquids via Bailer, EI-FS109, Rev 1, 9/11/06

## 14.3 SURVEY METHODS

### 14.3.1 Survey Area Classification

Historical review and surveys have identified areas at NAVSTA PS that have been classified as potentially impacted. Based on available information from previous surveys and the historical review, each area will be given a classification. Potentially impacted areas are divided into one of three classifications as described below.

### 14.3.2 Class 1 Areas

In general, Class 1 areas have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above the weighted derived concentration guideline level ($DCGL_W$). Examples of Class 1 areas include:

- Site areas previously subjected to remedial actions,
- Locations where leaks or spills are known to have occurred,
- Room sink sewer line,
- Former burial or disposal sites,
- Waste storage sites (MARSSIM [DoD, 2000], Section 2.2).

Specifically, based on current knowledge the anticipated Class 1 areas are indicated in Work Plan, Figure 6. This includes the floor of the Radium Room and the floor beneath the contaminated sink drain pipe.

### 14.3.3 Class 2 Areas

Generally, Class 2 areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the $DCGL_W$. Examples of areas that might be classified as Class 2 for the FSS include:

- Locations where radioactive materials were present in an unsealed form (Buildings 2 and 27 Instrument Shop Areas).Potentially contaminated transport routes.
- Areas downwind from stack release points (Building 27, South Shed and Roof Area).
- Upper walls and ceilings of buildings or rooms subjected to airborne radioactivity (Buildings 2 and 27, Instrument Shop Areas).
- Areas handling low concentrations of radioactive materials.
- Areas designated as such in any Historical Site Assessment performed.
- Buffer areas on the perimeter of Class 1 areas (MARSSIM [DoD, 2000], Section 2.2).

Specifically, based on current knowledge the anticipated Class 2 areas are indicated in Work Plan, Figures 6 and 7. This includes the floors of the instrument identified shops in Buildings 2 and 27, and the Building 27 hanger floor adjacent to the area beneath the contaminated sink drain pipe.

### 14.3.4 Class 3 Areas

Generally, Class 3 areas are not expected to contain residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the $DCGL_W$, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include:

- Buffer zones around Class 1 or Class 2 areas.
- Areas with very low potential for residual contamination but insufficient information to justify a non-potentially impacted classification.
- Areas designated as such in the Historical Site Assessment (MARSSIM [DoD, 2000], Section 2.2).

Specifically, the walls and ceilings surrounding the identified Class 1 and Class 2 areas have been identified as Class 3.

### 14.3.5 Final Status Survey

This section summarizes the primary objectives of the FSSs and design criteria of FSSs based on the MARSSIM (DoD, 2000).

### 14.3.6 Final Status Survey Objectives

The objective of each of the FSSs is to demonstrate that the identified residual radioactivity levels are below the project cleanup criterion for each survey unit (SU), including facility surfaces, SD, sanitary sewer pipes, and associated sludge. The FSSs provide data to demonstrate that all radiological parameters satisfy the established criterion values and conditions. In demonstrating that this objective is met, the null hypothesis ($H_0$) is tested to reject the assumption that the residual contamination that exceeds the release criteria. A successful rejection of the $H_0$ demonstrates that the established criteria have been met.

### 14.3.7 Survey Grid

A reference coordinate system will be laid out for each SU. A triangular grid system will be used for each survey area. The spacing of the systematic pattern is determined by the total number of samples or measurements to be collected and the area of the SU. The spacing of the grids will be calculated for each of the SUs using the process defined in MARSSIM (DoD, 2000), Section 5.5.2.5.

### 14.3.8 Survey Unit

The work described in the Work Plan will be performed within the impacted areas at NAVSTA PS. The Radium Room is initially assumed to be Class 1. Class 1 areas require the highest level of survey effort because they have a potential for radioactive contamination (based on site operating history) above the project cleanup criteria. Information, such as characterization surveys or new historical information, indicating that the potential or known contaminant concentration is less than the site cleanup criteria can be used to support re-classification of an area or SU as Class 2 or Class 3. Reclassification to a lower risk class will result in survey savings while allowing a final status determination.

SUs should be limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. The suggested areas for SUs are summarized in the following table, summarized from MARSSIM, Section 4.6.

Structure Area SUs

| Classification | Suggested Area |
|---|---|
| Class 1 | Up to 100 $m^2$ floor area (1076 $ft^2$) |
| Class 2 | 100 to 1000 $m^2$ (1076 to 10,760 $ft^2$) |
| Class 3 | No limit |

#### 14.3.9 Statistical Tests

Statistical testing will be used to evaluate data from the FSS. For contaminants that are present in the background, the Wilcoxon Rank Sum test will be used. This non-parametric statistical test compares the SU measurements with the reference area measurements and is designed to detect whether or not the SU mean exceeds the project cleanup criteria. It does not rely on assumptions of normal or log-normal data distributions (MARSSIM (DoD, 2000), Section 5.5.2.2.) To determine data needs for these tests, the acceptable probabilities of making Type I decision errors and Type II decision errors have been established. Once the type of statistical test is determined, the number of data points to be collected in each SU can be determined.

### 14.4 WASTE CHARACTERIZATION SAMPLING

All waste generated will be characterized for proper disposal. Wastes generated include soil, sediment, building debris and wastewater. Low-level radioactive waste and mixed waste will be handled, transported and disposed of in accordance with the WMP.

All excavated soil will be transported to a radiological holding area and will be sampled and managed by Shaw. Shaw will sample and manage the volume of waste water generated from site activities.

#### 14.4.1 Wastewater Characterization Sampling

Wastewater will be generated by sewer and SD sampling (small amounts), video inspection, cleaning (sewer jetting), and from runoff collection. Wastewater will be collected and stored in approved storage containers and sampled. Wastewater sampling will be performed in accordance with:

- Sampling of Aqueous Liquids via Bailer, EI-FS109, Rev 1, 9/11/06,
- Sampling of Tanks and Storage Vessels, EI-FS115, Rev 1, 9/21/06.

#### 14.4.2 Removable Waste Contamination (Swipe) Sampling

Representative swipe samples of waste surfaces will be collected following Shaw SOP T-RA-011. Swipe samples will indicate the level of removable surface contamination and be documented in the sample logbook.

#### 14.4.3 Building Material Waste and Debris Sampling

Non-impacted building material and debris will be subject to representative sampling and survey to demonstrate that it is not contaminated above project release levels. If this is the case, the material will be managed and disposed of off-site by Shaw.

### 14.5 EQUIPMENT DECONTAMINATION

Decontamination of non-disposable sampling equipment that comes in contact with samples will be performed to prevent the introduction of extraneous material into samples, and to prevent cross contamination between samples. All sampling equipment will be decontaminated in accordance with Decontamination of Contact Sampling Equipment, EI-FS014, Rev 1, 9/8/06

### 14.6 SAMPLE NUMBERING

Samples will be uniquely numbered using a system that identifies the location, type and sequential number

Building # – (B2, B27, B116, SD-SD, GS-gravity drain sewer, PS-pressurized sewer)
Location – (room, manhole number, SU)
YY – matrix (SL-sludge, SO-soil, TO-total, SW-swipe, WT-water, WW-wastewater, FL-floor monitor)
ZZZZ – sequential number.

### 14.7 ANALYTICAL REQUIREMENTS

The following radioanalytical method will be used for soil and sludge characterization for this project:

- EPA 903.1M.

This analytical laboratory method is a modification of the EPA Part 136 approved method for $^{226}$Ra in drinking water (USEPA, 1980, Method 903.1). This method is specific for $^{226}$Ra and is based on the emanation and scintillation counting of radon-222, a daughter product of $^{226}$Ra. The method can achieve a very low detection limit and has no radioactive interferences. The method requires 14 – 21 days for the ingrowth of radon-222 before analysis can be completed.

### 14.8 DATA MANAGEMENT

This section describes the data management procedures for data review, verification, reporting, and validation for chemical analyses (off-site laboratory for import fill).

#### 14.8.1 Data Reduction, Verification, and Reporting

All analytical data generated by the laboratory projects will be reviewed prior to reporting to assure the validity of reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks, that will be signed and dated by the reviewer.

#### 14.8.2 Data Reduction

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform reduction of analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. For each method, all raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

All data calculations will be verified and initialed by personnel both generating and approving them. All raw and electronic data, notebook references, supporting documentation, and correspondence will be assembled, packaged, and stored for a minimum of 10 years for future use. All reports will be held client confidential. If the laboratory is unable to store project related data for 10 years, then it is the responsibility of the laboratory to contact Shaw to make alternative arrangements.

### 14.8.3 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality are generated consistently. All data generated and reduced will follow well-documented in-house protocols.

#### Level 1. Technical (Peer) Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this SAP, and as stated within the laboratory QA Manual. This review will, at a minimum, ensure that the following conditions have been met:

- Sample preparation information is correct and complete,
- Analysis information is correct and complete,
- Appropriate SOPs have been followed,
- Calculations are verified,
- There are no data transposition errors,
- Analytical results are correct and complete,
- QC samples are within established control limits,
- Blanks and laboratory control samples (LCSs) are within appropriate QC limits,
- Special sample preparation and analytical requirements have been met.

Documentation is complete, for example, any anomalies and holding times have been documented and forms have been completed.

#### Level 2. Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted according to an established set of guidelines and will be structured to verify the following finding of Level 1 data review:

- All appropriate laboratory SOPs have been followed,
- Calibration data are scientifically sound, appropriate to the method, and completely documented,
- QC samples are within established guidelines,
- Qualitative identification of contaminants is correct,
- Manual integrations are justified and properly documented,
- Quantitative results and calculations are correct,
- Data are qualified correctly,
- Documentation is complete, for example, any anomalies and holding times have been documented and appropriate forms have been completed,
- Data are ready for incorporation into the final report,
- The data package is complete and complies with contract requirements.

The Level 2 review will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10% of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If any problems are found with the data package, an additional 10% of the sample results will be checked back to the sample preparatory and analytical bench sheets. This cycle will then be repeated either until no errors are found in the checked data set or until all data has been checked. All errors and corrections noted will be documented.

#### Level 3. Administrative Quality Assurance Data Review

The Laboratory QA Manager will review 10% of all data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. All errors noted will be corrected and documented.

## 14.9 Data Recording and Transfer

This section details the requirements for data reporting and data package formats that will be provided by the laboratory.

### 14.9.1 Electronic Deliverables

The EDD will be formatted into Shaw database format (ShawView or equivalent). The analytical laboratory will follow the requirements stated in the Laboratory Interface Document for the Analytical Laboratory EDD.

Field information (e.g., date and time collected, sample identification, etc.) will be entered directly into the main database from the CoC form or uploaded from electronic files generated in the field.

### 14.9.2 Laboratory Data Reports

All relevant raw data and documentation, including (but not limited to) logbooks, data sheets, electronic files, and final reports, will be maintained by the laboratory for at least 10 years. The laboratory will notify Shaw 30 days before disposal of any relevant laboratory records. The laboratory data packages will contain the information shown below:

| Deliverable Requirement | Level IV | Level III | Level II |
|---|---|---|---|
| Case Narrative | X | X | |
| Corrective Action Report(s) | X | X | |
| Cross-reference of field sample numbers, laboratory IDs, and analytical QC batches | X | X | X |
| CoC Form, Cooler Receipt Form | X | X | X |
| Sample log-in sheet | X | | |
| Data summary for each blank and sample | X | X | X |
| LCS/laboratory control duplicate (LCD) report (including concentration spiked, percent (%) recovered, % recovery acceptance limits, RPD, and RPD acceptance limits) | X | X | X |
| Matrix spike (MS)/matrix spike duplicate (MSD) report (including concentration spiked, % recovered, % recovery acceptance limits, RPD, and RPD acceptance limits) | X | X | X |
| Initial calibration data (including acceptance limits) | X | X (summary only) | |
| Continuing calibration data (including acceptance limits) | X | X (summary only) | |
| Sample preparation bench sheets | X | X | |
| Standard preparation logs | X | | |
| Analysis run logs | X | X | |
| % moisture | X | X | |
| pH | X | | |

The following data deliverables will be obtained for this project:

- Off-site radiological analysis – 90% EPA Level III; 10% EPA Level IV.

## 14.10 DATA VALIDATION

All off-site radiological analysis will be validated by the Shaw Project Chemist. Laboratory data for waste samples will not be validated but will be reviewed by a Shaw Project Chemist.

Where applicable data review/validation will be performed using methods consistent with the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2004), *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008), Quality Systems Manual (QSM) (DoD, 2009), laboratory SOPs and the QC criteria specified in this SAP. Data will be validated and flagged with the following data qualifiers:

***J qualifier*** denotes the analyte was positively identified, but the associated numerical value is estimated.

***U qualifier*** denotes the analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.

***R qualifier*** denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

***UJ qualifier*** denotes the analyte was analyzed for, but not detected. There is uncertainty associated with the reporting limit or MDA.

# QAPP Worksheet #15a – Reference Limits (Radiological Release Criteria) – Sludge

| Analyte | CAS Number | Remedial Action Objectives Sludge (picocuries per gram [pCi/g]) | Project Action Limit Reference | Project Quantitation Limit (QL) Goal (pCi/g) | Laboratory-Specific (pCi/g) | |
|---|---|---|---|---|---|---|
| | | | | | QLs | MDAs |
| $^{226}Ra$ | 13982-63-3 | Plus three standard deviations of statistical mean background[14] | Navy Scope of Work, PTO XX24 | 1 | (1) | (1) |

*Notes:*
*(1) QLs and MDAs are determined on a sample specific basis and will vary.*

[14] Statistical mean background is determined by reference sampling of non-impacted locations selected for similarities in sampled material and location history (see QAPP Worksheet #17 for additional information).

## QAPP Worksheet #15b – Reference Limits (Radiological Release Criteria) –Surfaces

| Analyte | CAS Number | Remedial Action Objectives Surfaces- Loose [a] disintegrations per minute (dpm/100centimeter [cm]$^2$) | Remedial Action Objectives Surfaces–Total [a] (dpm/100cm$^2$) | Project Action Limit Reference | Project QL Goal (pCi/g) | Laboratory-Specific (pCi/g) | |
|---|---|---|---|---|---|---|---|
| | | | | | | QLs | MDAs |
| Radium-226 ($^{226}Ra$) | 13982-63-3 | 20 | 100[15] | Note [b] | 20/100[b] | (1) | (1) |

*Notes:*

*(1) QLs and MDAs are determined on a sample specific basis and will vary.*

*[a] Limits are based on USAEC Regulatory Guide 1.86.*

*b Action levels are set at close to the QL; lower QL goals are not practical.*

[15] Total surface contamination measurements on curved pipe surfaces or within pipe interiors will require careful evaluation by the project RSO. Geometry issues associated with curved pipes or surrounding of the detector by pipe material containing naturally occurring radioactive material will affect measurements.

## QAPP Worksheet #15c – Reference Limits (Radiological Release Criteria) - Water

| Analyte | CAS Number | Remedial Action Objectives (picocuries per liter [pCi/L]) | Project Action Limit Reference | Project QL Goal (pCi/L) | Laboratory-Specific (pCi/L) | |
|---|---|---|---|---|---|---|
| | | | | | QLs | MDAs |
| $^{226}Ra$ | 13982-63-3 | 60[16] | WAC 246-221-290 | 1 | (1) | (1) |

*Notes:*

*(1) QLs and MDAs are determined on a sample specific basis and will vary.*

[16] Water remediation is outside the scope of this project. This is the regulatory effluent discharge limit.

## SAP Worksheet #16 – Project Schedule[a]/Timeline Table

| Activities | Organization | Dates | | Deliverable | Deliverable Due Date |
|---|---|---|---|---|---|
| | | Anticipated Date(s) of Initiation | Anticipated Date of Completion | | |
| Off-Site Laboratory Analysis | TA | Field work spring 2010 | Field work summer 2010 | Data Report | 28 days |
| Data Review/validation | Shaw | After hardcopy data received from laboratory | 15 - 21 days after receipt of hardcopy data | Validation Report | Final Report TBD[a] |

*Notes:*
*TAT denotes turn-around-time*
*a TBD denotes please refer to project schedule*

# QAPP Worksheet #17 – Sampling Design and Rationale

## 17.1 BACKGROUND (REFERENCE SAMPLING)

Prior to the start of survey activities a designated background area located on-site or near the site will be identified for each radiological measurement method and matrix type. The background area will be selected to have similar properties to those areas to be surveyed and in a location unlikely to be potentially impacted by radioactive material. The average background level will be determined by performing a minimum of nine measurements at systematic or random locations within each designated background area. Additional background samples may be collected as directed by the Radiological Site Manager.

Sludge and water samples will be sent to an off-site laboratory for analysis for $^{226}$Ra. The background values for $^{226}$Ra will be determined by laboratory analysis, using the technique typically necessary to meet the applicable maximum MDA. If the result of the average background determination indicate $^{226}$Ra activity less than half the release criterion (without regard to MDA) with few or no negative results, then the background will be considered acceptable. Background values will be calculated using the reported activity, regardless if the value is below MDA or less than zero.

Measurement uncertainty values will be considered acceptable if, in the opinion of the laboratory manager, a longer duration count would not improve the counting statistics markedly, and the two-sigma total uncertainty is less than 10 pCi/g for $^{226}$Ra for activity indicated below the MDA.

Data collected in reference areas will be statistically evaluated using a graphical format, such as a frequency distribution chart, and approved for use by the Project RSO. The purpose of the evaluation is to ensure that the data collected in the reference area are consistent with a normal distribution and that the variability of the background is appropriate.

A minimum of 18 measurements will be performed for each field survey instrument on each different matrix. Similarly, these measurements will be used to establish backgrounds for each measurement.

## 17.2 STRUCTURE SURFACES (WALLS & FLOORS)

The general approach for surveying wall and floor surfaces, three types of radiological measurements will be performed. A scan survey will be performed using an alpha-beta/gamma survey instrument. By passing the detector surface slowly over the surface (e.g., ½ inch per second) and close to the surface (e.g., less than ½ inch), it is possible to detect small areas of total (fixed + removable) contamination at less than the project cleanup criteria. Elevation in the background count rate is detected by careful attention to the audible output of the instrument as well as watching the visual indicator. If an elevation is detected, the scan is stopped and the detector held steady over the location of the elevated count (e.g., 6 – 15 seconds). If the elevation persists, a stationary count is performed. A stationary count is performed by holding the detector over the suspect location and initiating an extended count (e.g., two minutes) which is accumulated on the instrument indicator (meter). At the end of the count period, the count result and location are documented. Stationary counts are also performed at preselected locations to help characterize the radiological status of the area.

Removable contamination is measured by performing a swipe survey of a representative 100 $cm^2$ area. This sample is counted in an onsite desk-top smear counter which measures both alpha emissions and beta/gamma emissions.

## 17.3 SEWER AND DRAIN PIPE SAMPLING

The general approach to sampling the SD and sanitary sewer lines will be to access the ends of the pipe available at manholes, catch basins, pump houses, or exposed ends of the pipe. If sludge is accessible, it will be sampled using appropriate sampling tools per SOP-30[17], "*Trowel Spoon Surface Soil Sampling*." An adequate quantity must be collected to meet laboratory analysis requirements.

Accessible portions (arm's length) of the manhole and in-place piping will be surveyed for alpha and beta/gamma contamination. Swipe samples will be collected to identify the presence of removable surface contamination. Swipe samples will be analyzed on-site, using a dual channel sample counter for gross alpha and gross beta contamination. Additional swipe samples may be collected based on the result of the field surveys, and are typically collected in the event that threshold criteria have been exceeded.

## 17.4 WASTE CHARACTERIZATION SAMPLING

Waste sampling and surveying will be performed in accordance with the WMP and as directed by the Navy waste disposal contractor.

[17] QAPP Worksheet #21

# QAPP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table

| Sampling Location | ID Number | Matrix | Analytical Group | Concentration Level | Number of Samples | Sampling SOP Reference[18] | Rationale for Sampling Location |
|---|---|---|---|---|---|---|---|
| Sewer | GS-MHxxx-SL-xxxx | Sludge | Radiochem analysis | Background | 11[19] | SOP-12 | Upstream manhole |
| Sewer pipe | GS-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer pipe | GS-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer manhole | GS-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer manhole | GS-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer | GS-MHxxx-WT-xxxx | Water | Radiochem analysis | Background | 11 | SOP-12 | Upstream manhole |
| SD | SD-MHxxx-SL-xxxx | Sludge | Radiochem analysis | Background | 11 | SOP-12 | Upstream manhole |
| SD pipe | SD-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| SD pipe | SD-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| SD manhole | SD-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| SD manhole | SD-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| SD | SD-MHxxx-WT-xxxx | Water | Radiochem analysis | Background | 11 | SOP-12 | Upstream manhole |
| B27 Tiles | B27-xxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Neighboring room[20] |
| B27 Tiles | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 80 $ft^2$ | SOP-20 | Neighboring room 2% of survey area |
| B27 Tiles | B27-xxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Neighboring room |

18 From Project Sampling SOP References table (Worksheet #21)
19 Nine samples + 20% field duplicates
20 With similar floor tiles

| Sampling Location | ID Number | Matrix | Analytical Group | Concentration Level | Number of Samples | Sampling SOP Reference[18] | Rationale for Sampling Location |
|---|---|---|---|---|---|---|---|
| B27 Roofing | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Roofing material remote from exhaust stack |
| B27 Roofing | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Roofing material remote from exhaust stack |
| B27 concrete under sewer | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Neighboring room |
| B27 concrete under sewer | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 110 $ft^2$ | SOP-20 | Neighboring room 2% of survey area |
| B27 concrete under sewer | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Neighboring room |
| B27 concrete hangar | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Remote area in hangar[21] |
| B27 concrete hangar | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 22 $ft^2$ | SOP-20 | Remote area in hangar, 4% of survey area |
| B27 concrete hangar | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Remote area in hangar |
| B2 Tiles | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Neighboring room[22] |
| B2 Tiles | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 110 $ft^2$ | SOP-20 | Neighboring room 2% of survey area |
| B2 Tiles | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Neighboring room |
| Pump House 116 | PH116-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Concrete on exterior of pump house |
| Pump House 116 | PH116-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Concrete on exterior of pump house |
| *B27 Survey* | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping Survey* | 11 | SOP-18 | 10 biased locations plus 1 QC |

[21] With similar concrete
[22] With similar floor tiles

| Sampling Location | ID Number | Matrix | Analytical Group | Concentration Level | Number of Samples | Sampling SOP Reference[18] | Rationale for Sampling Location |
|---|---|---|---|---|---|---|---|
| *B27 Survey* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping Survey* | 11 | SOP-18 | 10 biased locations plus 1 QC |
| *B27 Survey* | B27-xxxx-TO-xxxx (3 SUs) | Surface | Total α/β/γ | *Character. Survey* | 66 | SOP-18 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |
| *B27 Survey* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Character. Survey* | 66 | SOP-18 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |
| *B27 Survey* | B27-xxxx-FL-xxxx | Surface | Floor Monitor | *Character. Survey* | 4725 $ft^2$ | S0P-20 | Instrument shop floor surface |
| *B27 Vent* | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping* | 11 | SOP-18 | 10 biased locations plus 1 QC |
| *B27 Vent* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping* | 11 | SOP-18 | 10 biased locations plus 1 QC |
| *B27 Roofing* | B27-xxxx-TO-xxxx (1 SU) | Surface | Total α/β/γ | *Character. Survey* | 28 | SOP-18 | Class 3 roofing and subroofing |
| *B27 Roofing* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Character. Survey* | 28 | SOP-18 | Class 3 roofing and subroofing |
| *B27 Roofing* | B27-xxxx-FL-xxxx | Surface | Floor Monitor | *Character. Survey* | 4095 $ft^2$ | S0P-20 | Roof area |
| *B2 Survey* | B2-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 21 | SOP-18 | 19 biased locations plus 2 QC |
| *B2 Survey* | B2-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping survey* | 21 | SOP-18 | 19 biased locations plus 2 QC |
| *B2 Survey* | B2-xxxx-TO-xxxx (3 SUs) | Surface | Total α/β/γ | *Character. survey* | 84 | SOP-18 | Class 2 floor of instrument shops, Class 3 walls |
| *B2 Survey* | B2-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Character. survey* | 84 | SOP-18 | Class 2 floor of instrument shops, Class 3 walls |
| *B2 Survey* | B2-xxxx-FL-xxxx | Surface | Floor Monitor | *Character. survey* | ~4725 $ft^2$ | S0P-20 | Instrument shop floor area |
| *B2 vent* | B2-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 11 | SOP-18 | 10 biased locations plus 1 QC |

| Sampling Location | ID Number | Matrix | Analytical Group | Concentration Level | Number of Samples | Sampling SOP Reference[18] | Rationale for Sampling Location |
|---|---|---|---|---|---|---|---|
| *B2 vent* | B2-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping survey* | 11 | SOP-18 | 10 biased locations plus 1 QC |
| Pump House 116 | PH116-xxxx-TO-xxxx (2 SUs) | Surface | Total α/β/γ | *Characterization* | 17 | SOP-18 | Class 2 floor and walls |
| Pump House 116 | PH116-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Characterization* | 17 | SOP-18 | Class 2 floor and walls |
| *Gravity flow sewer* | GS-xxxx-SL-xxxx | sludge | Radiochemical analysis | *Scoping survey* | 18 | SOP-12 | 8 manholes plus 2 QC |
| *Gravity flow sewer* | GS-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 18 | SOP-18 | 8 manholes plus 2 QC |
| *Gravity flow sewer* | GS-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping survey* | 18 | SOP-18 | 8 manholes plus 2 QC |
| *Pressurized sewer line* | PS-xxxx-SL-xxxx | Sludge | Radiochemical analysis | *Scoping survey* | 5 | SOP-12 | 2 at each end plus 1 QC |
| *Pressurized sewer line* | PS-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 3 | SOP-18 | 2 at each end plus 1 QC |
| *Pressurized sewer line* | PS-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping survey* | 3 | SOP-18 | 2 at each end plus 1 QC |
| *SD* | SD-xxxx-SL-xxxx | Sludge | Radiochemical analysis | *Scoping survey* | 16 | SOP-12 | 7 manholes and catch basins |
| *SD* | SD-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 16 | SOP-18 | 7 manholes and catch basins |
| *SD* | SD-xxxx-SW-xxxx | Surface | Removable α/β/γ | *Scoping survey* | 16 | SOP-18 | 7 manholes and catch basins |
| *B27 FSS* | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | *FSS* | 140 | SOP-18 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |
| *B27 FSS* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | *FSS* | 140 | SOP-18 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |
| *B27 FSS* | B27-xxxx-FL-xxxx | Surface | Floor Monitor | *FSS* | 5250 $ft^2$ | S0P-20 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |

| Sampling Location | ID Number | Matrix | Analytical Group | Concentration Level | Number of Samples | Sampling SOP Reference[18] | Rationale for Sampling Location |
|---|---|---|---|---|---|---|---|
| *Waste Water* | WW-xxxx-WW-xxxx | Waste Water | Radiochemical Analysis | *FSS* | 11 | SOP-10<br>SOP-11 | *Waste Characterization* |

# QAPP Worksheet #19 – Analytical SOP Requirements Table

| Matrix | Analytical Group | Analytical and Preparation Method/SOP Reference | Sample Volume | Container (number, Size, and type) | Preservation Requirements (chemical, temperature, light protected) | Maximum Holding Time (preparation/analysis) |
|---|---|---|---|---|---|---|
| Surface | Total α/β/γ | SOP-18 | Probe Surface Area ($100cm^2$) | Not Applicable | Not Applicable | Not Applicable |
| Surface | Removable α/β/γ | SOP-18 | Smear of $100cm^2$ | Smear folder or envelope | None | Not Applicable |
| Surface | Floor Monitor (Total α/β/γ) | SOP-20 | Probe Surface Area (TBD) | Not Applicable | Not Applicable | Not Applicable |
| Sludge | Radiochemical Laboratory analysis | EPA 903.1M (Ra-226)<br>Analytical laboratory SOP | 10g | (laboratory provided) | None | Not Applicable |
| Waste Water | Radiochemical Laboratory Analysis | EPA 903.1(Ra-226)<br>Analytical laboratory SOP | 1 liter | (laboratory provided) | Nitric acid | Not Applicable |

# 8 QAPP Worksheet #20 – Field Quality Control Sample Summary Table

| Matrix | Analytical Group | # of Primary Sampling Locations | # of Field Duplicates | # of MS/MSDs | # of Field Blanks | # of Equipment Rinse Blanks | # of Trip Blanks | Total # of Samples to Laboratory |
|---|---|---|---|---|---|---|---|---|
| Sludge | Radiochemical analysis | | 1 per 20 samples | One per analytical batch[23] | 1 per 20 samples or one per day | One per sampling event | One per analytical batch | |
| Surface | Total α/β/γ | | 1 per 20 measurements | NA[24] | Background performed 1 per 20 measurements | NA | NA | |
| Surface | Removable α/β/γ | | 1 per 20 measurements | NA[25] | 1 per 20 measurements | NA | NA | |
| Surface | Floor Monitor | | 5% of floor area surveyed | NA[26] | Background location 1 per 5% of floor area | NA | NA | |
| Waste Water | Radiochemical Analysis | | 1 per 20 samples | One per analytical batch[27] | 1 per 20 samples or one per day | One per sampling event | One per analytical batch | |

[23] Performed by analytical laboratory
[24] Daily performance check
[25] Daily performance check
[26] Daily performance check
[27] Performed by analytical laboratory

## QAPP Worksheet #21 – Project Sampling SOP References Table

| Reference Number | Title, Revision Date and/or Number | Originating Organization | Equipment Type | Modified for Project Work? (Y/N) | Comments |
|---|---|---|---|---|---|
| SOP-01 | Field Logbook, EI-FS001, Rev 1, 9/8/06 | Shaw | Recordkeeping | No | |
| SOP-02 | Field Log sheet, EI-FS002, Rev 1, 9/8/06 | Shaw | Recordkeeping | No | |
| SOP-03 | CoC Documentation – Paper, EI-FS003, Rev 1, 9/8/06 | Shaw | Sample handling | No | |
| SOP-04 | Custody Seals, EI-FS005, Rev 1, 9/8/06 | Shaw | Sample handling | No | |
| SOP-05 | Sample Labeling, EI-FS006, Rev 1, 9/8/06 | Shaw | Sample handling | No | |
| SOP-06 | Decontamination of Contact Sampling Equipment, EI-FS014, Rev 1, 9/8/06 | Shaw | Sludge sampling equipment | No | |
| SOP-07 | Data Usability Review, EI-FS020, Rev 1, 9/8/06 | Shaw | Data analysis | No | |
| SOP-08 | Soil Sampling using a Soil Probe or Core-Type Sampler, EI-FS103, Rev 1, 9/11/06 | Shaw | Sludge sampling equipment | No | |
| SOP-09 | Sampling of In-Process Piles, EI-FS106, Rev 1, 9/11/06 | Shaw | Soil sampling equipment | No | |
| SOP-10 | Sampling of Aqueous Liquids via Bailer, EI-FS109, Rev 1, 9/11/06 | Shaw | Water sampling equipment | No | |
| SOP-11 | Sampling of Tanks and Storage Vessels, EI-FS115, Rev 1, 9/21/06 | Shaw | Water sampling equipment | No | |
| SOP-12 | Site Specific Sampling Methods TBD | Shaw | Sludge sampling equipment | No | TBD |
| SOP-13 | Shipment of Radioactive Materials, SOP TA-RA-003, Rev 2, 10/07/2008 | Shaw, U.S. Nuclear Regulatory Commission (NRC) License 20-31340-01 | Sample handling | No | |
| SOP-14 | Radiological Controls Portable Instrument Procedure, SOP TA-RA-006, Rev 2, 10/07/2008 | Shaw, NRC License 20-31340-01 | Radiological instrumentation | No | |
| SOP-15 | Airborne Radioactive Particulate Monitoring, SOP TA-RA-007, Rev 2, 10/07/2008 | Shaw, NRC License 20-31340-01 | Air sampling equipment | No | |
| SOP-16 | External Dosimetry Administration, SOP TA-RA-008, Rev 2, 10/07/2008 | Shaw, NRC License 20-31340-01 | External dosimeters | No | Not required |

| Reference Number | Title, Revision Date and/or Number | Originating Organization | Equipment Type | Modified for Project Work? (Y/N) | Comments |
|---|---|---|---|---|---|
| SOP-17 | Radiation Exposure Monitoring, SOP TA-RA-009, Rev 2, 10/08/2008 | Shaw, NRC License 20-31340-01 | Radiological instrumentation | | |
| SOP-18 | Surface Contamination Monitoring, SOP TA-RA-012, Rev 2, 10/07/2008 | Shaw, NRC License 20-31340-01 | Radiological instrumentation | | |
| SOP-19 | Bioassay and Internal Exposure Monitoring, SOP TA-RA-013, Rev 2, 10/07/2008 | Shaw, NRC License 20-31340-01 | Urinalysis sampling supplies | No | Not required |
| SOP-20 | Work Instruction – Operation of Floor Monitor (TBD) | Shaw | Radiological instrumentation | Yes | Project-specific equipment |
| SOP-21 | (FSS Scanning) | Shaw | Radiological instrumentation | Yes | Project-specific work instruction |
| SOP-22 | (FSS Stationary Count) | Shaw | Radiological instrumentation | Yes | Project-specific work instruction |
| SOP-23 | (Scoping Survey) | Shaw | Radiological instrumentation | Yes | Project-specific work instruction |
| SOP-24 | (Characterization Survey) | Shaw | Radiological instrumentation | Yes | Project-specific work instruction |
| SOP-25 | (Equipment Release) | Shaw | Radiological instrumentation | Yes | Project-specific work instruction |
| SOP-26 | (Personnel Frisking) | Shaw | Radiological instrumentation | Yes | Project-specific work instruction |
| SOP-27 | (Video Pipe Survey) | Video inspection subcontractor | Video survey equipment | TBD | |
| SOP-28 | (Asbestos Sampling) | Asbestos abatement subcontractor | Asbestos sampling | TBD | |
| SOP-29 | (Waste Characterization) | Shaw | | Yes | Project-specific work instruction |
| SOP-30 | Trowel Spoon Surface Soil Sampling, SOP EIFS101 | Shaw | Sludge sampling equipment | No | |
| MARSSIM | MARSSIM, NUREG-1575, Rev 1, August 2000 | EPA, NRC, DoD, U.S. Department of Energy | NA | No | Basis for characterization and FSSs |

# 1 QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection Table

| Field Equipment | Calibration Activity[28] | Maintenance Activity[29] | Testing Activity[30] | Inspection Activity[31] | Frequency[32] | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference[1] |
|---|---|---|---|---|---|---|---|---|---|
| 2-channel α/β survey meter | SOP T-RA-006, Section 6.2 | SOP T-RA-006, Section 6.5 & 6.6 | SOP T-RA-006, Section 6.3 | SOP T-RA-006, Section 6.3.2 | Cal: annual[33] Perform: daily | SOP T-RA-006, Section 6.3.5.5 | SOP T-RA-006, Section 6.3.5.6 | SOP T-RA-006, Section 6.2 & 5.4 | (see specific reference) |
| γ scint. Survey meter | SOP T-RA-006, Section 6.2 | SOP T-RA-006, Section 6.5 & 6.6 | SOP T-RA-006, Section 6.3 | | Cal: annual[34] Perform: daily | SOP T-RA-006, Section 6.3.5.5 | SOP T-RA-006, Section 6.3.5.6 | SOP T-RA-006, Section 6.2 & 5.4 | (see specific reference) |
| Floor monitor | SOP T-RA-006, Section 6.2 | SOP T-RA-006, Section 6.5 & 6.6 | SOP T-RA-006, Section 6.3 | | Cal: annual[35] Perform: daily | SOP T-RA-006, Section 6.3.5.5 | SOP T-RA-006, Section 6.3.5.6 | SOP T-RA-006, Section 6.2 & 5.4 | (see specific reference) |
| Lo-vol air sampler | SOP T-RA-007, Section 6.2.1.1 | | | SOP T-RA-007, Section 6.2 | | | | | (see specific reference) |
| α/β sample counter | SOP T-RA-006, Section 6.2 | SOP T-RA-006, Section 6.5 & 6.6 | SOP T-RA-006, Section 6.4 | | Cal: annual[36] Perform: daily | SOP T-RA-006, Section 6.4.2.4 | SOP T-RA-006, Section 6.4.2.4 | SOP T-RA-006, Section 6.2 & 5.4 | (see specific reference) |
| Γ dose rate monitoring | SOP T-RA-009, Section 6.1, 3rd bullet | SOP T-RA-009, Section 6.1, 3rd bullet | SOP T-RA-009, Section 6.3 | SOP T-RA-009, Section 6.2 | Cal: annual[37] Perform: daily | SOP T-RA-009, Section 6.1, 3rd bullet | SOP T-RA-006, Section 6.3.5.6 | SOP T-RA-006, Section 6.2 & 5.4 | (see specific reference) |
| Photoionization detector | | | | | | | | | |
| Lower Explosive Limit 4 Gas Meter | | | | | | | | | |
| | | | | | | | | | |

28 Instrument shop calibration
29 Field maintenance
30 Prejob & Daily performance check
31 Daily inspection
32 Calibration & performance check frequency
33 MARSSIM, Section 6.5.4; WA 246-221-110
34 MARSSIM, Section 6.5.4; WA 246-221-110
35 MARSSIM, Section 6.5.4; WA 246-221-110
36 MARSSIM, Section 6.5.4; WA 246-221-110
37 MARSSIM, Section 6.5.4; WA 246-221-110

# QAPP Worksheet #23 – Analytical SOP References Table

| Lab SOP Number | Title, Revision Date, and / or Number | Definitive or Screening Data | Matrix and Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? (Y/N) |
|---|---|---|---|---|---|---|
| TBD[a] | TBD[a] | Definitive | Sludge – Radiochemical Analysis | | TA | N |
| TBD[a] | TBD[a] | Definitive | Water – Radiochemical Analysis | | TA | N |

*Notes:*

*a TBD – to be determined, SOP numbers for chemical analyses will be provided in the Final SAP when laboratory provides*

## QAPP Worksheet #24 – Analytical Instrument Calibration Table

| Instrument | Calibration Procedure | Frequency | Acceptance Criteria | Corrective Action | Person(s) Responsible for Corrective Actions | SOP Reference |
|---|---|---|---|---|---|---|
| TBD[38] | | | | | | TBD[b] |

TBD denotes laboratory will provide. Will be included in Final QAPP/SAP

[38] *TBD – to be determined, instrumentation analyses will be provided in the Final SAP when laboratory is selected*

# QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

| Instrument / Equipment | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference |
|---|---|---|---|---|---|---|---|---|
| TBD[a] | | | | | | | | |

*Notes:*
*a TBD denotes fixed based lab will provide. Will be updated in Final QAPP/SAP.*
*SOP denotes standard operating procedure.*

## QAPP Worksheet #26 – Sample Handling System

| |
|---|
| SAMPLE COLLECTION, PACKAGING, AND SHIPMENT |
| Sample Collection (Personnel/Organization): Shaw, Field Technician or Project Chemist |
| Sample Packaging (Personnel/Organization): Shaw, Field Technician or Project Chemist |
| Coordination of Shipment (Personnel/Organization): Shaw, Field Technician or Project Chemist |
| Type of Shipment/Carrier: Lab Courier, UPS or FedEx |
| SAMPLE RECEIPT AND ANALYSIS |
| Sample Receipt (Personnel/Organization): Laboratory Sample Receiving & PM |
| Sample Custody and Storage (Personnel/Organization): Laboratory Sample Receiving |
| Sample Preparation (Personnel/Organization): Laboratory extraction group |
| Sample Determinative Analysis (Personnel/Organization): Laboratory Analyst |
| SAMPLE ARCHIVING |
| Field Sample Storage (No. of days from sample collection): For the samples shipped to laboratory for off-site analysis, the samples will be shipped at the end of the sampling campaign or when a sufficient number have been accumulated for an analytical laboratory batch |
| Lab Sample Storage (No. of days from sample collection): Minimum 6 months |
| Sample Extract/Digestate Storage (No. of days from extraction/digestion): TBD[39] |
| Biological Sample Storage (No. of days from sample collection): Not Applicable to this project |
| SAMPLE DISPOSAL |
| Personnel/Organization: Subcontract Laboratory |
| Number of Days from Analysis: 60 days |

[39] after analytical laboratory is selected

# QAPP Worksheet #27 – Sample Custody Requirements Table

## 27.1 SAMPLE CUSTODY AND DOCUMENTATION

Sampling information will be recorded on a CoC form and in a permanently bound field logbook. All entries will be legible and recorded in indelible ink.

## 27.2 SAMPLE LABELING

Sample labels will be filled out with indelible ink and affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory. Each sample container will be labeled with the following, at minimum:

- Sample identification number,
- Sample collection date (month/day/year),
- Time of collection (24-hour clock),
- Sampler's initials,
- Analyses to be performed,
- Preservation (if any),
- Location (i.e., site name).

## 27.3 CHAIN OF CUSTODY

Use of the CoC is addressed in SOP-03. In addition to providing a custody exchange record for the samples, the CoC Form serves as a formal request for sample analyses. The CoC will be completed, signed, and distributed as follows:

- One copy retained by the sample coordinator (this may be an electronic copy),
- The original sent to the analytical laboratory with the sample shipment.

After the laboratory receives the samples, the Sample Custodian will inventory each shipment before signing for it, and note on the original CoC Form any discrepancy in the number of samples, temperature of the cooler or broken samples. The Project Chemist will be notified immediately of any problems identified with shipped samples. The Project Chemist will in turn notify the Project QC Manager, and together they will determine the appropriate course of action. The Project Chemist will also notify the PM if the project budget and schedule may be impacted.

The laboratory will initiate an internal CoC that will track the sample within the various areas of the laboratory. The relinquishing signature of the Sample Custodian and the custody acceptance signature of the laboratory personnel transfer custody of the sample. This procedure is followed each time a sample changes hands. The laboratory will archive the samples and maintain their custody as required by the contract or until further notification from the Project Chemist, at which time the samples will either be returned to the project for disposal, or disposed by the laboratory.

## 27.4 SAMPLE PACKING AND SHIPMENT

After sample collection, sample labels will be affixed to each sample container. Each sample will be placed in a resealable plastic bag to keep the sample container and the label dry. All glass sample containers will be protected with bubble wrap (or other cushioning material) to prevent breakage. There is no need to control temperature with $^{226}Ra$ samples.

Samples to be shipped by commercial carrier will be prepared in accordance with SOP-13 and packed in a sample cooler lined with a plastic bag. Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent any leakage. Saturday deliveries will be coordinated with the laboratory.

If samples are picked up by a laboratory courier service, the CoC form will be completed and signed by the laboratory courier. The cooler will then be released to the courier for transportation to the laboratory.

If a commercial carrier is used, the CoC form will include the airbill number in the "Transfers Accepted By" column, and will be sealed in a resealable bag. The CoC form will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape, and two custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory. A copy of the courier airbill will be retained for documentation.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to the U.S. Department of Transportation regulations. The International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to assure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. No samples will be accepted by the receiving laboratory without a properly prepared CoC record and properly labeled and sealed shipping container(s).

## 27.5 FIELD LOGBOOKS

Field Logbooks will be used in accordance with SOP-01. A permanently bound field logbook with consecutively numbered pages will be assigned to this project. All entries will be recorded in indelible ink. Corrections will be made following the procedure described below in Section 27.6, "Document Corrections." At the end of each workday, the responsible sampler will sign the logbook pages, and any unused portions of a logbook page will be crossed out, signed, and dated.

At a minimum, the logbook will contain the following information:

- Project name and location (on the front page of the log book),

- Date and time of collection for each sample (in the upper right corner of each page),
- Sample number,
- Sample location (i.e., soil boring or sampling point),
- Sample type (i.e., soil and water),
- Composite or grab,
- Composite type (the number of grab samples),
- Depth of sample,
- Weather information (e.g., rain, sunny, approximate temperature, etc.),
- Containers used and requested analyses.

In the graph paper portion of the field logbook, the sampler will fill in the following information:

- A map with sample locations (drawn or paste copy). Each sample location must be clearly identified on the map. Several sample locations may be presented on one map; however, the page with the map must be referred on each of the individual sample pages.
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments.
- Descriptions of deviations from this SAP.
- Problems encountered and corrective action taken.
- Identification of field QC samples.
- Verbal or written instructions from the Navy and Shaw Project QC Manager.

The sampler will cross out the unused portion and sign each page.

### 27.6 DOCUMENT CORRECTIONS

Changes or corrections on any project documentation will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

## QAPP Worksheet #28a -- Laboratory QC Samples Table (EPA 903.1M)

| | | | | | | |
|---|---|---|---|---|---|---|
| Matrix: Sludge, Soil, and Water | | | | | | |
| Analytical Group: Radioanalytical Laboratory | | | | | | |
| Method: EPA Method 903.1M / Lab SOP TBD[a] | | | | | | |
| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Actions | DQI | Measurement Performance Criteria |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

## QAPP Worksheet #28a -- Laboratory QC Samples Table (EPA 903.1M) (Continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Actions | DQI | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| | | | | | | |

*Notes:*
*a TBD – to be determined – laboratory SOP number will be provided in the Final SAP when provided by TA*

## QAPP Worksheet #28b --Laboratory QC Samples Table (Total α/β/γ and Floor Monitor)

| QC Check | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Actions | DQI | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Matrix: Surface | | | | | | |
| Analytical Group: Total α/β/γ and Floor Monitor | | | | | | |
| SOP-18 | | | | | | |
| Instrument Calibration | Annual for after instrument maintenance | Within manufacturer's specification | Perform maintenance and adjustment to meet specification | Instrument maintenance and calibration laboratory | Accuracy | Within valid calibration period |
| Source Check | Daily performance check | Instrument fall within ±20% of initial (following calibration) | Remove from service and notify RSO | RCT | Accuracy | Instrument fall within ±20% of initial (following calibration) |
| Background | Daily Performance Check and field background | Must be low enough for measureable response to check source; track daily | Relocate to low-background area or remove instrument from service and notify Project RSO | RCT | Sensitivity | Must meet criteria established when determining MDA |
| MDA determination | At beginning of project and if any change in equipment | Must meet MARSSIM requirements | If cannot meet MARSSIM requirements, increase survey sensitivity through longer count our slower scanning | Project RSO | Sensitivity | Must meet MDA necessary to accomplish MARSSIM objectives |

# QAPP Worksheet #28c --Laboratory QC Samples Table (Removable α/β/γ)

| Matrix: Surface |
|---|
| Analytical Group: Removable **α/β/γ** |
| SOP-18 |

| QC Check | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Actions | DQI | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Instrument Calibration | Annual for after instrument maintenance | Within manufacturer's specification | Perform maintenance and adjustment to meet specification | Instrument maintenance and calibration laboratory | Accuracy | Within valid calibration period |
| Source Check | Daily performance check | Instrument fall within ±20% of initial (following calibration) | Remove from service and notify RSO | RCT | Accuracy | Instrument fall within ±20% of initial (following calibration) |
| Background | Daily Performance Check and field background | Must be low enough for measureable response to check source; track daily | Relocate to low-background area or remove instrument from service and notify Project RSO | RCT | Sensitivity | Must meet criteria established when determining MDA |
| MDA determination | At beginning of project and if any change in equipment | Must meet MARSSIM requirements | If cannot meet MARSSIM requirements, increase survey sensitivity through longer count our slower scanning | Project RSO | Sensitivity | Must meet MDA necessary to accomplish MARSSIM objectives |

# QAPP Worksheet #29 – Project Documents and Records Table

| Document | Where Maintained |
|---|---|
| Field notes/logbook | Shaw Project file |
| CoC forms | Shaw Project file |
| Laboratory raw data package | Shaw Project file |
| Audit/assessment checklists/reports | Shaw Project file and laboratory |
| Corrective action forms/reports | Shaw Project file and laboratory |
| Laboratory equipment calibration logs | Laboratory |
| Sample preparation logs | Laboratory |
| Run logs | Laboratory |
| Sample disposal records | Laboratory |
| Data validation reports and validated data | Shaw Project file |
| Radiological survey records | Shaw Project file |
| Radiological smear count records | Shaw Project file |

## QAPP Worksheet #30 – Analytical Services Table

| Matrix | Analytical Group | Sample Locations/ID Numbers | Analytical Method | Data Package Turnaround Time | Laboratory/Organization (Name, Address, Contact, & Telephone #) | Backup Laboratory (Name, Address, Contact, & Telephone #) |
|---|---|---|---|---|---|---|
| Soil / Sediment / Swipes | Gamma Spec<br>Alpha Spec<br>Gross Alpha/Beta | All Radiation Survey Confirmation Samples | Gamma Spec<br>Alpha Spec<br>Gross Alpha/Beta | 7 Days | On-Site Radiological Laboratory | TBD |
| Sludge | Radiochemical Analysis | Sewer and SD access points | EPA 903.1M | 28 days | TA | TBD |
| Surface | Total α/β/γ | Scoping, Characterization, and FSS Locations | Survey per SOP-18 | 1 day | Project RCTs using project radiological instrumentation | NA |
| Surface | Removable α/β/γ | Scoping, Characterization, and FSS Locations | Survey per SOP-18 | 1 day | Project RCTs using project radiological instrumentation | NA |
| Surface | Floor Monitor | Large characterization and FSS floor areas | Survey per SOP-20 | 2 days | Project RCTs using project radiological instrumentation | NA |
| Waste Water | Radiochemical Analysis | Water collected during field operations | TBD | 28 days | TA | TBD |

*Notes:*

*a TBD- Subcontract analytical laboratory has not yet been selected for this project*

## QAPP Worksheet #31 – Planned Project Assessments Table

| Assessment Type | Frequency | Internal or External | Organization Performing Assessment | Person(s) Responsible for Performing Assessment | Person(s) Responsible for Responding to Assessment Findings | Person(s) Responsible for Identifying and Implementing Corrective Actions | Person(s) Responsible for Monitoring Effectiveness of CA |
|---|---|---|---|---|---|---|---|
| Laboratory Technical Systems Audit (TSA) | If deemed necessary prior to start of sampling activities | E | Shaw | Shaw Project or Program Chemist | Laboratory QAO | Laboratory QA Officer | Laboratory QAO and Shaw Project Chemist |
| Initial Inspection / Preparatory Meeting | Prior to the start of sampling activities | I | Shaw | Shaw Project or Program Chemist | Project Chemist or Sample Technician | Project Chemist or Sample Technician | Program Chemist or QC Manager |
| Field audits | As needed as the project progresses | I | Shaw and/or Navy QA Officer | Shaw Project or Rose Condit | Project Chemist | Project Chemist | Project Chemist |
| Field documentation review | At least once at the beginning of sampling activities and then as needed as the project progresses | I | Shaw | Rose Condit or Project QC Manager | Shaw Technical Manager; Field Sampling Technician or Project Chemist | Shaw Technical Manager; Field Sampling Technician or Project Chemist | Shaw Program Chemist or Field QA Manager |

## QAPP Worksheet #32 – Assessment Findings and Corrective Action Responses

| Assessment Type | Nature of Deficiencies Documentation | Individual(s) Notified of Findings | Timeframe of Notification | Nature of Corrective Action Response Documentation | Individual(s) Receiving Corrective Action Response | Timeframe for Response |
|---|---|---|---|---|---|---|
| Field Sampling Technical System Audit | Written Audit Report | PM or Technical Manager | 48 hours after audit | Email or letter | Field Technician, Shaw Project Chemist, Shaw Program Chemist | 24 hours after notification |
| Off-Site Laboratory Audit (if performed for project) | Written Audit Report | Laboratory QA Manager, Laboratory PM | 5 days after audit | Corrective Action Plan | Field Technician, Shaw Project Chemist, Shaw Program Chemist | 10 business days after receiving report |
| Laboratory Data Review Findings | Memo | Laboratory QA Manager, Laboratory PM | 48 hours after audit | Email or letter | Field Technician, Shaw Project Chemist, Shaw Program Chemist | 3 days after notification |

.

# QAPP Worksheet #33 – QA Management Reports Table

| Type of Report | Frequency | Projected Delivery Date(s) | Person(s) Responsible for Report Preparation | Report Recipient(s) |
|---|---|---|---|---|
| Field Sampling TSAReport | At least once at the beginning of sampling activities and then as needed as the project progresses | Within 24 hours of Field Sampling Audit | Shaw QA Manager or Shaw Project Chemist | Shaw PM |
| Off-Site Laboratory TSA Report (if performed) | Prior to sample receipt at laboratory | Within 48 hours of on-site audit | Shaw Project Chemist or Shaw Program Chemist | Laboratory QA Manager, Laboratory PM |
| Data Review Report | After all waste sample data reviewed by Project Chemist | As received from laboratory | Shaw Project Chemist or Shaw Program Chemist | Shaw PM |
| Data Validation Report | After all data packages are received from laboratory | Within 2 weeks of data package receipt | Independent 3rd party data validation company | Shaw Project Chemist or Shaw Program Chemist |
| Final Project Report | After completion of all field work | Project document delivery schedule is provided in the Work Plan | Shaw Technical Manager | Navy RPM and regulatory agencies (see distribution list) |

## QAPP Worksheet #34 – Verification (Step I) Process Table

| Verification Input | Description | Internal (I)/ External (E) | Responsible for Verification (Name, Organization) |
|---|---|---|---|
| CoC forms | CoC forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the CoC should be initialed by the reviewer, a copy of the CoC retained in the project file, and the original and remaining copies taped inside the cooler for shipment. | I | Shaw field sampling team leader or Project Chemist |
| Field notes/logbook | Field notes will be reviewed internally and placed in the project file upon project completion. | I | Project Chemist |
| Audit reports | Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the PM will be notified to ensure action is taken. | I | Shaw Project Technical Manager or Shaw PM |
| Laboratory data | All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified by the Shaw Project Chemist and a third party reviewer according to the data validation procedures specified in this SAP. | I / E | Laboratory, Shaw Project Chemist and third party reviewer |
| EDDs | All EDDs will be verified internally by the subcontract laboratory for completeness and technical accuracy prior to submittal to Shaw. All received EDDs will be verified by Shaw and/or the validation company against the hardcopy laboratory reports | I / E | Laboratory, Shaw Chemist and a third party reviewer |

# QAPP Worksheet #35 – Validation (Steps IIa and IIb) Process Table

| Step IIa / IIb | Validation Input | Description | Responsible for Validation |
|---|---|---|---|
| IIa | Sampling Methods and Procedures | Ensure that the required sampling methods were used to collect project samples, any field changes or deviations are noted in the field logbook. Review field sample collection logbooks for compliance with the Approved SAP. | Shaw Project QC Manager or Project Chemist |
| IIa | Analytes | Ensure that the required list of analytes was reported per project requirements. | Analyst – Laboratory PM, Project Chemist |
| IIa | Hardcopy data packages | Review data package for compliance with EPA Method Requirements, per EPA National Functional Guidelines; Approved SAP, Navy EWI #1 and DoD QSM requirements. | Project Chemist |
| IIa | Documentation of all EPA Method QC sample Results; 100% Level III data review | Determine if all EPA Method required QC samples were analyzed and met required control limits per SAP and DoD QSM requirements when applicable. | Project Chemist |
| IIb | Documentation of all SAP QC sample Results | Determine if all SAP required QC samples were collected and met required control limits per SAP and DoD QSM requirements when applicable. | Shaw Project Chemist |

## QAPP Worksheet #35 – Validation (Steps IIa and IIb) Process Table (Continued)

| Step IIa / IIb | Validation Input | Description | Responsible for Validation |
|---|---|---|---|
| IIb | Sampling Plan | Determine whether the SAP was executed as specified (number, location, type of field samples collected). | Shaw Project QC Manager or Project Chemist |
| IIb | Sampling Procedures | Evaluate whether sampling procedures were followed with respect to techniques, decontamination, sample volume and preservation. | Shaw Project QC Manager or Project Chemist |
| IIb | Field duplicate precision | Compare results for field duplicates with criteria established in the SAP. | Project Chemist and 3rd Party Data Validation Company |
| IIb | Project QLs met | Review all laboratory data to ensure that project-specific QLs specified in the SAP are met. | Project Chemist and 3rd Party Data Validation Company |
| IIb | Method performance criteria | Evaluate laboratory QC data against project-specific criteria. | 3rd Party Data Validation Company |

*Notes:*
*IIa denotes compliance with methods, procedures, and contracts.*
*IIb denotes comparison with measurement performance criteria in the SAP.*

# QAPP Worksheet #36 – Analytical Data Validation (Steps IIa and IIb) Summary Table

| Step IIa / IIb | Matrix | Analytical Group | Validation Criteria | Data Validator |
|---|---|---|---|---|
| IIa | Sludge | Radiochemical Analysis | In accordance with laboratory SOP, NAVFAC, and EPA Level III and IV guidance | Project Chemist<br>Analytical Laboratory PM |
| IIb | Surface | Total α/βγ | In accordance with SOP and MARSSIM Guidelines | Radiation Safety Manager |
| IIb | Surface | Removable α/βγ | In accordance with SOP and MARSSIM Guidelines | Radiation Safety Manager |
| IIb | Surface | Floor Monitor | In accordance with SOP and MARSSIM Guidelines | Radiation Safety Manager |
| IIa | Waste Water | Radiochemical Analysis | In accordance with laboratory SOP, NAVFAC, and EPA Level III and IV guidance | Project Chemist<br>Analytical Laboratory PM |

*Notes:*
*IIa denotes compliance with methods, procedures, and contracts.*
*IIb denotes comparison with measurement performance criteria in the SAP.*

# QAPP Worksheet #37 – Usability Assessment

## 37.1 DATA QUALITY ASSESSMENT REPORT

Based on data validation/review, the Project Chemist will determine if the PQOs have been met, and will calculate data completeness. To reconcile the collected data with project PQOs and to establish and document data usability, the data will be reviewed against DQIs (Section 37.2).

The Project Chemist will prepare a Data Quality Assessment (DQA) Report. The DQA Report will cover the following topics:

- Implementation of sampling design and analysis according to the approved SAP (or sample completeness and representativeness).
- Proper frequency of field QC samples and the adequacy of field decontamination procedures.
- Accuracy and precision of the data collected.
- Data comparability, if appropriate.
- Data usability for project decisions.

The DQA Report will be included in the After Action Reports.

## 37.2 DATA QUALITY INDICATORS

This section defines the DQIs and their use for assessment of data quality.

### 37.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The following equation illustrates the method for calculating RPD to assess a method's precision:

$$\text{Precision as RPD} = \frac{2 \text{ x (Result-Duplicate Result) x } 100\%}{\text{Result + Duplicate Result}}$$

The laboratory uses MS/MSD pairs to assess the precision of analytical procedures, with one MS/MSD pair analyzed for every batch of up to 20 samples. According to the Navy requirements, analytical laboratories perform MS/MSD on the Navy project samples. This allows determining whether matrix interferences may be present.

The laboratory uses LCS/LCD pairs when MS are not practical due to the nature of sample or analytical method used, and they are prepared and analyzed with each batch of samples instead of MS/MSD. LCS/LCD may also be prepared in place of MS/MSD in the case that a sufficient sample volume was not obtained in the field to perform the MS/MSD analysis. For inorganic analyses, analytical precision is usually calculated based on the sample and sample duplicate results.

Analytical laboratory will have statistically based acceptability limits for RPDs established for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken.

Soil field duplicates assess the heterogeneity of contaminant distribution and not precision, soil field duplicates will not be collected for this project.

### 37.2.2 Accuracy

Accuracy measures the bias of an analytical system by comparing the difference of a measurement with a reference value. The % recovery of an analyte, which has been added to the environmental samples at a known concentration before extraction and analysis, provides a quantitation tool for analytical accuracy. The spiking solutions used for accuracy determinations are not used for instrument calibrations. The following equation illustrates how accuracy is evaluated:

$$\text{Accuracy as \% recovery} = \frac{\text{Spiked Sample Result-Sample Result x 100\%}}{\text{Spiked Sample True Value}}$$

Percent recoveries for MS, MSD, and LCS that are analyzed for every batch of up to 20 samples serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs analyzed for organic contaminants to evaluate the method's accuracy and to help determine matrix interferences.

As a general rule, the recovery of most compounds spiked into samples is expected to fall within a range of 70 to 130%. This range represents the EPA advisory acceptability limits for MS, MSD, and LCS recoveries for all organic analysis methods. The surrogate standard advisory acceptability limits are also 70 to 130% for all organic analyses. Laboratories may use the advisory limits until the in-house, statistically-based control limits are developed for each method of organic analysis and sample matrix.

Control limits are defined as the mean recovery, plus-or-minus three standard deviations, of the 20 data points, with the warning limits set as the mean plus-or-minus two standard deviations. The laboratory will review the QC samples and surrogate standard recoveries for each analysis to ensure that internal QC data lie within the limits of acceptability. The laboratory will investigate any suspect trends and take appropriate corrective actions.

### 37.2.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the SAP, Chemical Data Quality Management Plan, and field SOPs. Errors in sample collection, packaging, preservation, or CoC procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

Data generated by the laboratory must be representative of the laboratory database of accuracy and precision measurements for analytes in different matrices. Laboratory procedures for sample preparation will ensure that aliquots used for analysis are representative of the whole sample. Aliquots to be analyzed for volatile parameters will be removed before the laboratory composites/homogenizes the samples, to avoid losing volatile compounds during mixing.

#### 37.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during inter- laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units, standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

#### 37.2.5 Completeness

Completeness is a measure of whether all the data necessary to meet the project have been collected. For the data to be considered complete, they must meet all acceptance criteria including accuracy and precision and other criteria specified for an analytical method. The data will be reviewed and/or validated to keep invalid data from being processed through data collection. Completeness is evaluated using the following equation:

$$\text{Completeness} = \frac{\text{Acceptable Results x 100\%}}{\text{Total Results}}$$

The goal for completeness for all QC parameters, except holding times, will be 90%. The goal for holding times will be 100%. If these goals are not achieved, the sources of nonconformances will be evaluated to determine whether re-sampling and re-analysis is necessary.

### 37.3 PROJECT-REQUIRED REPORTING LIMITS

Following Navy requirements, the laboratory will determine the method detection limits (MDLs) for each method, instrument, analyte and matrix by using the procedure described in Title 40 Code of Federal Regulations Part 136B. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

A MDL study involves preparation/digestion and analysis of seven replicates of a given matrix spiked with target analytes at concentrations two to five times greater than the estimated MDL. At a minimum, the laboratory will conduct annual MDL studies or quarterly MDL verifications (according to DoD QSM requirements). The laboratory will select reporting limits for all analytes at concentration levels that exceed the calculated MDL by a factor of two to ten.

Project needs and PQOs may require reporting analyte concentrations down to the MDLs.

# References


Argus Pacific, 2009a, *Radiation Screening, Building 27, Former Sand Point Naval Facility, Seattle, Washington*, April 30.

Argus Pacific, 2009b, *Radiation Screening, Building 2 and Pump Houses, Former Sand Point Naval Facility, Seattle, Washington*, May 28.

Naval Facilities Engineering Command SW, 2001, *Environmental Work Instruction 3EN2.1 - Chemical Data Validation*.

Naval Facilities Engineering Command SW, 2006, *Environmental Work Instruction EVR.2 - Review, Approval, Revision, and Amendment of Sampling and Analysis Plans (SAPs)*.

Naval Facilities Engineering Command SW, 2006, *Environmental Work Instruction EVR.6 – Environmental Data Management and Required Electronic Delivery Standards.*

Naval Facilities Engineering Command SW, 2007, *Environmental Work Instruction EVR.4 - Implementing and Maintaining the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Administrative Record and Compendium at NAVFAC Southwest.*

URS Consultants, Inc. 1996, Environmental Baseline Survey, Naval Station Puget Sound (NAVSTA PS), Seattle Washington, TO 0104, January.

U.S. Department of Defense, Department of Energy, Nuclear Regulatory Commission, and U.S. Environmental Protection Agency, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) *NUREG-1575*, August.

U.S. Department of Defense, 2009, *Quality Systems Manual for Environmental Laboratories, Version 4 Final, June 5*.

U.S. Environmental Protection Agency, 1980, *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA–600/4–80–032, August.

U.S. Environmental Protection Agency, 2001, *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS*.

U.S. Environmental Protection Agency, 2004, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, Washington D.C., OSWER 9240.1-45, EPA 540-R-04-004,* October.

U.S. Environmental Protection Agency, 2005, *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)*.

U.S. Environmental Protection Agency, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*.

U.S. Environmental Protection Agency, 2008, *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA 540/R-99-009 (PB99-963506)*

# APPENDIX B

## *WASTE MANAGEMENT PLAN*

*DRAFT*

# WASTE MANAGEMENT PLAN

## TIME CRITICAL REMOVAL ACTION

FORMER NAVAL STATION PUGET SOUND
SEATTLE, WASHINGTON

CONTRACT NUMBER N62470-08-D-1007

**Prepared for:**

**U.S. Department of the Navy**
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315

**Prepared by:**
**Shaw Environmental and Infrastructure, Inc.**
12100 NE 195th Street
Bothell, Washington 98296

TASK ORDER FNZ4
SHAW PROJECT NO. 137165

JANUARY 2010

# TABLE OF CONTENTS

# List of Acronyms and Abbreviations

| | |
|---|---|
| ACM | asbestos-containing materials |
| AJMC | Army Joint Munitions Command |
| CFR | Code of Federal Regulations |
| DOT | Department of Transportation |
| EPA | United States Environmental Protection Agency |
| IDW | investigation-derived waste |
| LBP | lead-based paint |
| LLRW | low-level radioactive waste |
| MOU | Memorandum of Understanding |
| Navy | United States Department of the Navy |
| NAVST PS | Naval Station Puget Sound |
| PPE | personal protective equipment |
| PSCAA | Puget Sound Clean Air Agency |
| QAPP/SAP | Quality Assurance Project Plan/Sampling and Analysis Plan |
| $^{226}Ra$ | Radium-226 |
| RASO | Radiological Affairs Support Office |
| RCRA | Resource Conservation and Recovery Act |
| ROC | Radionuclide of Concern |
| RPP | Radiation Protection Plan |
| Shaw | Shaw Environmental and Infrastructure, Inc. |
| SSHP | Site Safety and Health Plan |
| TCRA | time-critical removal action |
| TO | Task Order |
| U.S. | United States |
| WAC | Washington Administrative Code |
| WDOE | Washington Department of Ecology |
| WMP | Waste Management Plan |

# Waste Management Plan

**Time Critical Removal Action**
Former Naval Station Puget Sound
Seattle, Washington

# Signature Sheet

______________________________ ____________________
Patrick T. Moore, CIH CSP Date
Shaw Project Health and Safety Manager

______________________________ ____________________
Chris Generous, L.G. Date
Shaw Project Manager

______________________________ ____________________
Jim Langsted, CHP Date
Radiation Safety Officer

# *1.0 BACKGROUND INFORMATION*

This Waste Management Plan (WMP) has been prepared by Shaw Environmental and Infrastructure, Inc. (Shaw) under Contract Number N62470-08-D-1007, Task Order (TO) FZN4 to present the waste management practices and procedures to be followed for the types and quantities of waste expected to be generated while performing radiological surveys and time critical removal action (TCRA) of identified radiologically impacted areas at the former Naval Station Puget Sound (NAVSTA PS), Seattle, Washington.

The procedures and guidelines contained herein were based upon the best available information at the time of the plan's preparation. Specific requirements may be revised if new information is received or conditions change. Written amendments will document any changes made to the plan and will be included as an addendum to this WMP.

## 1.1 SITE LOCATION, DESCRIPTION AND HISTORY

This information is provided in Section 1 of the project Work Plan.

## 1.2 PROJECT OBJECTIVES

The objective of this TO is to conduct characterization surveys, TCRAs, and final status surveys to address radiological contamination identified in building materials and associated sewer and storm drain lines for Building 27 and Building 2 (see Figure 2 of the Work Plan) in order to support timely renovation of the building for recreational purposes. The only known radionuclide of concern (ROC) known or suspected within the area of concern is radium-226 ($^{226}Ra$).

## 1.3 WASTE MANAGEMENT SCOPE

All waste streams generated during the radiological survey and TCRA will be managed in accordance with all applicable local, state and federal regulatory requirements.

LLWRW and mixed waste will be handled, and transported for proper disposal under a separate contract issued to the Army Joint Munitions Command (AJMC), Rock Island, Illinois and managed by the Radiological Affairs Support Office (RASO) (Section 2.10).

Identified asbestos containing material (ACM) and lead-based paint (LBP) waste materials will be handled by a certified asbestos and LBP abatement contractor and shall be stored and disposed of in accordance with the state of Washington regulations.

Liquids will be stored in U.S. Department of Transportation (DOT)-approved 55-gallon drums or a polyethylene tank within lined, bermed areas. Following analysis, if appropriate these liquids will be discharged to the sanitary sewer system under a temporary sewer discharge permit (if required) and in compliance with Chapter 246-221-290 of the Washington Administrative Code (WAC), Appendix A concentration limits. The waste liquids will be sampled in accordance with the analytical requirements of the project Quality Assurance Project Plan/Sampling and Analysis Plan (QAPP/SAP).

Waste solid materials are expected to be non-hazardous based on prior site history. These wastes will be stored in DOT-approved 55-gallon drums in the designated storage areas until the waste can be sampled, profiled, and sent off site for disposal by the United States Department of the Navy (Navy) radiological waste contractor. Sample analyses will be selected based on the history of contamination, at the point where sediments or other solid wastes were generated, and/or other location-specific factors that could require additional analytical methods.

The Site Supervisor will be responsible for documenting and maintaining an inventory of the wastes generated under this radiological survey and TCRA. The Site Supervisor or a designated support person will also be responsible for inspections and maintenance of the waste storage location, preparation of the batch discharge permit, sampling, and profiling of the waste streams, and coordination with the Navy regarding the disposal of the non-radiological wastes to a Navy-approved waste disposal location. Radiologically contaminated waste will be provided to the Navy radiological waste contractor in accordance with the Memorandum of Understanding (MOU) (Section 2.10).

## 1.4 REGULATORY REQUIREMENTS

Project activities may potentially generate non-hazardous waste, low level radioactive waste (LLRW) and mixed wastes, and Resource Conservation and Recovery Act (RCRA) hazardous wastes. As such, the following federal and state regulations are applicable and must be complied with during implementation of planned project activities:

- Washington State and United States Environmental Protection Agency (EPA) regulations for identification and management of hazardous waste, WAC Chapter 173-303 *Dangerous Waste Regulations*, and 40 Code of Federal Regulations (CFR), Parts 260 through 299;
- DOT rules for hazardous materials transport, 49 CFR, Parts 100 through 178;
- Puget Sound Clean Air Agency (PSCAA) regulations;
- Washington State Department of Labor and Industry regulations pertaining to asbestos and lead abatement activities;

Applicable Department of Navy and Department of Defense environmental permits, policies, and procedures.

Also potentially applicable are Washington State regulations for LLRW disposal, WAC Chapter 173-325 and Chapter 173-326.

Appropriate best management practices will be followed to control run-on/runoff and to minimize fugitive dust emissions during project activities.

# 2.0 *WASTE MANAGEMENT PRACTICES*

This section describes in more detail how waste generated during site characterization activities will be characterized and classified.

## 2.1 PROJECT WASTE DESCRIPTIONS

Solid and liquid waste streams will be generated during the radiological survey and TCRA.

The solid waste streams that will be generated include the following:

- LLRW and mixed waste,
- Personal protective equipment (PPE) (for example, Tyvek® coveralls, protective gloves, monitoring supplies, etc.),
- Sediments from sewer/stormwater pipeline and pump house flushing activities,
- ACM,
- LBP contaminated building materials (potentially),
- Concrete and/or asphalt,
- Building materials.

Liquid waste streams that will be generated during radiological survey and TCRA activities include the following:

- Equipment rinsate water from decontaminating equipment and machinery,
- Stormwater during survey activities that may gather within blocked-off stormwater sewers,

Wash water from sewer/storm water pipeline and pump house flushing activities.

## 2.2 RADIOACTIVE WASTE

Radioactive waste will be minimized by compliance with contamination control practices combined with segregation and survey practices as detailed in the Radiation Protection Plan (RPP), Appendix C of the Work Plan. Contaminated sediments, debris, PPE, etc. shall be placed in 55 gallon drums or roll-off bins and the filled drums/bins will be transferred to the custody and control of the authorized shipper.

## 2.3 WASTE CHARACTERIZATION/CLASSIFICATION

Unless investigation-derived waste (IDW) is predetermined to be hazardous waste, WAC 173-303-070 and 40 CFR, Part 261 require a determination of whether or not the materials are a hazardous waste. Listed wastes are specifically identified in WAC 173-303-080. Where a clear hazardous waste determination cannot be made, the materials will be sampled and analyzed in accordance with federal regulations and WAC 173-303-090. A determination will then be made as to whether the material is a characteristic hazardous waste based on the criteria for ignitability, reactivity, corrosivity, or toxicity as defined in WAC 173-303-090(5) – (8).

In addition to IDW, the hazardous waste classification requirements may also apply to decontamination water generated from daily decontamination activities and to PPE used during project activities.

Appropriately trained personnel will accurately prepare and make all final waste stream characterizations. They will also accurately prepare all waste documentation, including waste profiles and manifests for Navy signature. The Navy will sign the waste manifests and will also receive a copy of the waste stream characterizations.

All non-hazardous waste transported from the site will be accompanied by a non-hazardous waste manifest. Navy personnel will be responsible for reviewing and signing all non-hazardous waste documentation, including waste profiles and manifests.

## 2.4 HAZARDOUS WASTE MANAGEMENT

RCRA Subtitle C and the Washington Dangerous Waste Regulations govern hazardous waste management from the point of generation through storage and treatment (if necessary) to ultimate disposal. The EPA authorizes the Washington Department of Ecology (WDOE) to oversee management of the hazardous waste program in Washington.

Hazardous waste must comply with the following requirements:

- Any waste generated during project activities must be characterized to determine whether it is a hazardous waste. Analytical testing requirements are detailed in the QAPP/SAP.
- Hazardous waste must be managed in accordance with WAC 173-303-170 through 230, Requirements for Generators of Dangerous Waste.
- Hazardous waste transported off site must be manifested in accordance with WAC 173-303-180 manifest, and accompanied by land disposal restriction certification notices per WAC 173-303-140(2)(f).
- Hazardous waste must be stored in accordance with WAC 173-303-160, Containers.
- All containers of hazardous waste to be stored or disposed of will be clearly marked with a completed hazardous waste label, indicating the starting date of accumulation, EPA identification number, EPA waste code, and DOT markings.
- Hazardous waste may be stored on site for a maximum of 90 days. The 90 days begin on the date that the waste is first generated and containerized (the day that the first waste is placed in a container).

Hazardous waste must be disposed of only at a hazardous waste disposal facility permitted for the disposal of the particular type of hazardous waste generated.

## 2.5 WASTE STORAGE

Container selection will be performed by DOT-trained personnel and will be based on the type and quantity of waste to be generated. Containers may include either DOT-specification drums or roll-off bins for regulated, hazardous material. DOT-specification containers are not required for material that does not meet a DOT hazard class.

Prior to commencing project activities, the Site Supervisor, in conjunction with the Navy, will select areas for the temporary staging and storage of IDW, decontamination fluids, and PPE. These areas will include secondary containment, where appropriate and feasible.

Waste material must be classified according to Washington and DOT criteria before the labels are applied. Upon classification, each container will be marked and labeled as required. Trained personnel, as required by 49 CFR, Part 172, Subpart H, will conduct all DOT functions.

At the time of generation, all waste containers will be labeled, using indelible ink, with the following information:

- Source and location,
- Contents and quantity of material in the container,
- Potential health, safety, and environmental hazards,
- Accumulation start date (the date the first drop of material was put in the container).

Containers determined to contain hazardous waste will be immediately labeled with a completed commercial "HAZARDOUS WASTE" label, which will include the accumulation start date and other requested information. Containers of waste material suspected of being hazardous will be presumed to be hazardous and managed as such. In addition, these containers will be marked or labeled as “Potentially Hazardous Pending Analysis” until a proper waste determination can be made (the results of waste analysis are received).

As practicable, hazardous waste stored in containers (55-gallon drums or roll-off bins) will also be stored on wooden pallets, if possible, and within a predesignated waste storage area with secondary containment. An inventory of waste containers will be maintained for later submittal to and inspection by Navy personnel, if required.

Containers of hazardous waste will be inspected and logged weekly while the fieldwork is in progress. Tanks containing hazardous waste will be inspected on a daily basis. Inspections will encompass an evaluation for proper labeling, secure closure, the condition of each container/tank, number of containers/tanks, and condition of the storage and secondary containment area. Any signs of deterioration, leaking, or significant dents will be noted, and containers will be immediately over packed or replaced, if necessary. Inspection results will be provided to the Navy, as requested.

## 2.6 WASTEWATER AND WASTE FLUIDS

The WAC 173-303-202 and 40 CFR, Part 265, contain applicable requirements for facilities that manage hazardous wastes in tanks or containers. Tanks will be installed, managed, and inspected in accordance with the substantive requirements of WAC 173-303-202. Containers and tanks must be labeled in a manner which adequately identifies the major risk(s) associated with the contents for employees, emergency response personnel and the public, per WAC 173-303-395(6).

Decontamination water and waste water from the flushing of sewer/storm water lines and from power washing of the pump houses will be contained within 55-gallon drums or a polyethylene tank, characterized, appropriately labeled, and situated within a predesignated and properly designed waste container storage area. For non-hazardous wastewaters, the containers will be closed when not in use and inspected on a weekly basis.

## 2.7 ASBESTOS AND LEAD-BASED PAINT WASTES

Identified ACM and LBP waste materials will be handled by certified asbestos and LBP abatement contractors and shall be stored and disposed of in accordance with the State of Washington regulations, including the following:

- PSCAA, Regulation III, Article 4: "*Asbestos Control Standards*;"
- WAC Chapter 296-62, Part I-1, *Asbestos, "Tremolite, Anthophyllite, and Actinolite*;"
- WAC 296-155-176, "*Lead*."

The ACM and LBP waste materials will be disposed of by a certified abatement contractor to an approved Navy disposal facility.

Radiologically contaminated ACM or LBP waste materials will be provided to the Navy radiological waste contractor for proper disposal.

## 2.8 USED PERSONAL PROTECTIVE EQUIPMENT

Used PPE will also be stored in 55-gallon drums within the designated waste container accumulation area.

## 2.9 WASTE ACCUMULATION AREAS

The following requirements apply to hazardous waste storage areas:

- A sign with the legend, "Danger Hazardous Waste Area – Unauthorized Personnel Keep Out" (written in English and Spanish), which will be posted at each 90-day accumulation area in sufficient numbers to be seen from any approach. The signs will be legible from a distance of at least 25 feet.
- Aisle space will be maintained to allow the unobstructed movements of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless aisle space is not needed for any of these purposes.
- The following emergency equipment will be located or available to personnel during active waste management activities at each accumulation area:
  - A device, such as a telephone or a hand-held, two-way radio capable of summoning emergency assistance.
  - Portable fire extinguishers, fire control equipment.
  - Spill control equipment, and decontamination equipment.
  - Eye wash station and first aid kit.

Sediment and waste water IDW, LLRW, decontamination water, and used PPE will be contained, labeled, and stored according to the procedures described in the above sections.

ACM and LBP contaminated materials shall be handled and properly stored by the certified abatement contractor. Any contaminated materials left unattended overnight nights shall be placed in locked storage roll-off bins or 55 gallon drums.

## 2.10 WASTE DISPOSAL

All wastes disposed of offsite (including non-hazardous wastes) will be sent to RCRA Subtitle C or RCRA Subtitle D facilities. Decontamination water and storm water/sewer system wash water will be disposed of in the sanitary sewer system under a batch discharge permit and in compliance with WAC Chapter 246-221-290, Appendix A concentration limits. Sediment IDW and PPE will be temporarily stored on site pending off-site disposal. All waste will be disposed of only at a waste disposal facility approved by the Navy.

LLRW and mixed waste will be handled and transported for proper disposal under a separate contract issued to the AJMC, Rock Island, Illinois and managed by RASO.

A MOU between Shaw and the Navy radiological waste contractor will be completed, executed by both parties, and provided for Navy approval. This MOU will detail interface and responsibilities of each party with respect to radiologically contaminated and mixed waste. The MOU is anticipated to address:

- Regulatory responsibilities,

- Waste estimates and profiles,
- Containers and packaging,
- Waste characterization,
- Waste storage,
- Waste turnover and turnover documentation,
- Charges and fees,
- Waste disposal records,
- Project closeout.

## 2.11 WASTE MINIMIZATION

To minimize the volume of waste, the following general guidelines will be followed:

- Waste materials will not be contaminated unnecessarily.
- Work will be planned ahead.
- Materials may be stored in large containers, but the smallest reasonable container will be used to transport the material to the location where it is needed.
- Cleaning and extra sampling supplies will be maintained outside any potentially contaminated area to keep them clean and to minimize additional waste generation.
- Mixing of detergents or decontamination solutions will be performed outside potentially contaminated areas.
- Drop cloths or other absorbent material will be used to contain small spills or leaks.
- Contaminated materials will not be unnecessarily commingled with uncontaminated materials.
- Wooden pallets inside the exclusion zone will be covered with plastic.
- Materials and equipment will be decontaminated and reused when practical.
- Volume reduction techniques will be used when practicable.
- Waste containers will be verified to ensure that they are solidly packed to minimize the number of containers.
- Only the size waste containers adequate to contain the volume of waste generated will be used.
- Less hazardous substances will be used whenever possible (only the volume of standard solutions needed for testing will be brought; minimal amounts of decontamination water and solvent rinses will be used).

## 2.12 REPORTING SPILLS AND RELEASES

Precautions will be taken to prevent hazardous material spills. Informal daily inspections by site personnel of equipment, structure(s), and containers will be conducted. In addition, personnel using hazardous materials will inspect containers before and after use. In the event of a significant spill, the Seattle Fire Department and Parks & Recreation Department will be notified. Spill response will be conducted in accordance with Section 9.10 of the Site Safety and Health Plan (SSHP), Attachment 3 of the Accident Prevention Plan

# ***3.0*** *REFERENCES*

Department of the Navy, 2008, Scope of Work, Contract N 62470-08-D-1007, T O FZN4, Cleanup Action at Former Naval Station Puget Sound, Washington; Naval Facilities Engineering Command Southwest.

Shaw Environmental & Infrastructure, Inc., 2009, *Health and Safety Policies and Procedures Manual*.

U.S. Army Corps of Engineers, 2008, *Safety and Health Requirements Manual EM 385-1-1*.

# APPENDIX C

## *RADIATION PROTECTION PLAN*

*DRAFT*

# RADIATION PROTECTION PLAN FOR

# TIME CRITICAL REMOVAL ACTION FORMER NAVAL STATION PUGET SOUND SEATTLE, WASHINGTON

CONTRACT NUMBER N62470-08-D-1007

**Prepared for:**
**U.S. Department of the Navy**
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315


**Prepared by:**
**Shaw Environmental and Infrastructure, Inc.**
12100 NE 195th Street
Bothell, Washington 98296


TASK ORDER FNZ4
SHAW PROJECT NO. 137165

JANUARY 2010

# Radiation Protection Plan For

## Time Critical Removal Action
## Former Naval Station Puget Sound
## Seattle, Washington

# Signature Page

Date Effective: ____________________

This Radiation Protection Plan is applicable to the following activities: Radiological surveys of building surfaces, manhole surfaces, and sewer and storm drain pipe surfaces.

The specific requirements of this addendum and the general requirements of the Final Safety and Health Plan are mandatory for all personnel performing the aforementioned activities.

| | |
|---|---|
| ______________________________ | ____________________ |
| Christopher Generous<br>Shaw Project Manager | Date: |
| ______________________________ | ____________________ |
| Thomas Peterson<br>Shaw License Radiation Safety Officer | Date: |
| ______________________________ | ____________________ |
| Laurie Lowman<br>RASO Environmental Program Manager | Date: |
| ______________________________ | ____________________ |
| Justin Peach<br>Navy Remedial Project Manager | Date: |

# TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF ATTACHMENTS

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| µCi | microcurie |
| µR/hr | microroentgen per hour |
| AEC | Atomic Energy Commission |
| ALARA | As Low As Reasonably Achievable |
| APP | Accident Prevention Plan |
| Argus | Argus Pacific, Inc. |
| CFR | Code of Federal Regulations |
| $cm^2$ | square centimeters |
| DAC | Derived Air Concentration |
| DOH | Department of Health |
| DOT | United States Department of Transportation |
| dpm | disintegrations per minute |
| EPA | United States Environmental Protection Agency |
| FR | Federal Register |
| FSS | Final Status Survey |
| g | gram |
| JSA | Job Safety Analysis |
| LLRW | low-level radioactive waste |
| ml | milliliter |
| MDA | minimum detectable activity |
| MDC | minimum detectable concentration |
| MDL | minimum detection limit |
| MOU | Memorandum of Understanding |
| MTCA | Model Toxics Control Act |
| mph | miles per hour |
| mR/hr | milliroentgens per hour |
| mrem | millirem |
| Navy | Department of the Navy |
| NARM | Naturally occurring and accelerator produced radioactive material |
| NAVFAC NW | Naval Facilities Engineering Command Northwest |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| NAVSEA | Naval Sea Systems Command |
| NAVSTA PS | Naval Station Puget Sound |
| NIST | National Institute of Standards and Technology |
| NRC | United States Nuclear Regulatory Commission |
| pCi/L | picocurie per Liter |
| PM | Project Manager |
| PPE | Personal Protective Equipment |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |

| | |
|---|---|
| $^{226}Ra$ | Radium-226 |
| RASO | Radiological Affairs Support Office |
| RCA | Radiologically Controlled Area |
| RCS | Radiological Controls Supervisor |
| RCT | Radiological Control Technician |
| RMSA | Radioactive Material Storage Area |
| ROC | Radionuclide of Concern |
| RPD | Relative Percent Difference |
| RPP | Radiation Protection Plan |
| RSO | Radiation Safety Officer |
| RWP | Radiological Work Permit |
| SAP | Sampling and Analysis Plan |
| Shaw | Shaw Environmental and Infrastructure, Inc. |
| SSHP | Site Safety and Health Plan |
| SOP | Standard Operating Procedure (Shaw) |
| SOW | Scope of Work |
| SSN | Social Security Number |
| T&D | Transportation and Disposal |
| TCRA | Time Critical Removal Action |
| TEDE | Total Effective Dose Equivalent |
| TLD | Thermoluminescent dosimeter |
| TO | Task Order |
| U.S. | United States |
| WAC | Washington Administrative Code |

# *1.0 PURPOSE/INTRODUCTION*

This Radiation Protection Plan (RPP) provides guidance for identifying and protecting Shaw Environmental & Infrastructure, Inc. (Shaw) and subcontract workers from radiological hazards during the performance of work at the former Naval Station Puget Sound (NAVSTA PS) Seattle, Washington (Figure 1 in the Work Plan).

The RPP is to be implemented in concert with the Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP). The RPP addresses radiological hazards; the APP/SSHP addresses chemical and non-radiological physical hazards and includes Activity Hazard Analyses.

The objective of this Task Order (TO) is to conduct characterization surveys, time critical removal actions (TCRA), and final status surveys (FSSs) to address radiological contamination identified in building materials and associated sewer and storm drain lines for Building 27 and Building 2 (see Figure 2 of the Work Plan). The work is being undertaken to support timely renovation of the building for recreational purposes. The only known Radionuclide of Concern (ROC) known or suspected within the area of concern is radium-226 ($^{226}$Ra).

Overall guidance for the work is contained in the Scope of Work (SOW) prepared by Naval Facilities Engineering Command Northwest (NAVFAC NW), Rev 2 (03 September 2009). The work will be performed for the United States Department of the Navy (Navy) and administered under Contract N62470-08-D-1007, TO FNZ4.

All project participants performing work around identified or suspected radioactive material associated with this TO must read or be briefed about this RPP and must verify that they understand its content by signing the agreement and acknowledgement sheet, included as Attachment A, "Radiation Protection Plan Acknowledgement Form." A Radiological Work Permit (RWP), a work document that contains the necessary controls and proactive measures to prevent inadvertent exposures to radiation and radioactive contamination while performing work in radiologically controlled areas, will also be administered by the Project Radiation Safety Officer (RSO) and reviewed and signed by workers prior to initiating work in radiologically controlled areas.

Multiple agencies have jurisdiction or an interest in NAVSTA PS for current activities and proposed future uses. These agencies and their contact information are listed in Table 1.0, "Agency Contact Information."

*Table 1.0*
*Agency Contact Information*

| Contact | Address and Phone Number |
|---|---|
| United States Nuclear Regulatory Commission (NRC)<br>Region I<br>Division of Nuclear Materials Safety | 475 Allendale Road<br>King of Prussia, Pennsylvania 19406<br>(610) 337-5000 |
| United States Environmental Protection Agency (EPA)<br>Region 10 | 1200 Sixth Avenue, Suite 900<br>Seattle, WA 98101<br>(206) 553-1200 |
| Washington State Department of Health (DOH)<br>Division of Environmental Health<br>Office of Radiation Protection | P.O. Box 47827<br>Olympia, Washington 98504-7827<br>(360) 236-3251 |
| United States Department of the Navy<br>Naval Facilities Engineering Command,<br>Northwest Division (NAVFAC NW) | 1101 Tautog Circle, Suite 203<br>Silverdale, WA 98315<br>(360) 396-0082 |
| United States Department of the Navy<br>Naval Facilities Engineering Command,<br>Southwest Division (NAVFAC SW) | 1455 Frazee Road, Suite 900<br>San Diego, CA 92108-4310<br>(619) 532-0966 |
| Naval Sea Systems Command (NAVSEA) Detachment,<br>Radiological Affairs Support Office (RASO) | P.O. Drawer 260, Building 1971<br>Yorktown, VA 23691-0260<br>(757) 887-7650 |
| Seattle Parks and Recreation | 100 Dexter Ave N<br>Seattle, WA 98109<br>(206) 684-7133 |

For radiological activities, Shaw understands that NAVSTA PS is not under Exclusive Federal Jurisdiction. As a result, Shaw will use its NRC Service Provider's license under reciprocal recognition by the Washington State DOH, Division of Environmental Health, Office of Radiation Protection. It should be noted that although the NRC claims no jurisdiction over military sources of $^{226}$Ra and that notification to the NRC is not required for this removal action (naturally occurring and accelerator produced radioactive material (NARM) Rule, Federal Register (FR) citation 72 FR 55864), Shaw will follow the policies and procedures established by the NRC Service Provider's license. In addition, Shaw will follow the specific rules and regulations presented in the Washington Administrative Code (WAC), Title 246, Chapter 246-220 through Chapter 246-254.

For the purposes of this RPP, "Navy" is used for the following commands:

- United States Department of the Navy, NAVFAC NW.
- United States Department of the Navy, Base Realignment and Closure, Project Management Office.
- NAVSEA Detachment, RASO.

### 1.1 POLICY

It is Shaw's policy that all work with radioactive materials or ionizing radiation be purposeful and performed in a manner that protects workers, members of the general public, and the environment. Work involving radiological hazards may not begin unless that work can be performed in a safe manner, compliant with rules and regulations. Moreover, Shaw endorses and applies As Low As Reasonably Achievable (ALARA) principles.

### 1.2 PROJECT-SPECIFIC RADIATION PROTECTION PLAN

Shaw Procedure HS700, "Policy and Guidance for Developing Radiation Protection Plans" (Shaw, 2008), requires the preparation of a project-specific RPP for any project or activity involving the possession, use of, or work with materials with the potential for exposure to ionizing radiation. This RPP complies with Shaw policy and procedural requirements and provides the overall guidance to project management and personnel to execute the project SOW in a manner that protects workers, the public, and the environment. Specific guidance for implementation of radiological safety operations is provided in Shaw Standard Operating Procedures (SOPs). Applicable SOPs are listed in Table 1.2, "Shaw Standard Operating Procedures," and included in Attachment B.

*Table 1.2 Shaw Standard Operating Procedures*

| Procedure Number | Procedure Title |
|---|---|
| T-RA-001 | Health Physics Policy Manual |
| T-RA-002 | Radiological Controls Training and Qualification |
| T-RA-003 | Shipment of Radioactive Materials |
| T-RA-005 | Field Project Radiological Controls |
| T-RA-006 | Radiological Controls Portable Instrument Procedure |
| T-RA-007 | Airborne Radioactive Particulate Monitoring |
| T-RA-008 | External Dosimetry Administration |
| T-RA-009 | Radiation Exposure Rate Monitoring |
| T-RA-010 | Radiological Site Controls |
| T-RA-011 | USNRC Service License Implementation Procedure |
| T-RA-012 | Surface Contamination Monitoring |
| T-RA-013 | Bioassay and Internal Exposure Monitoring |

*Note: Informational uncontrolled copies of these Shaw SOPs are provided in Attachment B, the most current Controlled Copy of each procedure is maintained on the Shaw intranet. It is the responsibility of the Project RSO to insure that field activities are in compliance with current requirements. Revisions to the SOPs will not require a revision to this RPP. Informational copies of any SOP revisions will be available to the Navy.*

### 1.3 As Low As Reasonably Achievable

ALARA means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose for which the activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology and benefits to the public health and safety, and other societal and socioeconomic considerations (10 Code of Federal Regulations [CFR] 20.1003.)

### 1.4 Authorization to Stop Work

All employees working at the site have authorization to stop work if an unsafe condition exists or a safety procedure is being disregarded in accordance with Shaw Procedure HS040, "*Stop Work Authority*."

### 1.5 Scope of Work

The project SOW is detailed in Section 1.4 of the Work Plan and depicted on Figures 3 through 8 of the Work Plan. In general the SOW involves the following activities:

- Perform radiological scoping survey of impacted areas in Building 27 (Figure 6), Building 2 (Figure 7), associated roof vents, and Pump Houses.
- Remove and containerize exposed piping located below the former Radium Room in Building 27 (associated with sink previously located in the former Radium Room).
- Conduct sewer line location survey, dye tracer, or another appropriate method to identify whether the removed section of pipe was connected to the gravity flow sewer line or the abandoned pressurized sewer line.
- Conduct background radiological survey and sludge sampling to provide baseline data.
- Collect sludge samples at gravity feed sewer manholes, storm line manholes and catch basins, valve pit, and pump houses 98 and 116.
- Remove, handle, and transport asbestos contaminated tile and subflooring material including fire training area within the impacted areas of Building 27 and Building 2.
- Perform radiological characterization survey of impacted areas in Building 27 (Figure 6) and Building 2 (Figure 7).
- Remove contaminated subflooring and walls based on characterization surveys.
- Remove roofing at identified sampling points (Section 4.10) with 10 foot proximity to former instrument room exhaust vents and conduct characterization surveys.
- Perform radiological characterization survey of storm drain and sanitary sewer piping at accessible manholes and two pump houses (Figure 8).
- Conduct camera surveys of sewer and storm drain lines.

- Power wash storm and sewer lines including drains/manholes and pump houses if evidence of radiological contamination or significant sediment is detected during radiological or camera survey.
- Conduct FSSs of all areas requiring removal or power washing following initial characterization surveys
- Prepare an Engineering Evaluation and Cost Analysis and Action Memorandum on any areas identified for TCRA.
- Conduct TCRA as necessary.
- Conduct FSSs of TCRA areas in accordance with Multi-Agency Site Survey and Investigation Manual survey standards.
- Prepare After Action Reports.

## 1.6 QUALITY CONTROL AND AUDITING

To ensure compliance and evaluate implementation of the RPP, quality control (QC) measures, including self-assessment and management reviews, are employed. At the discretion of the License RSO, a formal audit may also be conducted, particularly if the project duration is greater than six months.

### *1.6.1 Self-Assessment, Management Reviews, and Audits*

Periodic self-assessments and management reviews will include evaluation of exposure rates present during excavation, collected air monitoring data, efficacy of established radiological work practices, ALARA practices, and the use and effectiveness of personal protective equipment (PPE). At a minimum, the Project RSO and the Project Manager (PM) or Technical Manager will conduct one self-assessment and one management review during the execution of project activities. Additional management reviews should be performed at four to six week intervals. Results of self-assessments and management reviews will be reported to and reviewed for concurrence by the License RSO.

An annual or more frequent radiation safety/compliance audit of the project operation and radiological records may be performed by the License RSO or delegate. Project personnel, including the PM, Project RSO, and on-site personnel, shall support and cooperate with any audit.

### *1.6.2 Responses and Corrective Actions*

Deficiencies identified during self-assessment, management review, or as the result of an audit must be tracked and corrected. At a minimum, the corrective action and completion must be documented to close the self-assessment or management review, and the corrective action must be approved by the License RSO. Findings resulting from an audit require a formal response that includes identification of the root cause, immediate action(s) taken to correct the nonconforming condition, the corrective action proposed or taken to prevent a recurrence, and the schedule for completion of any corrective action(s). Responses to findings must be submitted to the License RSO for review and approval.

Unplanned exposures, procedure or RWP violations, any personnel skin contamination, internal uptake, or deficiency or finding resulting from such an event will be tracked as a *radiological occurrence*. For any radiological occurrence, a Corrective Action Report shall be prepared by the Project RSO and the PM, and submitted to the License RSO for review and approval. All radiological occurrences shall be reported to the License RSO, the NRC, and the Navy within 24 hours of identification.

An informational copy of any Shaw-approved Corrective Action Report will be provided to the Navy.

### *1.6.3 Daily Instrumentation Check*

Laboratory and field radiological instrumentation is used, operated, and maintained by project Radiological Control Technicians (RCTs) under the supervision of the Project RSO. In accordance with SOP T-RA-006, "*Radiological Controls Portable Instrument Procedure*" (Attachment B), it is routine practice that each day a radiation protection instrument is used for making a field measurement; the instrument shall be checked for background and source response prior to use. Since radiation measurements are a critical activity, certain portions of the project may need to be suspended pending the arrival of an instrument that is qualified on the project site to be capable of making those measurements.

All instruments in use shall have current calibrations in accordance with the manufacturer's procedures and employing standards and sources traceable to the National Institute of Standards and Technology (NIST). Copies of instrument calibration certificates shall be maintained on site.

# 2.0 RADIATION PROTECTION PERSONNEL

This section defines the radiological responsibilities of key personnel for the project. The safety responsibilities of other personnel are specified in the Shaw SHP. Project roles and responsibilities including an organization chart are provided in the Quality Assurance Project Plan (QAPP)/Sampling and Analysis Plan (SAP). Table 2.0 of this RPP, "*Shaw Personnel Responsible for Radiation Protection*," lists the personnel and their respective responsibilities for radiation protection on the project. Those duties are defined in this section.

*Table 2.0*
*Shaw Personnel Responsible for Radiation Protection*

| Name | Project Role/ Responsibility | Phone Number | Email |
|---|---|---|---|
| Tom Peterson | License RSO | (631) 245-3672 (Cell) | thomas.peterson@shawgrp.com |
| John Hamm | Program RSO | (505) 259-1232 (Cell) | john.hamm@shawgrp.com |
| Jim Langsted | Project RSO/Radiological Controls Supervisor (RCS) | (303) 870-2802 (Cell) | jim.langsted@shawgrp.com |
| Troy Allen | Safety Director | (225) 932-2579 | troy.allen@shawgrp.com |
| Chris Generous | PM | (425) 402-3208 | christopher.generous@shawgrp.com |

## 2.1 SAFETY DIRECTOR

The Safety Director has overall responsibility for Shaw's radiological operations. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice. The Safety Director will establish and maintain all necessary management oversight and implement a management review process to ensure implementation of applicable requirements.

## 2.2 LICENSE RADIATION SAFETY OFFICER

The License RSO is responsible for implementing the Shaw Services Provider Radioactive Materials License, including all communications to the NRC and identifying and training qualified Authorized Users. Implementation responsibilities include identifying and assigning the Project RSO, other Authorized Users, reviewing and approving the RPP, coordinating investigation of any radiological occurrence, and the review and approval of any Corrective Action Report resulting from a radiological occurrence. When activities at a site are completed, the License RSO will notify the NRC in writing within 30 days of the termination of activities.

## 2.3 PROGRAM RADIATION SAFETY OFFICER

The Program RSO is the Shaw individual assigned corporate-level authority to oversee implementation of this project-specific RPP and the Shaw license at NAVSTA PS. As shown below, the Project RSO is responsible for:

- Preparing and maintaining the RPP.
- Coordinating required ALARA reviews.
- Verifying exposure to radiation is maintained ALARA.
- Verifying appropriate instrumentation, protective devices, dosimetry, training, and other items needed to perform work in accordance with elements of this RPP are available.
- Stopping work if necessary to ensure radiation safety.
- Maintaining communication with the PM and License RSO as needed to ensure that this RPP is fully implemented.
- Ensuring proper operation of radiation-measuring equipment, including the performance of daily function and QC tests and removing out-of-compliance instruments from service.
- Ensuring work is performed in accordance with the Work Plan and the RPP.
- Participating in periodic internal and external reviews of RPP content and implementation.

The Program RSO reports to and receives technical direction from the License RSO, advises the PM and Project RSO on radiation protection and radiological operation matters, and communicates and coordinates radiation protection and radiological operation activities with the License RSO and the Navy.

## 2.4 SITE SUPERVISOR

A Shaw Site Supervisor is not anticipated for the current SOW under this TO. However, Shaw and Navy approved subcontractors may be retained to perform tasks such as asbestos abatement, camera surveys, power washing of sewer and storm lines and/or other activities at the site. A Site Supervisor designated by the subcontractor will report to the Project RSO and will be responsible for the following:

- Ensuring that personnel under their direction comply with radiological requirements.
- Supplying necessary information to the Project RSO about projected work activities.
- Providing timely notification to the Project RSO and PM of any radiological problems or issues encountered.

- Ensuring that workers are sufficiently prepared for their tasks, with the necessary tools and equipment to minimize the amount of time spent in radiologically controlled areas (RCAs).
- Ensuring that escorted visitors are supervised and that they maintain safe work practices in accordance with the instructions of the Project RSO or designee.

## 2.5 PROJECT RADIATION SAFETY OFFICER/RADIOLOGICAL CONTROLS SUPERVISOR

The Project RSO/RCS is the Shaw individual assigned to supervise the RCTs and oversee daily radiological operations. The RCS is an Authorized License User and serves as the Project RSO. The RCS reports to and receives technical direction from the Program RSO. As shown below, the RCS is responsible for:

- Supporting required ALARA reviews.
- Ensuring exposure to radiation is maintained ALARA.
- Supervising the preparation of and performing reviews of RWPs.
- Stopping work if necessary to ensure radiation safety.
- Communicating with the PM, License RSO, and Program RSO as needed to ensure that this RPP is fully implemented.
- Maintaining radiation-measuring equipment in working condition in accordance with manufacturer recommendations.
- Directing and supervising the performance of radiological surveys and sampling in accordance with the RPP and Shaw SOPs.
- Reviewing survey findings and instrument performance data for accuracy, completeness, and compliance with project, procedural, and regulatory requirements.
- Performing and supporting self-assessments and management reviews.
- Correcting identified deficiencies within the required time frame.
- Preparing and maintaining reports and notices as required by this RPP.
- Ensuring proper operation of radiation-measuring equipment, including the performance of daily function and QC tests, and removing out-of-compliance instruments from service.
- Ensuring work is performed in accordance with the Work Plan and the RPP.
- Participating in periodic internal and external reviews of RPP content and implementation.
- Supporting self-assessments and management reviews.

## 2.6 RADIOLOGICAL CONTROL TECHNICIANS

RCTs receive day-to-day direction and supervision from the RCS. RCTs are responsible for the following:

- Complying with this RPP and all associated SOPs.
- Performing and documenting daily radiation-measuring equipment function and QC tests.
- Removing non-conforming radiation-measuring equipment from service and notifying the RCS.
- Timely notifying the RCS of any radiological problems or issues encountered.
- Performing and documenting radiological surveys.
- Performing radiation protection job coverage for radiological work activities.
- Establishing and maintaining appropriate RCA boundaries and postings.
- Establishing, maintaining, and operating control points (Contamination Reduction Zones) as necessary.
- Performing additional responsibilities as described in the SOPs contained in Attachment B.

## 2.7 RADIATION WORKERS

Radiation workers (general labor force) entering RCAs must do the following:

- Perform assigned radiological activities as directed by RCTs.
- Respond promptly to "stop-work" and "evacuate" orders from RCTs.
- Adhere to posted written and oral radiological control instructions and procedures, including instructions in RWPs.
- Immediately report lost dosimetry devices to the assigned RCT.
- Report medical radiation treatments to their Site Supervisor and the Project RSO prior to returning to work or wearing dosimetry devices.
- Periodically monitor their personal radiation exposure status to ensure that administrative dose limits are not exceeded.
- Notify the assigned RCT of faulty or alarming radiological protection equipment, as well as unsafe radiological conditions.

Radiation workers report to the Site Supervisor and receive direction from the Project Supervisors (for non-radiological requirements) and the assigned RCT (for radiological requirements).

## 2.8 STOP WORK AUTHORITY

All members of the project team, including all subcontractor personnel, have the responsibility and authority to stop or suspend an activity if they have a safety concern, recognize a potentially unsafe condition, or observe an unsafe condition or action. The affected activity will immediately be suspended and the PM, the RCS, and the Program RSO shall be notified. The activity will resume only after the safety concern or condition is resolved.

# *3.0 TASK-SPECIFIC HAZARD ANALYSIS/CONTROLS*

Task-specific hazard analysis is performed on a daily basis to identify potential hazards associated with site work, including physical, chemical, and radiological components. The task-specific hazards, and controls for the potential hazards, are defined on a Shaw Job Safety Analysis (JSA) form for each unique task. Each JSA is reviewed and signed daily by the workers assigned to the task, and is amended in the field as additional hazards are encountered or expected. The anticipated physical and chemical hazards are described in detail in the Shaw APP/SSHP. Radiological hazards are defined in Section 3.1 below, with the associated control measures defined within the task-specific RWP.

## 3.1 IDENTIFICATION OF RADIATION HAZARDS

Worker exposure may occur via any of the following: radiological surveillance work within Building 27 or Building 2, removal of the drain pipe originating in Building 27's Radium Room, radiological surveillance work within manholes and reachable pipe sections, and soil and sludge sample collection.

Assessments performed by Argus Pacific, Inc. (Argus) (April, 2009) identified several areas that are considered radiologically impacted: Building 27 was originally constructed and utilized as a hangar and is currently vacant. Site drawings indicate that one of the rooms, the Radium Room (since renamed "S-1"), may have been used to handle low-level radioactive materials, presumed to be $^{226}$Ra. Two radiologically-impacted locations were determined to be associated with (1) the wastewater drain pipe located on the North Wall of Room S-1 and (2) where the pipe extended to the first floor below S-1. Measurements indicate that the contamination is located within the drain pipe.

The following locations are considered to be potentially impacted:

- Building 2. In accordance with the SOW (revision dated 03 September 2009), Building 2 will undergo a characterization survey.
- Several sections of the sewer system and the storm drain system, including manholes and pump stations. Surveys will be performed to determine the presence of any residual contamination.

## 3.2 CONTROLLING DOCUMENTS

Shaw possesses a Services Provider Radioactive Materials License issued by the NRC, License Number 20-31340-01. Work will be performed under the reciprocity recognition by the Washington State DOH, Division of Environmental Health, Office of Radiation Protection and in accordance with the NAVSTA PS Work Plan. In addition, Shaw will follow the specific rules and regulations presented in the WAC, Title 246, Chapter 246-220 through Chapter 246-254.

Shaw has a set of SOPs (Attachment B) that are used to implement and meet license commitments. Since the license is issued by the NRC, only Title 10, CFR, Section 20 (10 CFR 20) applies to radiation control. In addition, industrial safety is covered under 29 CFR. EPA regulations under 40 CFR also have applicability for a variety of different regulatory subjects including Comprehensive Environmental Response, Compensation, and Liability Act, the Resource Conservation and Recovery Act, and the National Emission Standards for Hazardous Air Pollutants.

### 3.3 EVALUATION OF POTENTIAL EXPOSURE TO WORKERS

Dose limits governing this project are those of 10 CFR 20. In accordance with Shaw policy, exposures are minimized to the extent practical. To implement that policy, administrative limits have been developed and can be found in SOP T-RA-001, "*Health Physics Policy Manual*" (Attachment B).

Any dose is expected to come via external radiation exposure to $^{226}$Ra, the only ROC expected to be encountered. Doses resulting from internal exposures are not anticipated. External exposure controls are discussed in Section 3.8 and internal exposure controls are discussed in Section 3.9.

General area dose rates in work sites are typically at background values, approximately 5 to 10 microroentgens per hour [μR/hr]. At a minimum, radiological controls, including establishment of boundaries and postings, are implemented when dose rates reach or exceed 500 μR/hr. Individual exposures to Shaw personnel are expected to be less than 100 millirem (mrem) Total Effective Dose Equivalent (TEDE) per year.

### 3.4 EVALUATION OF PUBLIC DOSE

Based on the SOW, the limited activity of radionuclides expected, and the involved naturally occurring radioactive materials levels anticipated on surfaces, public dose due to work activities at this site is anticipated to be less than 100 mrem TEDE for the entire project. Shaw will perform air sampling for work activities where intrusive drain piping investigation/removal or soil excavations/handling may disturb radioactivity. These data shall be periodically reviewed by the Program RSO to validate conformance to public dose expectations and reported to the License RSO.

Shaw's site boundaries fall entirely within NAVSTA PS's property boundaries. Shaw's site boundaries will be routinely surveyed to verify that physical boundaries accessible to the public do not exceed a maximum dose rate of 10 μR/hr, ensuring an annual exposure rate less than 100 mrem.

### 3.5 TRAINING PROGRAM

All personnel assigned to the project and performing field activities at the site must meet the training requirements of the SSHP. Workers who may be exposed to occupational radiation shall receive additional training commensurate with the requirements of radiation workers as defined in 10 CFR 19.12. Visitors, at a minimum, must receive a site briefing and be escorted by an RCT anytime they are within the RCA boundaries.

### *3.5.1 Site Briefing*

The site briefing is presented to site visitors who may access RCAs with an escort. Visitors may not enter Radiation or Contamination Areas. The briefing consists of a description of site-specific hazards, locations on site that these visitors are allowed to access, emergency response and evacuation routes, and other applicable information.

The site briefing will additionally address the issue of potential exposure to radiation and radioactive materials.

### *3.5.2 Radiation Worker Training*

Site-specific radiation worker training is required for all individuals who will access RCAs, radiation areas, and contamination areas without an escort. Radiation worker training provides the following in addition to the training required by the SSHP:

- Review of the JSA for the specific site or task.
- Review of the project APP/SSHP.
- Review of the SOPs (Attachment B) and this RPP.
- Review of the Work Plan.
- Radiation awareness training is conducted by group briefings, video, or by printed handouts approved by the Project RSO. Training will include at a minimum:
  - Recognition of site-specific radioactive material and/or radiation producing devices (e.g., soil, deck markers, foils, buttons, beads, gauges, fragments, items, etc.).
  - Whom to contact if radioactive material is found in an area where it is not anticipated.
  - Whom to contact and expected actions in the event of an emergency, breakage, or spill of radioactive material.
  - Risks associated with the types of radioactive material and radiation-producing devices commonly encountered on the project site.
  - ALARA work principals and techniques.
  - Understanding the requirements for and compliance with RWPs.
  - Understanding the purpose and proper use of dosimetry.

- PPE requirements, including student demonstration of proper donning and doffing techniques.

- Demonstrate the correct technique for using portable instrumentation to perform a whole body frisk.

- Written examination requiring a grade of 80 percent or greater to pass.

Shaw will evaluate and qualify RCTs for assignment to this project. RCT qualifications are evaluated in accordance with the requirements contained in SOP T-RA-001, "*Health Physics Policy Manual*" (Attachment B). Project-specific training is provided to RCTs commensurate to their assigned duties.

### 3.6 DECLARED PREGNANT WOMAN PROGRAM

Women may claim pregnancy in writing in accordance with 10 CFR 20 as well as NRC Regulatory Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure*, Revision 3, Washington, D.C. (NRC, 1999) and NRC Regulatory Guide 8.29, *Instruction Concerning Risks from Occupational Radiation Exposure*, Revision 1, Washington, D.C. (NRC, 1996). Due to the small anticipated annual dose (less than 100 mrem/year), it is unlikely that separate dose tracking will be required. Managing individual exposures to this level meets the NRC requirement of maintaining total dose less than 500 mrem to the fetus during the term of pregnancy.

### 3.7 AS LOW AS REASONABLY ACHIEVABLE PROGRAM

Shaw is committed to maintaining exposures to workers and the public as far below company and regulatory exposure limits as practical. In support of this commitment, the procedural requirements of this RPP and the project APP/SSHP are in place to control field operations. Practices described below are employed to reduce and control probable exposure pathways.

- An RWP is required for any activity in an RCA. Use and handling of exempt-quantity radioactive check sources are exempt from the requirement for an RWP.

- Occupancy in posted radiation areas will be limited to necessary work.

- Proper use of PPE in accordance with the RPP, SSHP, and applicable RWP.

- Radiological work activities are suspended when a sustained wind event in excess of 25 miles per hour (mph) occurs or when dust control measures are ineffective, resulting in visible airborne dust for any sustained five minute period.

Review of these ALARA practices is necessary to assess their efficacy. An initial ALARA review will be conducted following the initial two weeks of field activities. Results of the ALARA review and any recommendations for changes will be presented to the project management team including the Program RSO, the PM, the RCS, and the Navy within five work days after the review is completed. The need for subsequent reviews will be determined by the License RSO, and a final review will be performed when field activities are completed to identify best practices and lessons learned.

### 3.8 External Exposure Control

The following steps are taken to control external radiation exposure to levels that are ALARA:

- Basic dose reduction strategies are employed using the concepts of time, distance, and shielding to control external exposure and minimize dose. Working efficiently in any work area requires advance planning. Morning meetings shall include a review of activities planned; a review of radioactive materials encountered or expected, applicable radiological controls, radiological postings, and good work practices. Workers who have no tasks to perform in areas known to have radioactive materials, and areas that have not been surveyed, shall not go into those areas.
- Instrumentation is routinely used to determine the level and extent of radiation fields. Portable survey instruments shall be on prior to and as approaching work areas, shall be on at all times that materials are being moved closer to workers, and shall be used for screening materials.
- Workers have been trained to (visually) look for objects that might be radioactive, to be wary of objects that are unfamiliar, and to rely on instrument readings to limit and manage external exposure.

### 3.9 Internal Exposure Control

Internal doses are not expected to occur on this project under routine circumstances. ALARA principles, along with task-specific engineered contamination control measures identified in RWPs, will be applied to prevent internal doses. Internal exposure is expected to be less than 1 mrem. Bioassay monitoring is not planned for this project based on the known and expected radiological conditions at the site. If radiological conditions change, or if air monitoring results or contamination survey data indicate a potential for internal exposure, the License RSO or Program RSO may require implementation of a bioassay monitoring program.

### 3.10 Monitoring and Measuring External Exposure

Shaw will provide external dosimetry from a vendor that is National Voluntary Laboratory Accreditation Program accredited. All field staff will be issued dosimetry that is exchanged on monthly intervals in order to generate a durable record of employee exposures. Project personnel are required to provide any prior exposure as specified in SOP T-RA-008, "*External Dosimetry Administration*." Individual exposure records require a unique identifier; Shaw will use Social Security Numbers (SSNs) only for that purpose. Electronic records containing SSNs will be maintained in password-protected files; paper records will be maintained in locked file cabinets. Paper records will be shredded upon disposal; in the event of a security breach, all potentially affected individuals will be notified.

## 3.11 MONITORING AND MEASURING INTERNAL EXPOSURE

For purposes of assessing dose used to determine compliance with 10 CFR 20.1502, determination of internal exposure will comply with the requirements of 10 CFR 20.1204 (a) through (g). Air sampling data shall be routinely reviewed by the RCS to determine whether negative trends (levels greater than 10 percent of derived air concentration [DAC]) exist that may require work stoppage and/or re-engineering of task-specific contamination controls. The RCS will evaluate the potential for internal exposure, and take the appropriate measures to ensure internal doses are ALARA.

## 3.12 SURVEYS AND MONITORING

Protection of workers, the public, and the environment requires meeting the clean-up criteria established for the project; this is achieved by surveying with field instruments or soil sampling and subsequent analysis in accordance with prescribed and approved procedures.

Surveys are performed to determine site conditions and establish appropriate controls, verify that radiological conditions are stable and boundaries are adequate, and identify changing conditions so that appropriate controls are implemented. Surveys are also performed to assess the progress of remediation. Guidance for performing surveys is provided in SOP T-RA-009, "*Radiation Exposure Rate Monitoring*," and SOP T-RA-012, "*Surface Contamination Monitoring*" (Attachment B). The RCS will direct the performance of surveys including identifying locations, required data, survey methods, survey frequency, and data quality requirements.

Qualitative measurements may be employed to assess for gross contamination levels. Large area smears may be used as a tool for preliminary determination of contamination conditions on equipment or waste containers prior to decontamination efforts or placement into a buffer zone for final release survey. Large area smears will be field-checked with a portable scaler/ratemeter such as a Ludlum Model 2360 with a Model 43-93 detector (or equivalent) by scanning the large area smear and performing a static count.

### *3.12.1 Surveys of Equipment and Materials*

Equipment and material coming into or out of areas controlled for radiological purposes will be surveyed following the methods defined in the SOPs (Attachment B). Table 3.12, "*Free Release Criteria for Surfaces/Objects*," provides the criteria for unconditional release of materials and equipment. In the event that survey results indicate that levels of contamination exceed the limits listed in Table 3.12, appropriate decontamination methods may be performed to minimize waste (see Section 5.0). If decontamination methods are unsuccessful, the material will be disposed of as low-level radioactive waste (LLRW).

*Table 3.12*
*Free Release Criteria for Surfaces/Objects*

| | Surfaces | | Soil and Sediment[c] | Water[d] (pCi/L) |
|---|---|---|---|---|
| | Equipment, Waste (dpm/100 $cm^2$)[a] | Structures (dpm/100 $cm^2$)[b] | | |
| $^{226}Ra$ | 100 | 100 | Greater than mean statistical background level plus 3 standard deviations | 3[e] |

AEC – Atomic Energy Commission
$cm^2$ – square centimeters.
dpm – disintegrations per minute.
pCi/L – picocurie per liter.
[a] These limits are based on AEC Regulatory Guide 1.86 (1974). Limits for removable surface activity are 20 percent of these values.
[b] These limits are based on Regulatory Guide 1.86.
[c] These limits are based on the SOW for this TO (Revised 03 September 2009).
[d] Release criteria for water have been derived from Radionuclides Notice of Data Availability Technical Document, (EPA, 2000) by comparing the limits from two criteria and using the most conservative limit.
[e] Limit is for total radium concentration.

Surveys of incoming (i.e., receipt) equipment or material will be performed on all rental equipment (i.e., rad instruments, power tools, scaffolds, ladders, heavy equipment, project trucks, etc.) upon delivery to the job site and prior to release from the job site in order to detect any residual contamination and to prevent importing contamination from an outside source and the uncontrolled release of contamination originating from this project.

Before leaving a contaminated area or RCA, equipment and/or materials (e.g., debris, concrete, and steel) will be surveyed prior to movement into the Access Control Point to ensure that the equipment and materials release criteria are not exceeded. Wood, insulation, and similar materials cannot effectively be surveyed for release; therefore, these materials will be managed as LLRW. The management of radiologically-identified wastes is addressed in Section 3.21.

Equipment and material surveys will include scans and static readings with a portable scaler/ratemeter and qualitative and quantitative smears at potential contaminated material contact points (i.e., wheels, tracks, buckets, floor boards, door handles, steering handles, levers or any other visible surfaces that may have come in contact with contaminated soil). Static measurements will be performed on potential contamination contact points and on large area smears. The scan rate will be ½ inch per second with approximately 15-second static pauses for areas that indicate an audible alpha response. Final release of materials or equipment is based on scan results, static measurements, quantitative smear results, and RCS approval. Final release of waste packages and waste transport vehicles will be based on United States Department of Transportation (DOT) limits for radiation and project release limits for removable contamination as measured by quantitative smears results. Scan surveys and static measurements are not required on loaded waste packages or waste transport vehicles.

## 3.13 ACTION LEVELS

Action levels are specific levels of radioactivity used to determine when additional response (PPE upgrades or modified work techniques) and/or investigation may be necessary. Action levels for radiological controls are listed in Table 3.13, "Action Levels."

*Table 3.13*
*Action Levels*

| Action Level | Response |
|---|---|
| Greater than 100 mrem, annual, expected | Action level for additional training |
| Greater than 100 mrem TEDE annual expected dose, requires thermoluminescent dosimeter (TLD) monitoring by license conditions. The decision has been made to monitor all employees for this project. | Action level for requiring individual monitoring |
| Greater than Table 3.12 free release criteria | Action level for requiring decontamination or storage/disposal as radioactive materials |
| Levels that exceed the administrative control limits for surface contamination of materials or equipment or exposure limits in Table 3.12<br>Excavation (disturbing soil) of any areas within the RCA | Action level(s) for notifying the Project RSO and the Navy, and evaluating additional engineering controls (in addition to existing administrative and engineering controls) |
| Readings above background levels on personnel | Action level for RCT assistance, notification of the Project RSO, License RSO, PM, and the Navy, and decontamination of personnel |
| Exposure rates > 500 µR/hr<br>Airborne radioactivity > 10 percent of DAC value<br>Removable surface contamination > 2,000 dpm/100 $cm^2$ alpha<br>Removable surface contamination > 100,000 dpm/100 $cm^2$ beta<br>Soil activity concentration exceeds 100 times Table 3.12 limits | Action level for notification of Project RSO, PM, and the Navy, and suspending work in the area until otherwise directed (if an RWP approved by Project RSO is not in place) |

When an action level is exceeded, the measurement will be confirmed to ensure that the initial measurement/sample actually exceeds the particular action level. This will involve taking additional measurements, of the same type as the original measurement, to confirm the initial result and, as appropriate, to quantify and/or remove the area of elevated residual radioactivity. Modification of action levels requires Navy concurrence.

## 3.14 RADIOLOGICAL AREAS AND POSTING

Boundaries are established to identify and control access to radiological areas, prevent (to the extent practical) unauthorized access, and protect members of the public from exposure to radiation or radioactive materials as a result of site activities. Areas and postings employed are listed in Table 3.14, "*Radiological Area Posting*," and described below. Known radiological areas are described in the assessment performed by Argus (April, 2009).

*Table 3.14A*
*Radiological Area Posting*

| Area | Criteria | Required Text Posting | Actions and Controls |
|---|---|---|---|
| RCA | Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials or to prevent the inadvertent release of radioactive material to the uncontrolled areas. | CAUTION, RADIOLOGICALLY CONTROLLED AREA | Controlled access, equipment/materials survey and personnel frisk, TLD, RWP sign-in, Level D PPE, routine surveys, boundaries less than 10 µR/h. |
| Contamination Area | Removable surface contamination levels on equipment or solid surface materials exceed 20 dpm/100 $cm^2$ alpha or 1,000 dpm/100 $cm^2$ beta.<br>Any excavated areas within the RCA. | CAUTION, CONTAMINATION AREA | Controlled access, equipment/materials survey and personnel frisk, TLD, RWP sign-in, Modified Level D PPE, routine surveys. |
| High Contamination Area | Removable surface contamination levels on equipment or materials exceed 2,000 dpm/100 $cm^2$ alpha or 100,000 dpm/100 $cm^2$ beta.<br>Soil activity concentration exceeds 100 times Table 3.12 limits. | CAUTION, HIGH CONTAMINATION AREA | Controlled access, equipment/materials survey and personnel frisk, TLD, RWP sign-in, Modified Level D PPE, routine surveys, engineering controls (e.g., misting). |
| Radiation Area | Radiation levels could result in an individual receiving a dose equivalent of greater than 5 mrem but less than 100 mrem in one hour at 30 cm. | CAUTION, RADIATION AREA | Controlled access, TLD, RWP sign-in, Level D PPE, routine surveys. |
| High Radiation Area | Radiation levels could result in an individual receiving a dose equivalent of greater than 100 mrem but less than 5 rem in one hour at 30 cm. | CAUTION, HIGH RADIATION AREA | Controlled access, TLD, RWP sign-in, Level D PPE, SRD, dose rate instrument, RCT coverage, positive control, routine surveys. |
| Airborne Radioactivity Area | Airborne concentrations exist at 10 percent of the DAC or higher. | CAUTION, AIRBORNE RADIOACTIVITY AREA | Controlled access, equipment/materials survey and personnel frisk, TLD, RWP sign-in, Level C PPE, RCT coverage, routine surveys. |
| Radioactive Material Storage Area | An area used for storage of items or containers of radioactive material in quantities exceeding 20 uR/hr or >Table 3.12 limits. | CAUTION, RADIOACTIVE MATERIAL | Controlled access, equipment/materials survey and personnel frisk, TLD, RWP sign-in, Level D PPE, routine surveys. |

### *3.14.1 Controlled Area*

An area is controlled to restrict access to the site to protect staff and authorized visitors and to exclude members of the public. A Controlled Area (may also be called a Restricted Area) is the outermost boundary around planned and established work zones, consists of fencing or an equivalent physical barrier, and provides physical separation from any area where contamination or radiation is present above the minimum threshold values listed in Table 3.12. The maximum allowable radiation dose rate at the Controlled Area boundary is 10 µR/hr.

Entry into the Controlled Area, only, requires Level D PPE as defined by the SSHP and does not require dosimetry or an RWP. Any entry into the Controlled Area requires a specific purpose. Authorized visitors must have the requisite training specified in the SSHP or be escorted by a project staff member and wear the required PPE. Personnel entering the Controlled Area may not enter more restrictive areas contained within the Controlled Area unless they meet the entry requirements for the more restrictive area.

Controlled Areas are posted with signs (black lettering on a white background) identifying it as a Controlled Area and providing a contact phone number. At least one sign facing outward shall be placed on each straight run of fencing, with additional signs placed every 60 to 100 feet along the boundary.

### *3.14.2 Access Control Point*

An Access Control Point is located in a Controlled Area and serves as a transition corridor to the RCA. The Access Control Point is maintained below Table 3.12's free release criteria. It is a designated point of entry into and exit from the RCA for personnel, tools, and heavy equipment. Donning of PPE is typically performed in the Access Control Point before entering the RCA, and all PPE is removed before exiting the RCA to the Access Control Point. A hydration station and restroom facilities may be located in the Access Control Point. An RCT is continuously present in the Access Control Point any time work is being performed within the RCA. During periods of no activity, gates that are a contiguous portion of the Controlled Area boundary are closed and locked.

### *3.14.3 Radiologically Controlled Area*

An RCA is an area inside the Controlled Area where minimal radiological controls are imposed. Entry into an RCA requires training as a Radiation Worker, an approved RWP, minimum PPE required by the RWP, a dosimeter, and a specific purpose. Authorized visitors must have the requisite training specified in the SSHP and be trained as Radiation Workers or be escorted by a qualified project staff member and wear the required PPE.

At a minimum an RCA boundary may be delineated with yellow and magenta rope (rad rope) supported on posts. More substantial barriers such as temporary or permanent fencing may be used as necessary. While it is desirable to have physical separation between an RCA boundary and a Controlled Area boundary, they may be co-located where there are space limitations, provided the maximum allowable dose rate for the Controlled Area boundary is maintained.

An RCA is posted with a yellow sign with a magenta or black radiation symbol (trefoil) and black lettering (may be printed on a white insert) that states "Caution - Radiologically Controlled Area, RWP Required for Entry" and any other information specified by the RCS. A minimum of one sign shall be posted on each straight run of the RCA boundary. Additional signs should be placed on long (greater than 60 feet) runs of the boundary.

### *3.14.4 Contamination Area*

A Contamination Area is any area inside the RCA that approaches or has the potential to exceed the values for surface contamination listed in Table 3.12. "Contamination" is defined as radioactive material in excess of Table 3.12's values on surfaces, in or on soil, or in water. Entry into a Contamination Area has the same requirements specified for RCA entry plus RCT coverage, and any other controls specified in the RWP. Visitors to the site will not be allowed to enter Contamination Areas.

At a minimum, a Contamination Area boundary may be delineated with rope that is specially colored to signify a radiation hazard/delineation ("rad rope") supported on posts. More substantial barriers, such as temporary or permanent fencing, may be used as necessary.

A Contamination Area is posted with a yellow sign with a magenta or black radiation symbol (trefoil) and black lettering (may be printed on a white insert) that states "Caution - Contamination Area, RWP Required for Entry" and any other information specified by the RCS. A minimum of one sign shall be posted on each straight run of the Contamination Area boundary. Additional signs should be placed on long (greater than 60 feet) runs of the boundary.

### *3.14.5 High Contamination Area*

A High Contamination Area is any area within the RCA that approaches or has the potential to exceed ten times the values for surface contamination or soil listed in Table 3.12. Entry requirements for High Contamination Areas are the same as those specified for Contamination Areas plus additional controls and PPE as specified in the applicable RWP. Visitors to the site will not be allowed to enter High Contamination Areas.

At a minimum, a High Contamination Area boundary may be delineated with rad rope supported on posts. More substantial barriers, such as temporary or permanent fencing, may be used.

A High Contamination Area is posted with a yellow sign with a magenta or black radiation symbol (trefoil) and black lettering (may be printed on a white insert) that states "Caution - High Contamination Area, RWP Required for Entry" and any other information specified by the RCS.

A minimum of one sign shall be posted on each straight run of the High Contamination Area boundary. Additional signs should be placed on long (greater than 60 feet) runs of the boundary.

#### *3.14.6 Radiation Area*

A Radiation Area is any area within the RCA where an exposed individual could receive at least 5 mrem but less than 100 mrem per hour. In practice, any area that exceeds 500 μR/hr (i.e., 0.5 mrem) will be posted as a Radiation Area. Entry into a Radiation Area requires training as a Radiation Worker, an approved RWP, minimum PPE required by the RWP, a dosimeter, and a specific purpose. Visitors to the site will not be allowed to enter Radiation Areas.

At a minimum, a Radiation Area boundary may be delineated with rad rope supported on posts. More substantial barriers, such as temporary or permanent fencing, may be used.

A Radiation Area is posted with a yellow sign with a magenta or black radiation symbol (trefoil) and black lettering (may be printed on a white insert) that states “Caution - Radiation Area, RWP Required for Entry” and any other information specified by the RCS. A minimum of one sign shall be posted on each straight run of the Radiation Area boundary. Additional signs should be placed on long (greater than 60 feet) runs of the boundary.

#### *3.14.7 High Radiation Area*

A High Radiation Area is any area within the RCA where an exposed individual could receive at least 100 mrem in one hour. In practice, any area that exceeds 80 milliroentgens per hour (mR/hr) will be posted and controlled as a High Radiation Area. Entry into a High Radiation Area requires training as a Radiation Worker, an approved RWP, the minimum PPE required by the RWP, a dosimeter, a radiation rate meter, full-time RCT coverage, a specific purpose, and authorization by the Project RSO. Visitors to the site will not be allowed to enter High Radiation Areas.

Any High Radiation Area should be maintained as small as possible. The boundary for a High Radiation Area must be of sufficiently durable construction to prevent unauthorized access and be capable of being locked or have another means for controlling access (such as a trench plate that requires heavy equipment to move). The area surrounding a High Radiation Area must be posted appropriately for the radiological conditions, typically as a Radiation Area. In some cases where a High Radiation Area is completely contained within a dedicated structure, it may be bounded with rad rope and the required signs, provided access and entry to the dedicated structure is controlled in the same manner as a High Radiation Area.

A High Radiation Area is posted with a yellow sign with a magenta or black radiation symbol (trefoil) and black lettering (may be printed on a white insert) that states “Caution - High Radiation Area, RWP Required for Entry” and any other information specified by the RCS. A minimum of one sign shall be posted on each side of the High Radiation Area boundary.

### *3.14.8 Airborne Radioactivity Area*

An Airborne Radioactivity Area is any area within the RCA where the concentration of airborne radioactivity is equal to or greater than 10 percent of the applicable DAC value (SOP T-RA-007 (Attachment B) and 10 CFR 20) for the ROC. The DACs and 10%-value Action Levels for the ROCs are listed in the table below.

*Table 3.14B*
*Derived Air Concentrations and Action Levels, NAVSTA PS*

| ROC | DAC | Action Level | Radiation Type |
|---|---|---|---|
| | All units microcurie per milliliter (µCi/ml) | | |
| $^{226}Ra$ | $3 \times 10^{-10}$ | $3 \times 10^{-11}$ | alpha |

*WAC 246-221-290.*

Entry into an Airborne Radioactivity Area requires training as a Radiation Worker, an approved RWP, minimum of Level C PPE (including a full-face air purifying respirator) and any additions required by the RWP, a dosimeter, RCT coverage, air sampling as specified in the RWP, and a specific purpose. Visitors to the site will not be allowed to enter Airborne Radioactivity Areas.

Administrative and engineering controls are implemented to control airborne radioactivity below the action level so that establishment of an Airborne Radioactivity Area is not necessary. Controls include monitoring wind speed and suspending work if a sustained (more than five minutes) wind speed of 25 mph or greater is observed, as well as application of water mists to prevent dust generation. A calibrated anemometer will be located at the Access Control Point, monitored with wind speeds recorded at least hourly, and whenever wind gusts are observed. In the event that it is necessary to establish an Airborne Radioactivity Area, it will be, at a minimum, delineated with rad rope supported on posts and shall enclose sufficient area downwind of the point of generation to prevent a release beyond the site boundary. Whenever practical, containment systems should be deployed to serve as the boundary for an Airborne Radioactivity Area. If neither approach above is viable the activity may not continue until appropriate engineering controls are determined and implemented.

An Airborne Radioactivity Area is posted with a yellow sign with a magenta or black radiation symbol (trefoil) and black lettering (may be printed on a white insert) that states "Caution - Airborne Radioactivity Area, RWP and Respiratory Protection Required for Entry" and any other information specified by the RCS. A minimum of one sign shall be posted at the entrance to the area and on each side of the Airborne Radioactivity Area boundary.

## 3.15 CONTAMINATION CONTROL

Site controls and contamination control practices are established to prevent the spread of contamination into uncontrolled areas. A Contamination Area will be established as defined in Section 3.14.4.

### *3.15.1 Contamination Areas*

A physical boundary will be established in accordance with Section 3.14.4 that fully encloses the Contamination Area with postings on all sides. A single access/egress point shall be established and should have a step-off pad or equivalent area for personnel to doff PPE as they exit the Contamination Area. There shall be physical separation between any Contamination Area and the Controlled Area boundary.

### *3.15.2 Entry*

Any entry into a Contamination Area requires an approved RWP, the minimum PPE required by the RWP, and RCT coverage. An RCT may cover their own entry into a Contamination Area, but must have a designated support person outside of the Contamination Area who can provide assistance or summon help if necessary.

### *3.15.3 Exit*

Personnel shall exit a Contamination Area at the designated access/egress point. An RCT must be present to monitor personnel doffing PPE and exiting the Contamination Area. A whole body frisk shall be completed after doffing PPE and prior to leaving the access/egress or Control Point.

### *3.15.4 Limitations on Entry*

Personnel with unprotected open wounds or sores shall not enter any Contamination Area. Entry may be authorized by the RCS on a case-by-case basis, if appropriate bandaging is verified, planned work activities are unlikely to compromise the bandaging, and there is no other medical reason to restrict entry.

Personal clothing beyond what is necessary for modesty should not be worn into Contamination Areas. Jewelry, phones, and other personal items shall not be worn or taken into Contamination Areas.

Only tools and materials necessary to accomplish the planned task are allowed into a Contamination Area. Packing and other non-essential materials and items shall be removed, collected, and properly secured prior to entry.

### *3.15.5 Control of Items*

Equipment, tools, and other items removed from a Contamination Area must meet unconditional release criteria (Table 3.12) or otherwise be managed as radioactive material. Soil or sediment exceeding the mean statistical background level plus three standard deviations will be removed, inventoried, packaged, labeled, and stored in a secure dedicated Radioactive Materials Storage Area in accordance with all appropriate regulations pending disposal by a separate contractor managed by the Navy. Equipment and building materials will be surveyed for compliance with NRC Regulatory Guide 1.86 with contaminated materials removed and segregated for disposal as waste by a separate contractor.

If reasonable efforts to decontaminate an item are unsuccessful or impractical, the item shall be wrapped with plastic sheeting (or equivalent) to prevent the release or spread of contamination, tagged to denote the radiological conditions of the item, and properly controlled. Such items may only be moved outside of a Contaminated Area under RCT supervision and control, and may only be stored in a designated Radioactive Material Storage Area (RMSA) controlled by the RCS.

### 3.16 INSTRUMENTATION

Shaw is providing all of the radiation-measuring equipment and details the calibration, operation, and QC requirements in SOP T-RA-006, "*Radiological Controls Portable Instrument Procedure*" (Attachment B). Survey instruments are calibrated in accordance with the manufacturers' instructions at least annually. Instruments are removed from service on or before the calibration expiration date and are sent for recalibration. A list of typical instruments and their performance characteristics are provided in Table 3.16, "*Portable Instrumentation for Radiological Surveys*." If instruments other than those listed are required, performance characteristics for the new instruments will be determined and documented when received on site.

*Table 3.16*
*Portable Instrumentation for Radiological Surveys*

| Measurement/ Technique for emission | Primary Use | Type of Instrumentation | | Typical Instrument Background | Typical Instrument Efficiency (2π) | Typical Static MDC | Typical Scan MDC |
|---|---|---|---|---|---|---|---|
| | | Detector Type and Ludlum Model Number(s) | Meter Description and Ludlum Model Number(s) | | | | |
| Static/scan alpha/beta | Equipment, material, debris, and personnel | Gas-flow proportional Ludlum Model 43-68 (126 $cm^2$) | Alpha/beta dual channel data logger Ludlum Model 2360 | 100 cpm β<br>1 cpm α | 0.30 β<br>0.44 α | 524 dpm/100 $cm^2$ β<br>61 dpm/100 $cm^2$ α | 1,600 dpm/100 $cm^2$ β<br>126 dpm/100 $cm^2$ α |
| Static/scan alpha/beta | | Alpha/beta scintillation Ludlum Model 43-93 (125 $cm^2$) | | 150 cpm β<br>1 cpm α | 0.25 β<br>0.44 α | 761 dpm/100 $cm^2$ β<br>61 dpm/100 $cm^2$ α | 2,351 dpm/100 $cm^2$ β<br>126 dpm/100 $cm^2$ α |
| Static/Scan gamma | Surface soil | Gamma scintillation Ludlum Model 44-10 2-inch x 2-inch NaI | Scaler/ratemeter data logger Ludlum Model 2221 | 3,037 cpm γ | N/A | 259 cpm | 794 cpm γ ($MDCR_{surveyor}$) |
| Static/scan beta/gamma | Equipment, material, debris, and personnel | Geiger-Mueller Ludlum Model 44-9 (15 $cm^2$) | Survey meter Ludlum Model 3 | 40 cpm | 0.38 β/γ | 1,706 dpm/100 $cm^2$ β/γ | 3,558 dpm/100$cm^2$<br>For a 2s observation interval |
| Exposure rates | All inclusive | Gamma scintillation 1-inch x 1-inch NaI | MicroR meter Ludlum Model 19 | 7-8 µR/hr | N/A | N/A | N/A |
| Sample counting/alpha/ beta | Smears and air filters | Alpha/beta/gamma scintillation Ludlum Model 44-10-1 thin window 2-inch x 2-inch NaI | Sample Counter Ludlum Model 2929 | 45 cpm β<br>0.12 cpm α | 0.35 β<br>0.65 α | 192 dpm/100 $cm^2$ β<br>8 dpm/100 $cm^2$ α | N/A |

*Note:The stated value for the Ludlum Model 44-10 2" x2" NaI detector is the net detection limit, $L_D$, above background for a one minute count.*

*Background is determined in accordance with the standard GammaVision™ 32 software protocols and standard programmed quality assurance/quality control criteria. If background is out of specification, the software alerts the operator. The counting chamber is cleaned and the check is repeated; if it fails a second time the system is recalibrated.*

*Efficiency is determined for each energy channel in the source library using the certified mixed gamma standard during the daily function check in accordance with the standard GammaVision™ 32 software protocols and standard programmed quality assurance/quality control criteria. If the efficiency is out of specification, the software alerts the operator. The check is repeated, and if it fails a second time the system is recalibrated.*

*Minimum detectable activity (MDA) is determined for each energy peak in the site-specific sample library for each sample counted using the Standard ORTEC® Method for calculating MDA in the GammaVision™ 32 software subject to the standard programmed quality assurance/quality control criteria. If MDA for the ROC exceeds the release limit, the sample is counted for a longer time period.*

*α – alpha β – beta γ – gamma cm2 – square centimeters N/A – not applicable cpm – counts per minute*
*NaI – sodium iodide µR/hr – microroentgen per hour dpm – disintegrations per minute pCi/g – picocurie per gram*
*MDC – Minimum Detectable Concentration*

## 3.17 CONTROL OF RADIOLOGICAL WORK

All radiological work activities will be planned in consultation with the RCS, the Program RSO, the PM, and other project personnel. An RWP is required to be prepared and approved for any activity that will be performed in any area where radioactive materials in excess of Table 3.12's free release criteria are present or suspected. Surveys, sampling, establishment of radiological areas, and radiological postings are implemented to define radiological areas and control access to and work in these areas. Access Control Points are established to provide limited entry points into radiological areas and prevent the inadvertent release of radioactive material or the spread of contamination.

### *3.17.1 Radiological Work Permits*

RWPs are employed to identify the applicable radiological controls for performing specific tasks in individual radiological areas. Information required in an RWP is detailed in Section 6.4.3 of SOP T-RA-005, "*Field Project Radiological Controls*." The RWP will typically be initiated by an RCT. RWPs are reviewed and approved by the RCS and the Program RSO or designee. Personnel who will work under an RWP will receive an initial briefing on the RWP prior to performing any covered work, and will sign the RWP acknowledging that they have been briefed and have read the RWP and will comply with its requirements.

### *3.17.2 Task-specific Work Instructions*

Non-routine activities and activities that have greater potential for personnel exposure or the spread of contamination require the preparation of task-specific work instructions. These work instructions provide the detailed steps for executing the required work. Work instructions are required for work in High Contamination Areas, Radiation Areas, for activities not specifically addressed in the RPP or the Work Plan, and for other tasks as determined by the PM, License RSO, Program RSO, RCS, or the Site Supervisor. The RCS will finalize, control, and issue work instructions.

## 3.18 CREDENTIALING OF STAFF

Qualification and training requirements for RCTs are provided in Attachment 1 of SOP T-RA-001, "*Health Physics Policy Manual*," and in SOP T-RA-002, "*Radiological Controls Training and Qualification*" (Attachment B). The Program RSO shall verify the qualifications of the RCS, conduct required license-specific training with the RCS, and report completion of these activities to the License RSO. The RCS is an Authorized User of the Shaw Services Provider Radioactive Material License when approved by the License RSO.

An American Board of Health Physics Certified Health Physicist is available within Shaw to support the project as necessary.

## 3.19 PROCUREMENT, RECEIPT, AND INVENTORY

Except for exempt-quantity radioactive check sources, the project will not be receiving radioactive materials shipments. Sources shall be controlled, stored, posted, and managed as radioactive material.

A source storage location shall be selected at the on-site project office and should consist of a lockable storage cabinet that can be secured inside of a lockable room or equivalent secure area. The Project RSO or his designee shall control the keys to the storage cabinet. When sources are initially placed in the storage cabinet, it shall be posted as a Radioactive Materials Area.

An area for the storage and operational checks of instruments shall be established and the use of the sources should be restricted to this area. The source storage cabinet shall remain locked while sources are stored in it; sources shall be returned to the storage cabinet immediately after any use.

Only project personnel trained in the requirements of this Section and authorized in writing by the Program RSO or the RCS may use sources at a project site; sources shall only be used to perform instrument set-ups and daily function tests.

All sources shall be obtained either from the Shaw Radiological Equipment Group or a vendor approved by the Shaw Quality Assurance Department. Supplied sources shall be provided in a storage container and accompanied by a manufacturer's certificate of assay or equivalent that identifies the following information:

- Radionuclide(s),
- Date of manufacture,
- Actual measured activity,
- Units of activity,
- Date of assay if different from date of manufacture, and
- Manufacturer's name and address.

### *3.19.1 Leak Testing*

Sources shall be leak tested:

- Prior to initial use on site,
- Every three months for alpha-emitting sources,

- Every six months for beta/gamma-emitting sources, and
- Immediately prior to return to the source provider.

Leak testing consists of collecting a smear sample collected on the source (encapsulated sources only), or the source storage container of electroplated sources, and counting the smear. Results of the leak test will be documented as a contamination survey.

Any leak test result with detectable activity above background shall immediately be reported to the RCS for further evaluation. Sources that are suspected or determined to be leaking shall be contained in a plastic bag, marked to identify the source as leaking, and segregated. A contamination survey of the storage cabinet, the area where the sources are used, and any other potentially affected locations shall be performed as soon as it is determined that a source is potentially leaking.

Leaking sources will be returned to the provider in accordance with their procedures and applicable state and federal transportation regulations.

### *3.19.2 Transport of Sources*

Sources will be employed only for the period of time necessary to execute planned work, will not be brought to a project location prior to project initiation, and will be returned to the provider immediately following the completion of planned field activities.

Sources shall be transported in a Shaw-owned or Shaw-rented vehicle by an authorized Shaw employee and accompanied by a copy of the RPP and the manufacturer's certificate of assay or equivalent.

Sources shall be shipped via a Shaw–approved commercial carrier in compliance with all applicable regulations and with carrier-specific requirements.

### *3.19.3 Reporting Lost, Damaged, or Stolen Sources*

If a source is lost, damaged, or stolen, the event shall be reported immediately to the RCS by the discovering individual. The RCS shall immediately notify the Program RSO, the License RSO, the PM, the Navy, and other project staff, and initiate appropriate actions to control site access and recover the missing or damaged source. If a source is missing, a search by radiological control personnel will be initiated. In consultation with the Navy, a report will be filed with the appropriate law enforcement agency if it is determined that radioactive material was stolen.

The License RSO will make any necessary notifications to the NRC.

### 3.20 Shipping and Transportation of Radioactive Materials

Off-site shipment of radioactive materials other than exempt-quantity radioactive check sources by Shaw is not part of the SOW. Offsite shipment of radioactive waste will be performed by the Navy's transportation and disposal (T&D) contractor (Section 3.21).

### 3.21 Control of Radioactive Waste

An RMSA will be established to store contaminated material. The storage area is posted as an RCA and may be posted as a radiation area or a high radiation area depending on the presence of stored material and the cumulative dose rates. Access to the RMSA is controlled by the RCS. The waste will be periodically packaged and transferred to the authorized shipper for disposal. Radioactive waste will be minimized by compliance with contamination control practices (Section 3.15) combined with segregation and survey practices.

The T&D Contractor for LLRW will be an NRC Radioactive Material Licensee contracted to the Navy (chosen by RASO), through the Army Joint Munitions Command, to provide brokerage services including waste characterization sampling, waste containers, and transportation of radioactive materials/waste generated from this project. Soil and used PPE shall be placed in 55-gallon drums or roll-off bins; the filled 55-gallon drums or roll-off bins will be transferred to the custody and controls of the authorized shipper.

Building or building foundation debris (i.e., floor or sub-floor material and drain piping) that has been radiologically identified will be loaded into 55-gallon drums or roll-off bins provided and operated by the T&D Contractor for LLRW for subsequent management and disposal. Processes for custody, transfer, and tracking of such materials will be addressed in a Memorandum of Understanding (MOU).

Work practices will be instituted to minimize or eliminate the generation of liquid waste (waste water) during or resulting from work activities. If dewatering is required, a field work variance will be prepared and approved by the Navy to facilitate active dewatering.

Steps will be taken to minimize the impact of equipment- and material-handling activities where water may cause the inadvertent transfer of contamination (e.g., parking contaminated equipment on impacted soil areas awaiting excavation so as to avoid rainfall causing unnecessary contamination of the final grade surface).

Liquid waste in excess of the limit specified in Table 3.21, will be collected in appropriately labeled DOT-approved containers, characterized for disposition, and handled in accordance with the MOU.

Additional guidelines for managing waste at the site are presented in the Waste Management Plan provided in Appendix B of the Work Plan.

A more detailed presentation for release criteria can be found in Table 3.12.

*Table 3.21*
*Liquid Waste Release Limits, Radionuclide of Concern, NAVSTA PS*

| ROC | Release Limit (pCi/L) | Notes |
|---|---|---|
| $^{226}$Ra | 3 | Limit is for total radium concentration |

*WAC 246-221-290.*

This value was derived from Washington State Department of Ecology Model Toxics Control Act (MTCA) Cleanup Regulation Chapter 173-340 WAC (MTCA 2003).

### 3.22 RADIATION PROTECTION RECORDS

The Project RSO is responsible for ensuring that airborne monitoring, contamination surveys, and exposure/dose rate surveys are reviewed for accuracy and completeness as an on-going process. Individual exposure records, including dosimetry and bioassay reports, for personnel are reviewed for positive results. All project personnel exposure records are transmitted to the Shaw Corporate Dosimetry Section in Stoughton, Massachusetts. Any positive results must be reported to the License RSO for assessment of the adequacy of field controls and notification provided to the Navy.

Specific information about the format and content of survey and other radiation protection records are detailed in the SOPs in Attachment B.

Records relating to radiological characterization, radiation and contamination control, waste characterization, uncontrolled release of material and equipment, self-assessments, management reviews, audits, radiological occurrences, corrective actions, and other responses to such findings or incidents are retained by Shaw as part of the official project record. All records are maintained for durations specified by contractual, Shaw, license, and regulatory requirements.

### 3.23 REPORTS AND NOTIFICATIONS

Workers who have had previous work history with radiological hazards shall supply the Project RSO with copies of their estimated or reported dose histories using an up-to-date NRC Form 4 (or equivalent) as defined in 10 CFR 20.2104.

Records of radiation exposures to workers provided external dosimetry monitoring devices shall be maintained. Results for both external and internal monitoring of workers shall be reported to the Shaw Corporate Dosimetry Section at least quarterly. A summary of individual exposures shall be reported to each exposed employee at least annually for the previous calendar year by the project. A copy of the annual reports shall also be submitted to the Shaw Corporate Dosimetry Section.

### 3.24 LICENSES AND MEMORANDUM OF UNDERSTANDING

As mentioned earlier, Shaw possesses a Services Provider Radioactive Materials License issued by the NRC, License Number 20-31340-01. Work will be performed under the reciprocity recognition by the Washington State DOH Division of Environmental Health Office of Radiation Protection. Shaw will ensure that the Radiological Control Program and work practices are implemented and performed in accordance with the NRC license requirements and this RPP.

If required, an MOU will be prepared between Shaw and the waste disposal contractor to develop clear procedural interfaces and commitments for the control of radiological areas and transfer of radioactive materials.

### 3.25 REVIEW AND APPROVALS OF RADIATION PROTECTION PLANS

Project RPPs are prepared and submitted to the Program RSO for review and to the PM and License RSO for approval. In addition, the Navy will have an opportunity to review, provide input, and indicate acceptance of the plans. Changes to RPPs will be reviewed and accepted following the same process.

### 3.26 PLANNED SPECIAL EXPOSURES

There is no anticipated work within this scope that would require a planned special exposure. In the event that it is necessary to execute a planned special exposure, an activity-specific work instruction, including a formal ALARA review and an RWP, will be prepared and submitted for review and acceptance following the same process as the RPP submittal.

# *4.0 PERSONAL PROTECTIVE EQUIPMENT*

Minimum PPE requirements based on the chemical contaminants of concern were established in the SSHP by the Shaw Project Health and Safety Manager. This primary level of PPE, Modified Level D, is sufficient for general work activities and is supplemented by this Section and activity specific RWPs based on the radiological conditions and field tasks required to perform planned activities.

## 4.1 SELECTION OF PERSONAL PROTECTIVE EQUIPMENT

Personnel must wear PPE commensurate with contamination hazards associated with both the work area and the planned activity. PPE requirements will be specified in the RWPs associated with this TO. Standard PPE will be identified by the generic name (e.g., Modified Level D) in the applicable RWP.

Activities that require heavy physical effort or that have an increased potential for damage to PPE may require additional layers or different PPE materials, even in areas of low contamination. The RCS will establish PPE requirements as necessary to address specific hazards associated with a site or field task.

## 4.2 DONNING AND DOFFING PPE

To prevent contamination of personnel or the spread of contamination, PPE must be donned and doffed in a specific manner. Directions for donning and doffing standard PPE ensembles are provided below. Additional instructions for non-standard site- or task-specific PPE requirements will be provided in the applicable RWP with the requirement for non-standard PPE.

### *4.2.1 Donning Instructions*

The following general instructions are for donning Modified Level D PPE or Level C PPE with respiratory protection. Site workers shall review the RWP for task-specific PPE requirements.

#### *4.2.1.1 Modified Level D PPE*

- Put on the PPE coveralls with attached booties required by the RWP.
- Put on overboots or approved secondary footwear.
- Put on one pair of nitrile gloves.
- Tape areas where gloves and boots meet the coveralls and tape over the zipper (buddy tabs).
- Put on the hood.
- Put on a second set of nitrile gloves - do not tape.

#### *4.2.1.2 Level C PPE with Respiratory Protection*

- Put on PPE coveralls.
- Put on overboots or other shoe cover as specified in RWP.
- Put on respirator, verify seal.
- Put on hood.
- Tape hood to respirator.
- Put on one pair of nitrile gloves.
- Tape gloves and boots/shoe covers to coveralls and tape over zipper – no exposed regular garments or skin.
- Put on second pair of nitrile gloves – do not tape.

### *4.2.2 Doffing Instructions*

An RCT must be present anytime PPE is removed. Site workers shall remove PPE as directed by the RCT and in a manner to contain any contamination that may be present on the PPE and to prevent the potential spread of contamination.

- Remove tape around ankles (Trash).
- Remove overboots.
- Remove outer set of gloves (Trash).
- Frisk inner set of gloves.
- Remove hood.
- Remove respirator (if worn).
- Remove tape from zipper, top to bottom (Trash).
- Remove tape from wrist (Trash).
- Carefully unzip coveralls.
- Roll coveralls inside out and downward – do not rip coveralls away from your body.
- Step out of coveralls and onto Step Off Pad.
- Roll coveralls into a ball (Trash).
- Remove inner gloves (Trash).
- Frisk out.

# *5.0 DECONTAMINATION PROCEDURES*

Equipment and other items used in RCAs may become contaminated as a result of that activity. Table 3.12 lists release limits for removable and total contamination on equipment, tools, and other solid objects, and for building and other structural surfaces. Equipment and tools that will be used in an RCA where there is a potential for contamination should be wrapped or otherwise protected to the extent practical. Taping and other coverings that use adhesives that could capture contamination on the item should be avoided. Only tools and equipment that are necessary to perform the required work should be taken into Contamination Areas. Equipment will be dedicated (as logistically possible) to contaminated area work to minimize potential for spread of contamination. Packing materials, unneeded accessories, spare parts, and similar items shall not be taken into Contamination Areas.

Equipment, tools, and other items being removed from Contamination Areas will be surveyed for removable and total contamination. Smear sampling for removable contamination will be performed in accordance with SOP T-RA-012, "*Surface Contamination Monitoring*" (Attachment B).

Frisking and static measurements for total contamination will be performed with an instrument that is appropriate for $^{226}$Ra. Shaw will revise this RPP if conditions occur or information is gained that indicate that another ROC may be appropriate for frisking and other decontamination surveys.

Frisking and static measurements will be for the ROC and the surface to be surveyed in accordance with SOP T-RA-012. Only items that meet the unconditional release limits of Table 3.12 will be released. Items that exceed the release limits shall be controlled as radioactive material in accordance with Section 3.15.5.

If decontamination is required, it will be performed at a dedicated decontamination pad located inside an established Contamination Area. In accordance with Section 6.10 of SOP T-RA-005, "*Field Project Radiological Controls,*" and where practical, dry removal techniques (e.g., wiping with disposable moist towels or rags) will be used for decontamination purposes. Wet decontamination, if necessary, will be performed on the decontamination pad; the rinse water will be collected and sampled to facilitate proper disposal.

Equipment or materials that cannot be easily or cost-effectively decontaminated will be evaluated for possible limited use in radioactive material use areas, or disposed of as radioactive waste. If not already controlled by existing RWP(s), a task-specific RWP may be required for decontamination activities. The RCS will notify the PM of equipment that cannot be decontaminated and radiologically free-released from the work locations.

Frisking personnel for surface contamination will be performed using a Ludlum Model 3 Survey Meter with a Ludlum Model 44-9 detector (or equivalent instrument). The RCS will be notified upon detection of contamination on personal clothing or skin. Notification of the PM, the Program RSO, and the Navy of a personnel contamination event will be made within the same work shift, sooner if practical. Decontamination to minimize exposure and prevent the spread of contamination is the first priority of the RCS.

If personnel are found to have skin contamination, disposable towelettes or damp wipe techniques will be utilized, as this process has been determined to be highly effective in the removal of contamination from personnel. On-scene control and decontamination direction and oversight will be provided by the RCS. The Shaw PM will be apprised of the results of the decontamination process. Decontamination techniques and the need for offsite resources will be determined by the RCS in consultation with the Program RSO and conform to Section 6.10 of SOP T-RA-005.

# *6.0 RADIONUCLIDE ANALYSIS*

The analysis of samples will be performed to provide qualitative and quantitative data to assess radiological conditions and assess remediation progress. Information for the collection and analysis of samples is provided in the following sections. Detailed information for sludge and water samples can be found in the QAPP/SAP.

For gross alpha and gross beta activity, analysis of air samples and smear samples will be performed on-site by Shaw using a Model 2929 or Model 3030 benchtop sample counter. Soil samples will be shipped and tracked by Shaw for testing by the off-site subcontracted laboratory.

## **6.1** AIR MONITORING

Monitoring for airborne particulate matter will be performed whenever soil or earthen materials are disturbed, or any other activity with the potential to generate dust is initiated. Requirements for air monitoring, including action levels, frequency, sample methods, and sample analysis, are presented in SOP T-RA-007, "*Airborne Radioactive Particulate Monitoring*" (Attachment B).

### ***6.1.1 Air Sampling Methods***

Air samples will be collected in several locations to assess the radiological conditions and potential exposures to protect personnel and the public, and evaluate the effectiveness of engineering controls. Typically, sampling in support of field activities will include area sampling (high volume and low volume samplers) in the work zone downwind of the intrusive activity and at site boundaries (low volume samplers).

Low volume samplers will be operated for the duration of a work shift to assess a time-weighted exposure for the entire exposure period. High volume samplers will be operated for a short duration to assess airborne radioactivity resulting from limited duration activities with a greater potential to generate airborne radioactive particulates. Air samples are collected on filter media installed in a filter holder connected to the sampling pump. New filters are installed in the sample holder for each sampling event.

### ***6.1.2 Air Sample Analysis***

Air samples will be analyzed in Shaw's field laboratory by counting with a dual channel sample counter for gross alpha and gross beta activity. Data conversion and calculation of DAC for comparison to regulatory limits will follow the instructions provided in SOP T-RA-007.

The DACs and the 10%-DAC Action Levels are listed in Table 6.1. Any sample result that exceeds 10 percent of a DAC is considered to have exceeded the Action Level and triggers implementation of appropriate controls as specified in Section 3.14.8 of this RPP, notification to the PM, License RSO, Program RSO, and the Navy, and documentation and reporting of any personnel exposure as required by SOP T-RA-013, "*Bioassay and Internal Exposure Monitoring*" (Attachment B).

*Table 6.1*
*Derived Air Concentration*

| Radionuclide | Radiation | DAC (µCi/mL) | 10% DAC (µCi/mL) |
|---|---|---|---|
| $^{226}Ra$ | Alpha (α) | $3.0 \times 10^{-10}$ | $3.0 \times 10^{-11}$ |

*Note: µCi/mL – microcurie per milliliter. DAC – derived air concentration (10 CFR 20, Attachment B).*

## 6.2 SMEAR ANALYSIS

Surface contamination surveys for removable radioactivity will be performed to ensure compliance with the applicable work area limits (Table 3.12), demonstrate the efficacy of contamination control measures, and the implementation of contamination control work practices. Surveys for removable radioactivity will be performed on materials and equipment to evaluate compliance with Table 3.12's release limits.

### *6.2.1 Smear Sampling Methods*

Surface contamination smear samples will be collected, controlled, and documented by RCTs in accordance with the requirements of SOPs T-RA-005, "*Field Project Radiological Controls*" and T-RA-012, "*Surface Contamination Monitoring*," (Attachment B), as required by work site RWPs, or as instructed by the RCS.

### *6.2.2 Smear Sample Analysis*

Analysis will be by counting with a dual channel sample counter for gross alpha and gross beta activity. Material sampled for radiological release will be controlled until the data is reviewed and release is authorized by the RCS.

## 6.3 SLUDGE ANALYSIS

Analysis of sludge and other earthen material samples will be performed to characterize soils and earthen materials, assess remediation progress, determine the suitability of excavated soils and earthen materials for radiological release, and document final conditions.

### *6.3.1 Sludge Sampling Methods*

Guidance for the collection of soil, sludge, and earthen material samples is provided in the SAP. Filled sample containers will be surveyed at the point of collection; sample containers that exceed 20 µR/hr will be labeled and controlled as radioactive material. Sample custody requirements are specified in the SAP.

### *6.3.2 Sludge Sample Analysis*

Analysis of soil samples will be performed at a laboratory to provide quantitative characterization data.

### *6.3.3 Off-Site Laboratory Sludge Analysis*

The off-site laboratory will perform sample analysis in accordance with the SAP. These samples will be analyzed by gamma spectroscopy using EPA Method 901.1M. Prior to shipment, they will be surveyed to determine whether they should be handled as radioactive material. The offsite laboratory is Test America, 13715 Rider Trail North, Earth City, Missouri, 63045.

### *6.3.4 Calibration and Maintenance of Laboratory Instrumentation*

The off-site laboratory will have written SOPs defining instrument calibration, operation, maintenance, and QC requirements. Instruments will be calibrated in accordance with the manufacturer's requirements and/or laboratory SOPs. Instruments will be calibrated with the standard appropriate to the type of instrument and the calibration range established for the method using NIST-traceable standards. Instruments will be maintained in working condition required by the methods specified for the analyses. Activity logs will be maintained of activities that impact the quality of the laboratory results.

Instrument backgrounds and source response checks will be run daily to ensure that residual contamination is not present in the system and that the system is performing properly. Data will undergo trend analysis; trends that are outside the tolerance limits will be investigated by the laboratory manager to determine the cause and potential effect on measurement results.

The minimum detection limit (MDL) will be used in calculations regarding MDA for gamma spectroscopy results. In discussions regarding gamma spectroscopy, any use of the term "MDA" will specifically describe the sample-specific MDL. The MDL is an estimate of the measured concentration at which there is 99 percent confidence that a given analyte is present in a given sample matrix. The MDL is the concentration at which a decision is made regarding whether an analyte is detected by a given method. The MDL will be calculated from replicate analyses of a matrix containing the analyte and is functionally analogous to the "critical value" or the "limit of detection." Gamma spectroscopy analysis software will utilize a mathematical model that ensures that the reported sample-specific MDA values are equivalent to the sample-specific MDL.

#### *6.3.5 Laboratory Quality Control*

The off-site laboratory will perform and analyze the following three types of QC samples to evaluate their own laboratory performance:

- Laboratory control samples (i.e., source counts) to evaluate potential bias in the measurement results.
- Replicate samples (i.e., duplicate sample counts) to measure precision and the effectiveness of sample preparation techniques.
- Method blanks (i.e., background counts) to evaluate the potential for laboratory contamination.

These analyses will be performed at a frequency of one per analytical batch or one per 20 samples, whichever is more frequent.

The measure of precision for replicate samples will be determined using the following calculation for relative percent difference (RPD):

RPD = 100 × 2 × (result - duplicate result)/(result + duplicate result).

# *7.0 REFERENCES*

Argus Pacific, Inc., 2009, Radiation Screening, Building 27, Former Sand Point Naval Facility, Seattle, Washington, April 2009.

Atomic Energy Commission, U.S., 1974 Regulatory Guidance 1.86.

Code of Federal Regulations, Title 10, Part 20, Standards for Protection Against Radiation, U.S. Government Printing Office via GPO Access, Washington D.C., January 1, 2003, <http://www.gpoaccess.gov/cfr/index.html>, May 2007.

Code of Federal Regulations, Title 29, Part 1910, Occupational Safety and Health Standards, U.S. Government Printing Office, Washington, D.C., July 1, 2003, <http://www.gpoaccess.gov/cfr/index.html>, May 2007.

Code of Federal Regulations, Title 49, Volume 2, Transportation, U.S. Government Printing Office via GPO Access, Washington D.C., April 1, 2006, <http://www.gpoaccess.gov/cfr/index.html>, May 2007.

NARM Rule, Federal Register citation 72 FR 55864, Requirements for Expanded Definition of Byproduct Material, <http://nrc-stp.ornl.gov/narmtoolbox/radium%20faq102008.pdf> FAQ C.5.

Shaw Environmental & Infrastructure, Inc., 2006, Health and Safety Policies and Procedures Manual, <http://shawnet3.shawgrp.com/sites/handspps/default.aspx>.

Shaw, 2008, Policy and Guidance for Developing Radiation Protection Plans, Procedure HS700.

U.S. Environmental Protection Agency, 2000, Radionuclides Notice of Data Availability Technical Support Document, Office of Ground Water and Drinking Water, March .

U.S. Nuclear Regulatory Commission, 1996, Regulatory Guide 8.29, Instruction Concerning Risks from Occupational Radiation Exposure, Revision 1, Washington, D.C., February.

U.S. Nuclear Regulatory Commission, 1999, Regulatory Guide 8.13, Instruction Concerning Prenatal Radiation Exposure, Revision 3, Washington, D.C., June.

Washington State Department of Health, Washington Administrative Code (WAC) Title 246, Chapter 246-220 through Chapter 246-254. <http://apps.leg.wa.gov/wac/default.aspx?cite=246>.

# ATTACHMENT A

## *RADIATION PROTECTION PLAN ACKNOWLEDGEMENT FORM*

## Radiation Protection Plan Acknowledgment Form

I have reviewed, understand, and agree to follow the Shaw Radiation Protection Plan for Naval Station Puget Sound. Additionally, I understand that there are additional non-radiological health and safety requirements, which are presented in the Site Safety and Health Plan. I agree to abide by the requirements of the Radiation Protection Plan for the work that I will perform.

| Printed Name | Signature | Representing | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Photocopy page as needed for additional personnel.

# ATTACHMENT B

## *STANDARD OPERATING PROCEDURES*

## *STANDARD OPERATING PROCEDURES*

| Procedure Number | Procedure Title |
|---|---|
| T-RA-001 | Health Physics Policy Manual |
| T-RA-002 | Radiological Controls Training and Qualification |
| T-RA-003 | Shipment of Radioactive Materials |
| T-RA-005 | Field Project Radiological Controls |
| T-RA-006 | Radiological Controls Portable Instrument Procedure |
| T-RA-007 | Airborne Radioactive Particulate Monitoring |
| T-RA-008 | External Dosimetry Administration |
| T-RA-009 | Radiation Exposure Rate Monitoring |
| T-RA-010 | Radiological Site Controls |
| T-RA-011 | USNRC Service License Implementation Procedure |
| T-RA-012 | Surface Contamination Monitoring |
| T-RA-013 | Bioassay and Internal Exposure Monitoring |

# RADIATION PROTECTION PROCEDURE

**Subject: Health Physics Policy Manual**

## 1. PURPOSE

The purpose of the Shaw E & I Radiological Services Health Physics Policy Manual is to define management policies and procedure requirements for the radiologically safe performance of operations. This Manual also establishes policy that all occupational radiation exposure be maintained As Low As Reasonably Achievable (ALARA). The provisions of this Manual shall be implemented by specific procedures, which may be more restrictive than the requirements herein. This manual is intended to supplement existing Shaw E & I policies as well as applicable Federal and State rules and regulations.

## 2. SCOPE

This procedure specifies standard practices for the performance of radiological operations. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing radiological operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations*
- Code of Federal Regulations, 29 CFR Section 1910.1096, *Ionizing Radiation*
- National Council for Radiation Protection and Measurements (NCRP) Report Number 39, *Basic Radiation Protection Criteria*
- Code of Federal Regulations, 29 CFR Section 1910.134, *Respiratory Protection*
- U.S. Environmental Protection Agency, EPA-400-R-92-001, *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*
- Shaw E&I Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*

## 4. DEFINITIONS

- **ALARA**—An acronym for “As Low As Reasonably Achievable.” Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and

socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Action Level**—A predetermined radionuclide concentration that, when reached, requires a specific, predefined set of follow up protocols go into effect, which may include re-analysis of the original sample, collection of additional samples, and dose assessments.

- **Alpha Radiation (α)**—Alpha particles (He-4++) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.

- **Annual Limit on Intake (ALI)** — The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Beta Contamination (β)**—Beta particles (e-) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Bioassay**— The measurement, or assay, of kinds, quantities or concentrations and in some cases, the locations of radioactive materials within an individual worker. Bioassay is generally determined by in vitro methods, such as urine analysis, sampling of other body fluids (such as blood), tissue analysis, or by fecal sample. Bioassay may also be performed by direct (in vivo) measurement using specialized radiation detection equipment.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.

- **Committed Dose Equivalent (CDE)**— The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. Committed dose equivalent is expressed in Rem.

- **Committed Effective Dose Equivalent (CEDE)**— The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues and is expressed in Rem.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Declared Pregnant Woman**—A woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Deep Dose Equivalent (DDE)**—Applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm.

- **Derived Air Concentration (DAC)**— The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

- **Dose**— A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.
- **Exposure**— Being exposed to ionizing radiation or to radioactive material.
- **Gamma Radiation(γ)**—High energy, short wavelength photons emitted from radionuclides while undergoing decay, or by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.
- **In Vitro**—"In the glass." For the purposes of an internal dosimetry program, in vitro bioassay measurements are performed by analysis of bodily fluids or tissues removed from the body and analyzed in a laboratory environment.
- **In Vivo**—"In the living body." For the purposes of an internal dosimetry program, in vivo bioassay measurements are performed by measuring radionuclide body burden within the body using specialized detection instrumentation and monitoring techniques.
- **Intake (or Uptake)**—Radionuclides entering the body by any exposure pathway, primarily inhalation, absorption, or ingestion means.
- **Investigation Level**—The level of exposure above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Lens Dose Equivalent (LDE)**—The external exposure of the lens of the eye, taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm$^2$).
- **Licensed Material**—Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under NRC license number 10-25362-01.
- **Minimum Detectable Concentration (MDC)**— The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity
- **Monitoring**- The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses
- **National Voluntary Laboratory Accreditation Program (NVLAP)**—Accredits testing and calibration laboratories that are found competent to perform specific tests or calibrations, or types of tests or calibrations. NVLAP is a U.S. Government entity administered by the National Institute of Standards and Technology (NIST), an agency of the Department of Commerce.
- **Neutron Radiation (n)**—An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.
- **Planned Special Exposure**—An infrequent exposure to radiation, separate from and in addition to the annual dose limits.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Radiological Controls Supervisor (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Radiological Work Permits (RWPs)**—A work document that contains the necessary controls and protective measures to prevent inadvertent exposures to radiation and radioactive contamination while performing work in radiologically controlled areas.

- **Radiologically Controlled Area (RCA)**— Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.

- **Rem**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor.

- **Self-Reading Dosimeter (SRD)**—Radiation monitoring device used to provide a direct readout of gamma and/or x-ray exposure.

- **Shallow Dose Equivalent (SDE)**—Applies to the external exposure of the skin or an extremity, taken as the dose equivalent at a tissue depth of 0.007 centimeter.

- **Survey**— An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Thermoluminescent Dosimeter (TLD)**—Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

- **Total Effective Dose Equivalent (TEDE)**—The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

- **Total Organ Dose Equivalent (TODE)**—The sum of the deep-dose equivalent (for external exposures) and the 50-year committed dose equivalent to a tissue or organ.

- **Transferable, Removable, or Loose Contamination**—Radioactive material that can be easily removed from a surface or item.

- **X-ray Radiation**—High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and pose a substantial external radiation hazard.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice. The Director will establish and maintain all necessary management oversight and implement a management review process to ensure implementation of applicable Manual requirements.

## 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program

## 5.3 Project Radiation Safety Officer

The Project RSO is designated by the License RSO as an Authorized User. Each Project RSO is responsible for the on-site implementation of this Policy Manual at their respective projects or locations.

## 5.4 Managers, Supervisors

All managers and supervisors are responsible to ensure compliance with the applicable portions of this policy manual by employees under their direction.

## 5.5 Individuals

Each individual performing assigned duties within the Shaw E & I organization is responsible for compliance with this Policy Manual including all applicable implementing procedures.

# 6. PROCEDURE

## 6.1 Prerequisites

No operational or related activities shall proceed unless the applicable requirements of this Manual are properly implemented through the use of Standard Operating Procedures or Site-Specific Plans and Work Instructions.

## 6.2 Limitations

The requirements of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Code of Federal Regulations, 10 CFR Part 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations*, and Code of Federal Regulations, 29 CFR Section 1910.1096, “Ionizing Radiation” will be met without exception, as they apply to specific projects and situations.

## 6.3 Personnel Training Policy

All personnel performing Shaw E & I operations or activities shall have received the necessary training to perform their jobs in a safe, effective, and regulatory compliant manner. Training must be provided that meets both the letter and intent of all federal, state, and local statutes and that imparts to personnel the necessary knowledge to meet the needs of our customers as well as the expectations of management, and which meets or exceeds industry standard training requirements.

### 6.3.1 Pre-Work Training

All Shaw E & I personnel, or employees of subcontractors under the direction of Shaw E & I personnel, whose work assignments will involve direct working contact with licensed radioactive materials or who will work within areas that require posting or boundary controls due to a radiological hazard in accordance with the posting requirements of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Code of Federal Regulations, 29 CFR Section 1910.1096, “Ionizing Radiation,” shall receive pre-work training. The training shall be conducted in accordance with NUREG 1556 and shall include the following elements:

- Principles of radiation protection
- Use of protective clothing and respiratory protection equipment
- Specific job precautions and requirements
- Emergency alarms and responses
- The requirements of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Code of Federal Regulations, 29 CFR Section 1910.1096, "Ionizing Radiation," as they apply to specific licenses, projects, and situations
- Applicable sections of State radiation protection regulations
- Requirements as stated in National Council for Radiation Protection and Measurements (NCRP) Report Number 39, "Basic Radiation Protection Criteria"

### 6.3.2 Refresher Training

All personnel who perform work as described in Section 7.1 of this document shall receive annual refresher training. In addition, instructions for specific job precautions or requirements shall be administered as needed to meet project requirements or ensure personnel safety.

### 6.3.3 Pre-Work Training Exemption

Visitors may be exempted from pre-work training requirements, provided such personnel are accompanied at all times by an escort who has had the training, as specified in Section 6.3.1.

### 6.3.4 Radiological Controls Technicians

All radiological controls technicians assigned to work on Shaw E & I projects will be properly trained and technically competent in the area of Health Physics as evidenced by education, training, or experience. Specific training requirements will be established in the Radiation Protection Plan for each project or operation. Requirements for the Acceptance and Use of Radiological Controls Technicians are provided in Attachment 1 of the procedure.

## 6.4 Occupational Radiation Exposure Policy

All potential occupational exposures to ionizing radiation during Shaw E & I activities shall be managed in such a way as to ensure that exposures are As Low As Reasonably Achievable (ALARA).

### 6.4.1 ALARA Planning

Pre-work planning is essential to ensuring that all radiological work is conducted in a manner that minimizes personnel exposure to ionizing radiation and complies with this ALARA Policy. All such planning should be performed by personnel who are experienced and knowledgeable in health physics principles, practices, and procedures; and who are familiar with those design features and operations of nuclear facilities and waste handling equipment that affect the potential for exposures of personnel to radiation

Exposure planning, including assessing the need for dosimetry and bioassays, shall be performed for projects with the potential for internal and/or external occupational radiation exposure. A written ALARA plan shall be prepared, and dose budgets established, for all operations and activities where there is a potential for personnel to exceed the administrative limits specified in Section 6.4.2.

### 6.4.2 Administrative Limits

In addition to maintaining exposures as low as reasonably achievable, occupational radiation doses shall be administratively controlled in a manner that ensures that no person receives exposure in excess of any regulatory limit. In order to ensure that no regulatory limits are exceeded, an administrative exposure limit will be established at 80% of regulatory limits with a goal of 10% or less of the regulatory limits. No Shaw E & I or subcontractor employee may ever be authorized to receive annual occupation radiation dose in excess of the following:

- 4.0 REM Total Effective Dose Equivalent (TEDE)
- 12.0 REM Lens Dose Equivalent (LDE)
- 40.0 REM Shallow Dose Equivalent (SDE) or Total Organ Dose Equivalent (TODE)

In addition to these limits, guideline levels are established to ensure exposure is consistently minimized on all projects. A set of monthly and quarterly administrative guideline levels, which are significantly below the limits established above, are given in Attachment 2 of this procedure. These levels are established to ensure proper exposure planning and to prevent any single individual from receiving their annual dose limit in a fraction of the year. Personnel are authorized to receive doses up to Level I without additional approval. Personnel shall not receive doses in excess of the Levels I and II monthly administrative level or the Level III quarterly administrative level without the appropriate approval. Approval by both the Project RSO, or equivalent, and the Project Manager responsible for the project on which the employee would exceed the limit are necessary to authorize exposures above the Level I administrative limits at their particular projects. Review by the License RSO is necessary to authorize exposures above the Level II administrative limits. The written approval of the Director of Radiological Services is necessary to authorize exposures above the Level III administrative limits.

Extensions beyond the Level II or Level III limits shall be granted in increments of no more than 0.250 REM. Requests for all exposure limit extensions shall be made by the appropriate Project Manager or designee prior to any operation that might cause any person to exceed a guideline level.

### 6.4.3 Radiation Exposure Equalization

In instances where an individual's quarterly cumulative dose reaches 1.0 REM Total Effective Dose Equivalent (TEDE), 3.0 REM Lens Dose Equivalent (LDE), 10.0 REM Shallow Dose Equivalent (SDE), or 10.0 REM Total Organ Dose Equivalent (TODE), equalization of exposures among project personnel within the limitations imposed by job classifications and personnel availability shall be practiced.

### 6.4.4 Other Limitations on Exposure

In addition to the requirements noted above, the additional limitations specified below shall be considered during project planning and execution.

- Individuals under 18 years of age shall not be occupationally exposed.
- Minors and members of the public shall not receive doses exceeding 100 mREM per year and should not receive more than 80 mREM per year.
- Employees shall not participate in Planned Special Exposures unless planned exposures are reviewed and approved by the Shaw Corporate RSO and Federal Technical Services Radiological Controls Hub Director.
- Prior to receiving occupational radiation exposure, newly hired or contracted individuals shall provide a signed statement documenting their radiation exposure for the current year. For exposures received while working under a radioactive materials license, an NRC Form 4 or equivalent will be required.
- The dose to an embryo/fetus during the entire pregnancy due to the occupational exposure of a declared pregnant woman shall not exceed 0.4 REM.

- Individuals shall enter Radiation Areas only if their current dose accumulation is less than the applicable limit of Administrative Exposure Limits table.
- Visitors shall not be allowed to receive a dose greater than 10 mREM per visit.

### 6.4.5 Emergency Exposures

In emergency situations, volunteers may accept exposures in excess of previously stated regulatory and administrative limits under the following circumstances in accordance with U.S. Environmental Protection Agency, EPA-400-R-92-001, *Manual of Protective action Guides and Protective Actions for Nuclear Incidents*:

#### 6.4.5.1 Life Saving Actions

This applies to search for and removal of injured persons, or entry to prevent conditions that would probably injure numbers of people. Planned doses shall not exceed 25 REM TEDE per volunteer.

#### 6.4.5.2 Valuable Equipment Emergency Actions

This applies to entries to protect facilities, to prevent further releases of radioactive material, or to control fires. Planned doses shall not exceed 10 REM TEDE per volunteer.

## 6.5 PERSONNEL MONITORING POLICY

All occupationally exposed workers who are likely to be exposed to airborne radioactivity concentrations in excess of 10% of applicable regulatory limits or who may receive more than 10 mREM in any calendar week of external whole body radiation exposure or permitted unescorted access to posted Radiation Areas shall be appropriately monitored for exposure to ionizing radiation.

### 6.5.1 Bioassay and Whole Body Counting

Workers subject to the Personnel Monitoring Policy (as determined above) shall submit bioassay samples and/or receive whole body counts as required by site-specific radiation protection plans.

### 6.5.2 External Monitoring

For all individuals subject to the Personnel Monitoring Policy, at least one of the following personnel monitoring devices or methods shall be used to monitor external occupational radiation exposures:

- Thermoluminescent dosimeters (TLDs)
- Self-reading dosimeters (SRDs)
- Film badge dosimeters
- Direct positive monitoring of the work area prior to and during the work activity and administrative assignment of exposure base on work area radiological conditions levels

### 6.5.3 Termination

All personnel subject to the Personnel Monitoring Policy will be requested to submit bioassay samples and/or receive whole body counts upon completion of their work assignments as prescribed by site-specific radiation protection plans.

### 6.5.4 Requirements

The monitoring of external and internal occupational dose of Shaw E & I personnel shall comply with applicable regulatory requirements.

### 6.5.5 Personnel Radiation Exposure History

Newly hired employees or contract workers shall provide, to the Shaw E & I Health and Safety Department, a complete radiation exposure history, as described in Section 6.4.4 of this document, prior to receiving any occupational exposure from Shaw E & I activities.

### 6.5.6 Action Levels

Action levels for the various techniques used in the personnel monitoring shall be stated in site-specific radiation protection plans and will reflect, as a minimum, the requirements of this Policy Manual and the recommendations of current regulatory standards.

### 6.5.7 Personnel Monitoring and Dosimetry Data

All monitoring data collected on an individual shall be considered private information. Personnel exposure information shall not be released except as required by regulation or license condition, or at the written request of the individual.

### 6.5.8 Dosimetry Processing

Personnel dosimeters that require processing and that are used to document personnel external dose shall be processed by a dosimetry processor that is NVLAP accredited and that is approved for the type of radiation(s) most similar to those that the personnel being monitored have been exposed to.

### 6.5.9 Monitoring for Intake

Personnel whose estimated intake may exceed 40 DAC-hours since their most recent bioassay shall be monitored for intake by bioassay or whole body count.

### 6.5.10 Visitors

Visitors entering a posted area shall be appropriately monitored. External monitoring may be performed with self-reading dosimeters and may be performed individually or with a single dosimeter for a group of visitors.

## 6.6 Survey Policy

Surveys shall be performed and documented as necessary to evaluate radiation levels, concentrations, or quantities of radioactive material and radiological hazards to ensure compliance with federal and/or state regulations. These surveys will be performed with instruments and equipment that has been calibrated as required by ANSI Standard N323 prior to use, and to the radiation being measured. Detection sensitivity (minimum detectable concentration) for these survey instruments shall be less than or equal to 90% of the applicable limit, with a goal of not more than 10% of the limit.

## 6.7 Contamination Control Policy

Proper site controls and contamination control procedures shall be established to preclude the spread of contamination into uncontrolled areas.

### 6.7.1 Contamination Areas

Contamination Areas shall be posted and bounded areas furnished with step-off pads wherever it is practical. The following restrictions shall apply to Contamination Areas:

#### 6.7.1.1 Entries

All entries into posted contamination areas shall require a radiation work permit approved in accordance with the site-specific radiation protection plan.

6.7.1.2 Smoking, Eating, and/or Drinking

Smoking, eating, and/or drinking shall not be allowed in any area that is posted as contaminated.

6.7.1.3 Breaches of Intact Skin

Personnel who have breaches of intact skin (e.g., open wounds, sores) should be excluded from participating in work activities in Contamination Areas. The Project RSO, or equivalent, may allow entry, if appropriate bandaging has been applied to the wound and if there is no other medical reason to restrict entry into the Contamination Area.

6.7.1.4 Personal Clothing and Articles

Personnel working in areas where substantial contamination is present should not wear personal clothing, jewelry, or other personal items other than socks and underwear into those areas.

### 6.7.2 Designation of Radiation/Contamination Areas

The Project RSO, or equivalent, shall have the responsibility and authority for posting and/or removing the boundaries for Radiation/Contamination Areas.

### 6.7.3 Item Control

Contamination status shall control the movement and/or use of items removed from contaminated areas.

### 6.7.4 Contamination Limits

Site or project-specific contamination limits shall be established in the radiation protection plan. These limits shall be below regulatory limits to ensure proper control.

### 6.7.5 Item Tagging

Items that are contaminated in excess of the applicable limit(s) and that are removed from contaminated areas shall be appropriately wrapped, tagged to denote conditions, and appropriately isolated.

### 6.7.6 Unconditional Release

Items shall not be released for unrestricted use from any radiological area if radioactive contamination is detected in excess of acceptable levels.

## 6.8 RESPIRATORY PROTECTION POLICY

Appropriate respiratory protection measures shall be taken during all Shaw E & I activities to limit the exposure of personnel to airborne radionuclides to levels that are not only within applicable regulatory limits but also ALARA.

### 6.8.1 Controls

Process or engineering controls shall be used to the extent practicable to reduce airborne radioactive material so that respirators are not needed.

### 6.8.2 Respiratory Protection Policy

All personnel who, while carrying out their work assignments, are likely to be exposed to airborne radioactive materials at levels exceeding 30% of the more restrictive Derived Air Concentration (DAC) of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation* shall do so only with appropriate respiratory protection.

### 6.8.3 Evaluation

If airborne radionuclide concentrations exceed 30% of the DAC, the need for respiratory protection equipment will be evaluated and documented prior to beginning work. Planned exposures greater than 12 DAC-hours per week should be avoided.

### 6.8.4 Protection Factors

The regulatory protection factors for respiratory protection devices are found in Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*. Respirators used in a work area shall have a protection factor greater than the number of DACs present in that work area.

### 6.8.5 Respiratory Protection Training

All personnel who are subject to this policy shall be medically qualified to use a respirator, fitted for the appropriate respiratory protective device, and shall have received applicable training in compliance with Code of Federal Regulations, 29 CFR Section 1910.134, *Respiratory Protection* prior to respirator use. Refitting and retraining shall be carried out at least annually.

### 6.8.6 Respiratory Protective Device Leak Check

Individually worn respiratory protective devices shall be tested for operability immediately prior to being worn into a potential airborne radioactivity contaminated environment.

### 6.8.7 Working Concentration Limits

Work activities shall not be carried out under conditions where air sample data show the concentration of airborne radioactive material exceeds 1000 times the applicable DAC limit without the review and written approval of the Federal Technical Services Radiological Controls Hub Director.

### 6.8.8 Physical/Emotional Discomfort

All personnel who are required to wear respiratory protective devices must be instructed that, should they experience physical and/or emotional discomfort that may be caused by wearing a respiratory protective device, they may leave the area at any time for relief.

### 6.8.9 Airborne Radioactive Materials Sampling

In areas of known or suspected airborne radioactive material concentrations exceeding 30% of the appropriate DAC, the following air sampling requirements shall be imposed to ensure the adequacy of prescribed respiratory protection devices:

- Prior to the start of work activities, airborne radioactive material concentrations shall be determined.
- Once work activities have begun in posted Airborne Radioactivity Areas, at least one air sample per shift shall be collected from the area(s) and the concentration of airborne radioactive materials determined.

  NOTE: ADDITIONAL SAMPLING MAY BE NECESSARY SHOULD WORK ACTIVITIES CHANGE.
- The need for continuous sampling shall be evaluated as necessary by the Project RSO.

### 6.8.10 Exemption from Airborne Radioactive Materials Sampling

Exemption from the provisions of Section 6.8.9 may be granted for a specific area when the history of airborne radioactivity concentrations in the area is adequately documented and indicates that significant personnel radiation exposures would be received during air sample collection.

### 6.8.11 Unidentified Airborne Radioactive Material Concentrations

In instances where there are unidentified radionuclides contributing to the airborne conditions, the most limiting DAC for radionuclides likely to be present shall be applied to the unidentified component(s) when respiratory protective devices are being prescribed.

### 6.8.12 Facial Hair

Any person who is required wear a respiratory protective device and who cannot, because of facial hair, obtain a proper respiratory protection device fit shall be excluded from entering posted Airborne Radioactivity Areas until an approved fit can be obtained.

### 6.8.13 Respiratory Protective Device Maintenance

A respiratory protective device maintenance program, consisting of cleaning, sanitizing, and inspection, shall be implemented in compliance with Code of Federal Regulations, 29 CFR Section 1910.134, *Respiratory Protection*. Respiratory protective devices worn by an individual shall not be reissued for general use until the maintenance program requirements have been performed.

## 6.9 Radiation Work Permit Policy

All personnel who are required to enter posted Radiologically Controlled Areas, Contamination Areas, and/or Airborne Radioactivity Areas shall do so only in compliance with an approved Radiation Work Permit (RWP).

### 6.9.1 RWP Content

An RWP shall contain a brief description of the scope of the task and descriptions of the hazardous conditions in the work area, the personal protective equipment (PPE) requirements, and special precautions.

The RWP shall have a unique identifier for tracking, a reference to surveys performed that are applicable to the area covered under the RWP, and a list of workers authorized to enter the RWP area.

### 6.9.2 RWP Issue

RWPs shall be issued by the cognizant radiological controls organization for any Shaw E & I work site. An RWP will be issued for all work activities carried out within posted RCAs, Contamination Areas, and/or Airborne Radioactivity Areas.

### 6.9.3 RWP Authorization

An RWP shall not be valid until all authorizing supervision signatures have been entered on the RWP form.

### 6.9.4 RWP Briefing

Prior to starting work covered by an RWP, all individuals shall be briefed on the conditions in the area, PPE requirements, and any special precautions associated with area radiological conditions.

### 6.9.5 RWP Termination

Any one, or combination, of the following can terminate RWPs:

#### 6.9.5.1 Work Completion

Work activities for which the RWP was issued are completed.

#### 6.9.5.2 Expiration

RWP authorization shall be limited to a specific time period established in the site-specific radiation protection plan. Generally, that period should not exceed seven calendar days from the time of issue, and the RWP will be automatically terminated at the end of that time period. Specific site or area radiological conditions may dictate more or less frequent termination.

#### 6.9.5.3 Withdrawal of Authorization

The cognizant radiological controls authority for a site or facility and any other authorizing supervisor who signed a specific RWP shall have the prerogative of withdrawing their specific authorization, thus terminating the RWP, at any time.

## 6.10 Radioactive Source Control Policy

All radioactive sources will be properly controlled and managed in full compliance with Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation* or the applicable state regulations, if applicable, and in such a manner as to ensure proper inventory controls and prevent release of radionuclides to the environment.

### 6.10.1 Requisition

Prior to ordering, all requisitions for radioactive sources shall be approved by the appropriate licensing authority or, for generally licensed or exempt quantity sources, the site Project RSO.

### 6.10.2 Receipt of Radioactive Sources

Upon arriving at a facility or project site, any package suspected of containing or known to contain radioactive sources shall be surveyed by competent Radiological Controls personnel. If the material is a Type A quantity of material, receipt of radioactive source will be in compliance with Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*.

### 6.10.3 Source Inventory

The license user or designee shall inventory all licensable quantities of radioactive laboratory and calibration sources whose possession is authorized by a radioactive materials license at least quarterly.

### 6.10.4 Leak Testing

All beta/gamma sealed sources in active use shall be leak tested at least semi-annually. In-use alpha-emitting sources shall be tested for leakage at least every 3 months. All licensable sealed radioactive sources that have been stored (out of use) for a period exceeding six months shall be leak tested prior to use.

### 6.10.5 Radioactive Source Shipment

Prior to release from a project site or facility, all shipments containing radioactive sources shall be cleared by the Project RSO.

### 6.10.6 Radioactive Source Disposal

The disposal of all radioactive laboratory and calibration sources whose possession is authorized by a radioactive materials license shall require the approval of the license RSO, or designee.

## 6.11 Effluent and Radioactive Material Release Policy

Releases or transfer of radioactive material, including air or liquid effluent, from a licensed facility, shall be documented. This documentation shall include the following:

- Quantity and radionuclide
- Chemical and physical form
- Point and rate of release
- Release survey forms
- Radioactive Shipment Manifest (if appropriate)

### 6.12 Environmental Monitoring Policy

Appropriate environmental monitoring shall be performed during Shaw E & I activities at all facilities/sites where the potential exists for release to the environment of radioactive material.

### 6.12.1 General Environmental Monitoring

Environmental monitoring shall include the following, as appropriate:

- Air sampling
- Groundwater and surface water sampling
- Direct radiation monitoring
- Flora and fauna sampling
- Soil sampling

### 6.12.2 Specific Environmental Monitoring

A site-specific environmental monitoring program shall be developed for each facility/site, to include the following:

- Locations to be sampled
- Media to be sampled
- Frequency of sampling
- Radioassays to be performed
- Actions to be taken as well as action levels

### 6.13 Health Physics Log Book Policy

A Health Physics Log Book, or equivalent, shall be established and maintained for each project site or facility. The Log Book, or equivalent, shall contain, at a minimum, daily records of the activities performed in radiological areas, the personnel involved, the radiological controls applied, any problems that are identified, and any corrective actions taken.

Entries shall be in ink and shall be signed by the individual making the entry. Corrections to the Log Book, or equivalent, shall be done with a single line through the material being corrected. The person making the correction shall write their initials and the date of the correction near the correction.

### 6.14 Records Policy

All records required or created as a result of Shaw E & I activities will be established and maintained in a manner that is consistent with regulatory requirements and the requirements of project-specific Quality Assurance Plans.

The following records shall be maintained on site during operations.

- Personnel Radiation Exposure Records
- Personnel Training Records
- Radiation/Contamination Survey Records
- RWP Records
- Effluent Records
- Environmental Monitoring Records
- Instrumentation Records
- Radioactive Source Control Records
- Radiological Controls Record Retention
- Personnel radiation exposure records

## 7. ATTACHMENTS

Attachment 1 - Acceptance Criteria for Radiological Controls Technicians

Attachment 2 - Administrative Exposure Limits Table

# ATTACHMENT 1

**Subject:** **Qualification and Use of Radiological Controls Technician**

## 8. PURPOSE

This document describes the qualification requirements for Radiological Controls Technicians and the method to be used to verify that those requirements are met.

## 9. DETERMINATION OF TECHNICIAN NEED

The Project Manager (PM) and the License RSO, will determine the number and type of technicians required to staff a particular project. This determination should be made as far as possible in advance of the project mobilization, preferably during the bid and proposal stage. Technicians are grouped in two categories based on the amount of responsibility they may assume.

### 9.1 Senior Radiological Controls Technicians

A Senior Technician (SRCT) is a technician that may assume all responsibilities for radiological control on a project except for the authority and responsibility of the Project RSO. Examples of a SRCT's responsibilities include: performing radiation and contamination surveys, performing air sampling and analysis, providing job coverage, responding to radiological emergencies, performing personnel decontamination, performing release surveys, performing incident investigations, performing instrument checks, conducting pre-job briefings, supervising radiological work performed by work crews, and supervising other Technicians.

### 9.2 Radiological Controls Technicians

A Radiological Controls Technician (RCT) may only assume limited responsibilities unless they are under the direct supervision of a SRCT or Project RSO. Examples of RCT responsibilities include: manning an access control point, issuing dosimetry, performing clean area routine surveys, surveying laundry and respiratory protection equipment, decontaminating equipment, performing instrument checks, and manning a counting room. RCTs may also assist, under direct supervision, SRCTs in the performance of their assigned tasks. All paperwork and records produced by RCTs must be reviewed and countersigned by a SRCT or Project RSO.

## 10. ACCEPTANCE CRITERIA FOR TECHNICIANS

### 10.1 Senior Radiological Controls Technician

SRCT must have at least 36 months of documented direct, hands-on radiological controls experience or equivalent education in radiological controls from a college, university or technical school.

### 10.2 Radiological Controls Technicians

RCT must have at least 12 months of documented direct, hands-on radiological controls experience.

### 10.3 Client Specific Requirements

In addition to the minimum experience and education requirements defined above, additional nationally recognized training and qualification requirements, such as DOE Radiological Controls

Technician, or US Navy Article 108 Radiological Control Monitor, or other client-mandated training requirements may be imposed on a project-specific basis.

## 11. QUALIFICATION OF TECHNICIANS

**11.1** The Project Manager or Project RSO will review candidate resumes.

**11.2** If the candidate meets the qualification and project-specific selection criteria, he/she is considered qualified to staff the project without further approval.

**11.3** If the candidate does not meet the criteria, the PM may request that the candidate be evaluated by the License RSO for exemption from the requirements. The License RSO may administer written or oral examinations to determine if the candidate may be qualified. Exemptions may not be granted for customer specific requirements such as Department of Energy Radiological Control Technician Qualification, Naval Reactors Article 108, or ANSI Standard requirements.

**11.4** A file must be kept for each successful candidate. This file shall contain the resume, qualification certificates, if appropriate, and any testing or evaluation results. At the end of the project, the PM and the Project RSO will execute a written evaluation of the contract technician and for placement into their file.

ADMINISTRATIVE EXPOSURE LIMITS

| LEVEL | ACCUMULATED DOSE (REM) | CATEGORY | CALENDAR PERIOD | APPROVALS REQUIRED FOR EXTENSION |
|---|---|---|---|---|
| I | 0.125 | TEDE | Quarter | Project RSO, or equivalent, and Project Manager |
| | 0.375 | LDE | Quarter | " |
| | 1.250 | SDE, TODE | Quarter | " |
| II | 0.25 | TEDE | Quarter | License RSO Review, Project Manager Approval |
| | 0.750 | LDE | Quarter | " |
| | 2.5 | SDE, TODE | Quarter | " |
| III | 1.0 | TEDE | Quarter | License RSO Review, Radiological Controls Director Approval |
| | 3.0 | LDE | Quarter | " |
| | 10.0 | SDE, TODE | Quarter | " |
| MAXIMUM LIMIT | 4.0 | TEDE | Annual | No Extension Allowed |
| | 12.0 | LDE | Annual | " |
| | 40.0 | SDE, TODE | Annual | " |

TEDE = Total Effective Dose Equivalent

LDE = Lens Dose Equivalent

SDE = Shallow Dose Equivalent

TODE = Total Organ Dose Equivalent

# RADIATION PROTECTION PROCEDURE

**Subject:** **Shipment of Radioactive Materials**

## 1. PURPOSE

This purpose procedure is to establish procedures for the safe shipment of radioactive materials, including mixed waste, by Shaw Environmental & Infrastructure (Shaw E & I) Radioactive Materials Brokers.

## 2. SCOPE

This procedure is applicable to all personnel who ship or assist in the shipment of radioactive materials as defined by the United States Department of Transportation (USDOT). This document outlines the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these operations. The direction provided by this document may be amended to comply with specific regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document.

## 3. REFERENCES

- Code of Federal Regulations, 49 CFR, *Transportation.*
- Code of Federal Regulations, 40 CFR, *Protection of Environment.*
- Code of Federal Regulations, 10 CFR, *Energy*.
- US Department of Transportation, *USDOT Emergency Response Guidebook*.
- Shaw E & I Health and Safety Procedure HS811, *DOT 24-Hour Emergency Number*.

## 4. DEFINITIONS

- **Broker—**Any individual who performs one or more of the following functions for a waste generator:
  - Arranges for transportation of the waste
  - Collects and/or consolidates shipments of waste
  - Processes waste in some manner

  This definition shall not apply to a carrier whose sole function is to transport waste
- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Disposal Site—**For the purposes of this procedure, any facility licensed for the purpose of disposing of low level radioactive waste
- **Disposer—**The site that receives radioactive or mixed waste for disposal.
- **Hazardous Material—**Any material that is determined by the Secretary of Transportation of the United States to present a hazard when transported in commerce.
- **Ionizing Radiation—**Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Function-Specific Training—**Training, specific to job function, provided in accordance with Title 49, Code of Federal Regulations, Part 172, Subpart H to all HAZMAT employees.
- **HAZMAT Employee—**An employee who loads, unloads, or handles hazardous materials; is responsible for the condition of containers used to transport hazardous materials; prepares hazardous materials for transportation; is responsible for the safety of hazardous materials; or operates a vehicle used to transport hazardous materials.
- **Hazardous Waste—** Any material that is subject to the Hazardous Waste Manifest Requirements of the U.S. Environmental Protection Agency specified in 40 CFR part 262.
- **International Air Transport Association (IATA)—**IATA is the trade association of the world's international airline industry and serves as the body that develops the international air transport working standards.
- **International Maritime Organization (IMO)—**IMO is a technical organization and specialized agency of the United Nations. Its main concern is to improve the safety of maritime operations, and thus it serves as the body that develops international maritime standards.
- **Low-Level Radioactive Waste—**Wastes containing source, special nuclear, or byproduct material that is acceptable for disposal at a low-level radioactive waste disposal facility.
- **Low-Level Radioactive Waste Compact—**A group of states that have formed a compact, as defined by the Federal Low Level Radioactive Waste Policy Amendments Act, for the purpose of managing the disposal of low-level radioactive waste within the compact states.
- **Mixed Waste—**Wastes containing materials that are, by definition, radioactive waste as defined by the United States Nuclear Regulatory Commission (USNRC) and hazardous waste as defined by EPA.

- **Monitoring-** The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **NORM Waste—**Wastes that contain only naturally occurring or accelerator-produced radioactive materials. These materials are regulated by state law and are not low-level radioactive waste.

- **TSD Facility—**A Treatment, Storage, or Disposal Facility as defined by EPA in accordance with Code of Federal Regulations, 40 CFR.

- **Radiological Controls Technician (RCT)—**An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Survey—** An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice. The Director will establish and maintain all necessary management oversight and implement a management review process to ensure implementation of applicable Manual requirements.

### 5.2 Radioactive Materials Broker

The Broker is responsible for the safe and proper shipment of radioactive materials, including the following activities:

- Identifying appropriate Proper Shipping Names
- Selecting packaging
- Packaging Materials
- Preparing USDOT shipping papers and required waste manifests
- Supervising loading of materials, if shipment is exclusive use
- Performing radiological surveys of waste packages and conveyance, as required to meet USDOT regulations

## 6. PROCEDURE

### 6.1 Prerequisites

Individuals performing any function related to the transport of hazardous materials shall be trained in accordance with the requirements of Title 49, Code of Federal Regulations, Part 172, Subpart H.

Individuals shipping radioactive materials shall ensure that the following administrative requirements have been met prior to shipment of materials:

- The material must be identified by the most appropriate Proper Shipping Name in accordance with the Hazardous Materials Tables of Code of Federal Regulations, 49 CFR Part 172. Radioactive Waste being shipped for disposal or shipped to a collector or processor for eventual disposal by shallow land burial shall be classified in accordance with Code of Federal Regulations, 10 CFR Part 61, or a valid disposal site license.
- If the material is a hazardous or mixed waste, the material must be identified by the most appropriate USEPA Waste Code in accordance with Code of Federal Regulations, 40 CFR Part 261.
- The generator, transporter, and disposer of hazardous or mixed wastes shall have valid EPA Identification Numbers and all EPA Permits (Generator Permits, Transporter Permits, TSD Permits, etc.), as appropriate. The generator shall also provide evidence that the waste stream(s) being shipped is acceptable at the receiving facility in accordance with all permit requirements.
- The generator of hazardous and mixed waste shall have completed all notifications and certifications for the waste material subject to the land disposal restrictions in accordance with Code of Federal Regulations, 40 CFR Part 268.
- The generator of radioactive waste or mixed wastes shall have all applicable permits or other requirements of the disposal facility, such as the following:
  - Evidence of the acceptability of the waste stream by the facility (including all waste profile information and analytical data)
  - Any other required federal, state, or local permits, or other requirements mandated by law including compact import/export requirements
  - Evidence, by provision of a receiving/disposal site license, of the acceptability of the waste being shipped
- Radioactive Materials not shipped as waste shall be shipped in such a manner as to conform to all federal, state, and local ordinances. Non-waste radioactive materials shall only be shipped to a facility upon provision of evidence, such as a valid USNRC license, by the customer, that the material is acceptable at the receiving facility.
- All radioactive materials shipped internationally shall be shipped in accordance with all applicable international regulations and requirements, i.e. IMO and IATA.

## 6.2 Tools, Materials, and Equipment

Unless provided by the customer, the broker will be required to provide all tools, administrative forms, survey instruments, labels, markings, and placards for each shipment of materials. Special care must be taken by the broker to ensure that an adequate supply of such materials is maintained. A Broker's Field Kit Materials List is provided with this procedure.

## 6.3 Detailed Instructions

### 6.3.1 Procedure for Material Preparation

All materials shipped by Shaw E & I shall be in strict adherence to the requirements of Code of Federal Regulations, 49 CFR, and all other applicable federal, state, and local regulations:

- Materials shall be packaged and the packaging inspected in accordance with the requirements of Code of Federal Regulations, 49 CFR Part 173 for the Proper Shipping Name and USDOT Subtype of the material being offered for transport. Type B and USNRC-approved Type A Packages shall be prepared in accordance with the applicable Certificate of Compliance.
- All packages offered for transport shall be properly marked and labeled in accordance with the requirements of Code of Federal Regulations, 49 CFR Part 172, prior to shipment.
- Shipping papers will be prepared for shipments as follows:
  - All radioactive materials (unless otherwise excepted) shall have USDOT hazardous materials shipping papers prepared in accordance with Code of Federal Regulations, 49 CFR Parts 172.200 - 172.205.
  - In addition to USDOT hazardous materials shipping papers, all mixed waste shall have a Uniform Hazardous Waste Manifest selected and prepared in accordance with Code of Federal Regulations, 40 CFR Part 262.20.
  - All low-level radioactive waste and "NORM" waste shall have a manifest prepared in accordance with the requirements of Code of Federal Regulations, 10 CFR Part 20.311.
  - Additional forms shall be prepared as may be required by Federal, State, and Local ordinances, and by receiving site license or acceptance criteria.

## 6.4 Procedure for Material Loading

With the exception of common carrier shipments of radioactive materials, the following procedure shall be followed when loading material for transportation:

1. Conduct and document a visual inspection of the conveyance and ensure that any discrepancies are repaired prior to loading. This inspection shall include all vehicle safety devices, tires, brakes, and trailer, as applicable.

2. If the vehicle floor shows evidence of moisture, wipe the floor as dry as possible and note the condition of the floor and action taken on the shipping papers. The consignee shall also be notified prior to shipment.

3. Perform and document a radiation and contamination survey of the conveyance prior to loading. Compare the survey results to the requirements of Code of Federal Regulations, 49 CFR Part 173.

4. The Broker shall inspect all packages as they are loaded to ensure that the packages are in full compliance with all the requirements set forth in this procedure. Incompatible materials shall be segregated as required by Code of Federal Regulations, 49 CFR.

   NOTE: SPECIAL CARE SHALL BE TAKEN TO ENSURE THAT ALL STRONG TIGHT CONTAINERS USED FOR RADIOACTIVE MATERIAL TRANSPORT ARE COMPLETELY SEALED TO THE MAXIMUM EXTENT PRACTICAL. THIS INCLUDES THE USE OF SEALANT ON SEAMS OF METAL BOXES. <u>SPECIAL CARE SHALL ALSO BE TAKEN TO ENSURE THAT ALL SPECIFICATION PACKAGES ARE PROPERLY PREPARED FOR TRANSPORT AND IN PRISTINE CONDITION PRIOR TO TRANSPORT.</u>

5. Upon completion of loading, visually verify that all packages are loaded.

6. Verify the proper use of blocking, bracing, dunnage, and tie-down, as appropriate.

7. Verify the conveyance is properly placarded, as applicable.

8. Perform and document a final contamination and radiation survey of the conveyance and ensure that the results are in compliance with the requirements of Code of Federal Regulations, 49 CFR Part 173.

9. Seal the vehicle/conveyance if required.

## 6.5 Post Loading Requirements

1. Have the driver (or transporter's representative) and shipper (or shipper's agent) sign all required forms.

2. Review all paperwork to ensure legibility.

3. Copy and distribute paperwork as needed. Uniform Hazardous Waste Manifests shall be distributed in accordance with Code of Federal Regulations, 40 CFR Part 262 and as required by the laws of the generating state.

4. Verify that the driver (transporter's representative) understands all special instructions such as the maintenance of exclusive use and prior notification requirements. The shipment may now be released for transport.

5. Make any required prior notification of correction telephone calls. Mail copies of the Radioactive Shipment Manifest (RSM) cover sheets to the disposal site for radioactive waste shipments.

6. Notify the emergency response services in accordance with Shaw E & I Health and Safety Procedure HS811, *DOT 24-Hour Emergency Number*.

## 6.6 Shipping Errors

If the responsibilities of the broker are improperly executed and/or negligence is shown on the part of the broker, the broker shall be suspended from all shipping activities until the error is investigated and appropriate corrective action determined. Reinstatement shall be made only after any required retraining or re-certification is completed.

## 6.7 Records

### 6.7.1 Broker

The broker shall retain copies of records, forms, and shipping papers generated as a result of this procedure until written acknowledgment is received from the consignee for all waste shipments or telephone acknowledgment is received for all non-waste shipments.

### 6.7.2 Project Records

All shipping papers shall be retained as part of a permanent project file for each project.

### 6.7.3 Generator

The generator of waste shall be provided with a copy of all shipping papers.

## 7. ATTACHMENTS

Broker Field Kit Recommended Material List

# BROKER FIELD KIT RECOMMENDED MATERIAL LIST

I. PROCEDURES AND REFERENCES

1.) 49 CFR, PARTS 100-177;

2.) 10 CFR, PARTS 0-50 AND 51-199;

3.) 40 CFR, PARTS 260-299;

4.) SHAW E & I PROCEDURE, T-RA-003, *SHIPMENT OF RADIOACTIVE MATERIAL*S;

5.) ALL APPLICABLE PROJECT SPECIFIC RULES, REGULATIONS, AND LICENSES (RADIOACTIVE MATERIAL LICENSES, STATE HAZARDOUS MATERIAL REGULATIONS, ETC.);

II. PAPERWORK

1.) BLANK LOW LEVEL RADIOACTIVE WASTE MANIFESTS;

2.) BLANK BILLS OF LADING;

3.) BLANK US EPA UNIFORM HAZARDOUS WASTE MANIFESTS;

4.) ALL PROJECT SPECIFIC PAPERWORK (STATE HAZARDOUS WASTE MANIFESTS, WASTE CERTIFICATION FORMS, PRIOR NOTIFICATION FORMS, ETC.).

III. LABELS AND MARKINGS

1.) "RADIOACTIVE" STICKERS;

2.) "RADIOACTIVE-LSA" STICKERS;

3.) WASTE CLASS AND STABILITY STICKERS;

4.) ITEM NO. AND WEIGHT STICKERS;

5.) HAZARDOUS MATERIALS LABELS;

6.) "7A TYPE A" STICKERS;

7.) HAZARDOUS WASTE CONTAINER LABELS;

8.) PERMANENT MARKERS (2) AND PENS (2);

9.) HAZARDOUS MATERIALS PLACARDS;

10.) PROJECT SPECIFIC MARKINGS AND LABELS AS REQUIRED.

# BROKER FIELD KIT RECOMMENDED MATERIAL LIST

IV. TOOLS AND MATERIALS

1.) 12" CRESCENT WRENCH (1);

2.) 15/16" COMBINATION WRENCH (2);

3.) HALF ROUND NEOPRENE GASKETS AND SILICONE GREASE (IF SHIPPING DRUMS);

4.) E-520 WITH HP-260 AND HP-270 PROBES, OR EQUIVALENT;

5.) OTHER TOOLS, MATERIALS, AND INSTRUMENTATION AS REQUIRED BY PROJECT.

# RADIATION PROTECTION PROCEDURE

**Subject: Field Project Radiological Controls**

## 1. PURPOSE

The purpose of this procedure is to describe in general the radiological controls that will be instituted on Shaw E & I projects involving radiological hazards. These projects typically include the survey or monitoring, analysis, and/or decontamination activities associated with fixed or temporary building structures, equipment, or environmental media. Each project will have a Site Specific Radiation Protection Plan approved by the License RSO which complies with Shaw's Health and Safety procedure HS700 *Policy and Guidance for Developing Radiation Protection Plans*. Scope

This procedure specifies standard practices for performing operations conducted in radiologically controlled areas. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 2. TABLE OF CONTENETS

## 3. REFERENCES

- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000
- US Nuclear Regulatory Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors.*
- US Nuclear Regulatory Commission, Regulatory Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure.*
- Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.
- Shaw E & I Health and Safety Procedure HS600, *Personnel Protective Equipment.*
- Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program.*
- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification.*
- Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.
- Shaw E & I Procedure T-RA-008, *Dosimetry Administration*.
- Shaw E & I Procedure T-RA-009, *Radiation Exposure Rate Monitoring*.
- Shaw E & I Procedure T-RA-010, *Radiological Site Controls.*
- Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*.
- Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*.

## 4. DEFINITIONS

- **Access Control Point**—A location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas.
- **Action Level**—A predetermined radionuclide concentration that, when reached, requires that a specific, predefined set of follow up protocols go into effect, which may include re-analysis of the original sample, collection of additional bioassay samples, and dose assessments.
- **Acute Exposure**—The uptake of a relatively large amount of radioactive material (or exposure to large amounts of ionizing radiation) over a short period of time.
- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Alpha Contamination**—The presence of radionuclides that emit alpha particles (He-$4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.
- **Alpha Radiation ($\alpha$)**—Alpha particles (He-4++) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.
- **Annual Limit on Intake (ALI)**— The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.
- **Anti Contamination Clothing (Anti-Cs)**—Personal Protective Equipment (PPE) worn by radiation workers to prevent the contamination of the worker's skin or clothing when working in contaminated areas.
- **Authorized License Users**—Individuals who, by virtue of training and/or experience, have been authorized by the RSO to use or directly supervise the use of radioactive materials under the requirements of USNRC Service License.
- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from

the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ‘‘Background radiation’’ does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination—**The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Beta Radiation (β)—**Beta particles (e-) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Bioassay—**The measurement, or assay, of kinds, quantities or concentrations and in some cases, the locations of radioactive materials within an individual worker. Bioassay is generally determined by in vitro methods, such as urine analysis, sampling of other body fluids (such as blood), tissue analysis, or by fecal sample. Bioassay may also be performed by direct (in vivo) measurement using specialized radiation detection equipment.

- **Calibration—**The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Contamination—**The deposition of unwanted radioactive material on surfaces or in media.

- **Contamination Areas (CA)—**Areas where surface contamination exceeds the established limits, areas where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in excess of the limits.

- **Controlled Materials—**Any licensable radioactive material controlled by Shaw at a project location under NRC license.

- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Decay Chain—**A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.

- **Declared Pregnant Woman—**A woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

- **Decontamination—**The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Derived Air Concentration (DAC)—**The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.
- **Derived Air Concentration hours (DAC-hours)—**The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).
- **Direct Measurement—**A reading taken using a portable instrument directly on a surface or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed location measurements and scans.
- **Dosimetry—**The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.
- **Exposure—**Being exposed to ionizing radiation or to radioactive material.
- **External Dose—** That portion of the dose equivalent received from radiation sources outside the body.
- **Fixed Location Measurements**—Direct measurements performed by placing a detector at a fixed location on, or near, the surface being evaluated.
- **Frisking**—The process of searching a person’s clothing or body with a radiation detection instrument prior to releasing the person from a radiologically controlled area.
- **Gamma Radiation (γ)—**High energy, short wavelength photons emitted from radionuclides while undergoing decay, or by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.
- **Guideline Values**—A predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.
- **High Radiation Area—**An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.
- **Intake (or Uptake)**—Radionuclides entering the body by any exposure pathway, primarily inhalation, absorption, or ingestion means.

- **Inventory—**Licensable radioactive materials that are in the position of Shaw (company-wide) prior to the beginning of a project and materials controlled by Shaw (company-wide) during the course of a project.

- **Investigation Level—**The level of exposure above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.

- **In Vitro—**"In the glass." For the purposes of an internal dosimetry program, in vitro bioassay measurements are performed by analysis of bodily fluids or tissues removed from the body and analyzed in a laboratory environment.

- **In Vivo—**"In the living body." For the purposes of an internal dosimetry program, in vivo bioassay measurements are performed by measuring radionuclide body burden within the body using specialized detection instrumentation and monitoring techniques.

- **Ionizing Radiation—**Alpha ($\alpha$) particles, beta ($\beta$) particles, gamma ($\gamma$) rays, neutrons (n), energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Licensed Material—**Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under NRC license number 10-25362-01.

- **Minimum Detectable Concentration (MDC)—**The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity.

- **Monitoring** -The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

- **Neutron Radiation (n)—**An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.

- **License Radiation Safety Officer (License RSO)—**An individual who, by virtue of education, certifications, or experience, is qualified to provide planning for, and oversee the proper implementation of, radiological controls measures for work activities involving the potential for exposure to ionizing radiation and has been approved by the NRC and is named in the license.

- **Quality Factor—**A unitless number assigned to a particular type (and energy) or radiation in producing biological effect. Quality factors are used to derive equivalent dose from absorbed dose. Gamma, X-ray, and Beta radiation are assigned a quality factor of 1. Alpha and Neutron radiation have quality factors between 2 and 20.

- **Radiation Area**—An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **RadCon**—An abbreviation for Radiological Controls.

- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians. The Project RSO is qualified as an "authorized user" by the License RSO.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Radiologically Controlled Area (RCA)**—Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.

- **Rem**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor.

- **Restricted Area**— An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

- **Roentgen**—A unit of exposure equal to the amount of gamma or X-rays required to produce 1 electrostatic unit (esu) of charge in 1 cc of dry air at standard temperature and pressure.

- **Scanning**—A type of direct measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.

- **Self-Reading Dosimeter (SRD)**—A radiation-monitoring device used to provide a direct readout of gamma and/or x-ray exposure.

- **Smear Sampling**—A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally 100 $cm^2$.

- **Stay Time—**Allowable dose (measured in mRem) divided by radiation level (measured in mRem/hr).
- **Survey—** An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.
- **Thermoluminescent Dosimeter (TLD)—**Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.
- **Total Contamination—**Radioactive material, including both the fixed and removable contamination fractions, found on, or as a part of, an item or surface.
- **Transferable, Removable, or Loose Contamination—**Radioactive material that can be easily removed from a surface or item.
- **Transient Shielding—**Any form of shielding that is used temporarily.
- **Very High Radiation Area—**An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.
- **Whole Body –** For purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.
- **Whole Body Counting—**An estimate of the amounts of internal contamination by a gamma-emitting nuclide obtained by counting the gamma rays emitted from the body and analyzing the pulse-height spectrum. This technique can also be used to measure the bremsstrahlung from energetic beta emitters.
- **Working Level (WL)—**Any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of 1.3 x $10^5$ MeV of potential alpha particle energy.
- **X-ray Radiation—**High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and pose a substantial external radiation hazard.

# 5. RESPONSIBILITIES

## 5.1 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License Users/Project RSO
- Maintain all required license records at the location specified on the license

## 5.2 Shaw E & I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

## 5.3 Project Managers

Project Managers are responsible to identify any radiological safety issues associated with projects under their cognizance. Further, Project Managers are responsible for ensuring that appropriate radiological controls are established on projects under their cognizance in order to ensure the protection of workers, the general public, and the environment and to maintain exposures to ionizing radiation As Low As Reasonably Achievable (ALARA).

## 5.4 Project Radiation Safety Officer

The Project RSO is designated by the License RSO as an Authorized User and is responsible to understand, implement, and properly document the performance of the Site Specific Radiation Protection Plan at a project location, as established by the License Radiation Safety Officer. The Project RSO shall report to the License RSO, on radiological matters. Further responsibilities include the following:

- The Project RSO shall be familiar with the procedures and Federal/State Regulations listed in Section 3.0 and all applicable Radioactive Material Licenses prior to beginning a project. Copies of these documents should be available at the job site.
- The Project RSO is responsible for issuing and reporting personnel dosimetry for projects as specified in Shaw E & I Procedure T-RA-008, *External Dosimetry Administration* and Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans. The Project RSO is also responsible for ensuring that personnel dosimetry is properly worn for the duration of each project.

- The Project RSO is responsible for developing site-specific radiological controls procedures or work instructions, as required, in accordance with all applicable Shaw radiological controls procedures.
- The Project RSO is responsible for maintaining project radiological records in the project file throughout the duration of the project and in the permanent project file.

### 5.5 Radiological Controls Technicians

Radiological Controls Technicians (RCTs) are responsible to understand and use procedures, instructions, and/or plans established by the License RSO or Project RSO. They shall conduct and document all radiological operations in accordance with this procedure and with the procedures referenced within. They shall also provide immediate oversight, guidance, and enforcement of the radiological control program to ensure that all operations are radiologically safe and exposures are maintained ALARA.

### 5.6 Site Radiation Workers

Site Radiation Workers are responsible to comply with all radiological controls procedures, including postings and verbal instructions from radiological controls personnel, that are applicable to their assigned work activities. Site Radiation Workers will receive training on all radiological control requirements and procedures prior to working in radiologically controlled areas.

## 6. PROCEDURE

### 6.1 Requirements

The following sections present the general requirements for conducting work with potential for exposure to ionizing radiation. Each project will have a Site Specific RPP which addresses the specific controls appropriate for the conditions existing at that site. All Projects with Site Specific RPP shall be reviewed annually to ensure compliance with the terms of the License and NRC and DOT regulations as applicable. The review shall ensure that occupational doses and doses to members of the public are ALARA. Records of audits and other reviews of program content are maintained for at least three years from the date of the record.

#### 6.1.1 Prerequisites

The following prerequisite requirements will be performed prior to conducting radiological work:

- An appropriate project-specific radiation protection plan (RPP), consistent with the identified radiological hazards, and in compliance with this document and Shaw Health and Safety Procedure HS700 Policy *and Guidance for Developing Radiation Protection Plans*, will be developed and approved by the License RSO prior to conducting radiological work.

- Permanent and temporary Shaw personnel and contractors shall be trained in radiation safety in accordance with Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification*, prior to beginning radiation work.

### 6.1.2 Tools, Materials, and Equipment

Radiological instruments in sufficient quantities to adequately perform the monitoring required by this procedure shall be available on the job site prior to the start of work.

### 6.1.3 Calibration and Maintenance of Radiation Detection Instruments

This section provides the minimum calibration and maintenance requirements for radiation detection instruments. Only instruments with a current calibration label shall be used for conducting surveys. Instruments suspected of providing incorrect measurements shall be removed from service and tagged pending a satisfactory response check. The Project RSO shall be notified of suspect instruments.

The requirements for instrument set up and checks are found in Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*. When this procedure is used, a current copy of Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*, shall be available. Only personnel trained in the use of portable radiation monitoring equipment shall be allowed to use this equipment.

### 6.1.4 Radioactive Check Source Handling

The following safety precautions should be observed by personnel working in radiological areas using radiation detection equipment:

- Damage to or loss of a radioactive source may result in the spreading, inhaling, or ingesting of contamination. If a source is lost, notify the Project RSO. Immediate steps should be taken to recover the source and minimize radiation exposure to or contamination of personnel as a result of the lost source.
- To prevent sources from being lost, all sources should be held under signature custody. These procedures are in addition to and do not supersede the accountability requirements for sources controlled under the Nuclear Regulatory Commission or Agreement State Licenses.
- Except for sources that are permanently attached to detection instruments (e.g., check sources), sources shall be kept in a locked cabinet when not in use. The number of keys to the cabinet and the number of personnel having access to the keys should be kept at a minimum.

## 6.2 Radiological Controls Requirements

This procedure provides methods for ensuring that satisfactory controls are in place to minimize personnel radiation exposure and to properly manage radioactive contamination at all times.

### 6.2.1 Related Instructions

This procedure has been developed to provide guidance for compliance with Shaw radiological controls policies, including Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans.

### 6.2.2 Implementation of Radiological Control Procedures

Radiological controls are required by Shaw in areas where radioactive materials are handled or stored, in areas traversed by potentially contaminated personnel and materials, and in other areas where radiological work is performed.

The radiological controls requirements of this procedure, and referenced Shaw procedures, include the following:

- Control of external radiation exposure to personnel by means of personnel monitoring, area monitoring, installed shielding, and planning and execution of radiological work
- Control of internal radiation exposure to personnel by monitoring for contamination in air and on surfaces, by using anti-contamination clothing and respiratory protective equipment, and by controlling contaminated areas
- Control of radioactive wastes by means of specified procedures
- Decontamination
- Instructions for receiving, transferring, storing, shipping, and accounting for radioactive materials

The instructions in subsequent sections are those required to ensure radiological safety under most situations. In unusual situations, personnel are expected to perform additional measurements and take other additional precautions as deemed necessary to provide adequate protection.

### 6.2.3 Radiological Control Training Requirements

Periodic radiological control training is necessary to ensure that all personnel understand the general and specific radiological aspects that they might encounter, understand their responsibilities to their employer and to the public for safe handling of radioactive materials, and understand their responsibilities for minimizing their own exposures to radiation.

The appropriate degree of training for each individual (Shaw employees and Shaw subcontractors) necessary for an individual project shall be determined by the requirements of the radioactive material license and Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification*. Personnel need to be trained in the appropriate categories discussed in the following sections.

The Project RSO shall ensure that the training requirements of this Section are implemented. Personnel designated to verify practical abilities, conduct classroom and practical training, and conduct oral examinations shall be designated in writing by the License RSO.

#### 6.2.3.1 Radiation Workers

Radiation workers include personnel authorized to receive radiation exposure in the course of their work.

Personnel who routinely require access to or work in RCAs shall have met the Radiation Worker Training Standard in Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification,* prior to being issued dosimetry equipment. Other personnel issued dosimetry, but who have not completed this training, shall be escorted by a qualified individual when in radiological areas.

Radiation Worker Training shall be verified by written examination(s), which includes questions concerning areas of required knowledge and questions concerning actions required by the individual in event of an unusual radiological control situation (e.g., puncture of a contamination containment area). Knowledge, understanding, and practical abilities shall be verified by the signature of a designated individual in accordance with Shaw E & I Procedure, T-RA-002, *Radiological Controls Training & Qualification*.

#### 6.2.3.2 Radiological Controls Technicians

Qualified radiological controls technicians shall have met the Radiological Control Technician Training Standard in accordance with Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification,* and shall be able to apply this knowledge to situations they might encounter during work.

#### 6.2.3.3 Visitors/Contract Workers

Management, technical, and other personnel who require occasional access to RCAs and areas where radioactive materials are stored and who enter these areas for observation or similar purposes, or to perform work not involving radioactive materials, shall have the radiological control training necessary for the radiological conditions expected to be encountered or shall be escorted by appropriately qualified personnel at all times. A continuous escort is not required if the visitor/contract worker is in continuous view of qualified personnel. The presence of personnel normally assigned to these areas fulfills this function. The Project RSO shall determine the training requirements and shall record the decision. Dosimetry shall be provided in accordance with Shaw E & I Procedure T-RA-008, *External Dosimetry Administration,* and Section 6.3 of this document.

### 6.2.4 Records and Certification of Training

Personnel training records shall be maintained in the on-site project file throughout the duration of the project.

Certification of radiological control training for all personnel shall be accomplished annually for continuous qualification as a Radiation Worker in accordance with Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification*.

Certification of training as a Radiation Worker shall include a comprehensive written examination. Personnel shall also demonstrate that they have retained the practical abilities needed to perform their specific jobs.

### 6.2.5 Instruction on Radiation Exposure to the Unborn Child

Prior to being issued dosimetry equipment, all personnel authorized to receive radiation exposure, all supervisors, and all females authorized to receive radiation exposure as visitors shall be given specific instruction about prenatal exposure risks to the developing embryo and fetus. This instruction shall include both verbal and applicable written information found in the appendix to U.S. Nuclear Regulatory Commission, Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." Instruction concerning prenatal exposure to the unborn child shall be given during initial and re-verification training. All personnel receiving instruction in accordance with this section shall sign the "Instruction on Radiation Exposure to the Unborn Child Acknowledgement Form" prior to being issued dosimetry.

This form shall be maintained by the Project RSO with the dosimetry records in accordance with Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*. Statements signed by visitors shall be retained for three years following project completion.

### 6.2.6 Radiological Incident/Investigation Reports

Instructions for incident reporting and incident investigation are located in Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. These instructions describe the circumstances and reporting requirements for incidence and occurrences.

Where applicable, site-specific procedures may be developed to meet further requirements specific to a field project.

Shaw recognizes that many situations arise that may not be considered an incident and do not require further reporting, but that these situations can be precursors to future incidents and accidents. All employees are encouraged to report unsafe acts or conditions on the appropriate form in Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. This reporting provides the documentation and informs management of situations that may be fixed prior to becoming more serious.

## 6.3 Radiation Exposure Limits and Exposure Monitoring

Exposure limits are established to control personnel exposure to ionizing radiation. Federal and state Regulations outline the maximum exposures that a person may receive. These radiation protection regulations stress maintaining personnel exposures As Low As Reasonably Achievable (ALARA).

### 6.3.1 Administrative Exposure Limits

Shaw has established administrative exposure limits that maintain exposure below the federal and state limits. General control procedures and exposure limits for personnel working on Shaw projects are found in Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*. During a field project, a current copy of Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*, shall be available.

Visitors/Contract workers shall not be allowed to receive exposures in excess of 100 mrem per calendar year unless they are fully trained as radiation workers per Section 6.2.4.

### 6.3.2 Radiation Exposure Limits for the Unborn Child

During the entire gestation period, the maximum permissible dose equivalent to a fetus from occupational exposure for a declared pregnant worker shall not exceed 0.5 rem for the entire gestation period.

Training shall be provided to all workers in accordance with section 6.2.2 of this document. .

### 6.3.3 Radiation Exposure to the Public

The Project RSO shall ensure the following with respect to Shaw operations:

- No member of the public receives a total effective dose equivalent in one year exceeding 0.1 rem.
- Radiation levels in unrestricted areas do not cause an individual continuously present in the area to receive more than 2 mrem in one hour.
- All doses to the environment and the public are consistent with Shaw ALARA policy.
- No suspected radioactive material is released outside a controlled area in excess of limits established in any applicable regulatory guidance.

### 6.3.4 Radiation Exposure Monitoring

The monitoring of personnel radiation exposure for all Shaw activities is controlled by Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*, Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*, and Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans, which provide the procedures for the issue, processing, and recording of personnel radiation exposures of all personnel working on projects.

Personnel dosimetry requirements for each project shall be determined and approved by the License RSO prior to work activities involving the potential for radiation exposure.

Individuals shall not enter any radiologically controlled area without required personnel dosimetry. Individuals other than visitors or contract workers shall not be issued dosimeters unless a record of the individual's current annual exposure is obtained.

### 6.3.5 External Dosimetry

Dosimetry shall be worn on the area of the body expected to receive the highest radiation dose; under most circumstances, this area shall be the frontal area of the chest or waist. When the location of the body that shall receive the maximum dose is not certain, additional dosimeters may be worn; radiological control personnel shall specify the location of these additional dosimeters. When exposure to extremities (hands and forearms below the elbow, feet and legs below the knees) is expected, or the exposure has the potential to exceed 25 percent of the administrative limits of Section 6.3.1, additional dosimetry shall be worn on the exposed extremity or forearm. Whenever additional dosimeters are worn, results of processing for all dosimeters shall be included in the individual's personnel exposure records. Care shall be taken to ensure separate recording of exposures for extremities or forearms and for the whole body radiation exposure.

In situations where beta radiation is significant, the lens of the eye shall receive special consideration. Personnel shall be shielded from the beta radiation by using masks, eye protection, and/or anti-contamination clothing. If the beta radiation cannot be shielded, methods for controlling beta radiation exposure shall be evaluated and implemented to control exposures to established limits for skin exposures.

Lost dosimetric devices shall be reported as specified in Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*, and Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans.

Personnel dosimetry data for an individual will be made available to authorized requestors and to the individual upon written request through the Shaw Health and Safety Department. This information will also be readily available on the project site to enable individuals to keep track of their own exposures.

### 6.3.6 Self-Reading Dosimeters (SRDs)

SRDs shall be worn to monitor radiation exposure accumulated between readouts of other dosimetric devices, such as TLDs. SRDs shall be worn in accordance with the applicable Radiation Work Permit (RWP). The following requirements apply to SRD use:

- All personnel entering a high radiation area or in radiation areas where they could receive a dose in excess of 15 mrem in one day shall be monitored by a SRD worn at the same location on the body as the their primary dosimeter. The above requirement does not preclude the use of SRDs for other exposure monitoring.
- An individual reaching 80% of the appropriate administrative limit of Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*, shall be placed on an Alert List and shall wear an SRD. The Project RSO shall closely monitor the exposure of individuals on the alert list to prevent administrative limits from being exceeded.
- Additional SRDs are required if the location of the maximum dose on the body is not certain, as is discussed in Section 6.3.5 above.

The Project RSO shall maintain a log of all SRD results obtained between routine TLD readouts. Before the SRD is re-zeroed, the measured radiation exposure is recorded. The individual's monthly, quarterly, and/or yearly exposure totals are determined. The individual is thereby prevented from inadvertently exceeding the control levels.

SRDs, whether low or high range types, shall be read by the wearer prior to entering radiation or high radiation areas and periodically thereafter to control the wearer's own radiation exposure while in these areas.

To prevent an off-scale reading, dosimeters shall be read and recharged, and doses shall be recorded, whenever the reading exceeds three-fourths of full scale.

When a SRD reading is off-scale or a dosimeter is lost under conditions such that a high exposure is possible, the person's primary dosimeter shall be processed immediately, and the person shall be removed from the radiological area until the exposure has been determined. The Project RSO shall notify the dosimetry contractor for appropriate dosimeter processing and reporting.

SRDs in use shall be tested at least every six months to ensure accuracy. If dosimetry performance is suspected to be unacceptable due to excessive drift or fails in use, the Project RSO shall initiate action to correct the problem.

### 6.3.7 Internal Exposure Monitoring

The site-specific internal monitoring requirements shall be determined by the License RSO, or designee, prior to the commencement of any work activities that could result in internal radiation exposure. Internal Exposure Monitoring will be conducting in accordance with Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*.

Internal contamination monitoring shall be performed when personnel are or may be exposed to airborne contamination exceeding 0.3 DAC, or have the potential for intakes greater than 0.1 ALI, as defined in Code of Federal Regulations, 10 CFR Part 20 Appendix B, Table I, *Standards for Protection Against Radiation*.

Suspected intakes of radioactive materials, such as may occur when there is significant skin contamination, shall be investigated by internal monitoring.

The Project RSO shall contact the License RSO for direction if the need for internal monitoring is uncertain.

Procedures for the collection of bioassay samples shall be specified by the License RSO in accordance with Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*.

All reports of internal contamination monitoring shall be maintained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13. Copies of these reports shall be forwarded to the License RSO for evaluation, and as required by Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*, Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans, and Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

Reports of overexposure shall be performed in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review,* or Title 10, Code of Federal Regulations, Part 20, *Standards for Protection Against Radiation*,.

### 6.3.8 Exposure Records

The Project RSO shall keep records of personnel exposure and shall forward those records and data as required by Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*, and Shaw E & I Health and Safety Procedure HS700 Policy and Guidance for developing Radiation Protection Plans. Copies of all exposure records will be maintained on the project site, while original exposure reports are forwarded to the Shaw Health and Safety Department.

### 6.3.9 Visitors/Contract Workers

A record of visitor and contract worker exposures shall be maintained in the on-site project exposure files using the Visitor/Contract Worker Exposure Record Form and in accordance with Section 6.13. A report of exposure shall be provided to the individual upon written request.

## 6.4 Methods for Controlling Radiation Exposure

### 6.4.1 General Requirements

Shaw activities shall maintain personnel radiation exposure ALARA. A continuing effort is required to meet this goal by developing and implementing improvements to work procedures and work performance. Procedures for managing the ALARA Policy are found in Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*. The following general requirements are designed to assist in meeting this goal:

- In radiological work areas, work shall be performed only under the guidance of an approved procedure, work instruction, or Radiation Work Permit (RWP).
- Individual work procedures shall specify engineering controls and other applicable actions to be used to minimize radiation exposure during work. These controls/actions may include pre-work decontamination of work areas, use of ventilation to reduce airborne radioactivity, mock-up training, or removal of radioactive sources from work areas.
- Supervisory personnel and radiological control personnel shall ensure that personnel are not waiting unnecessarily in RCAs.
- Before entering an RCA, workers shall receive specific job training and/or briefings necessary to enable them to perform work with minimum radiation exposure. Examples of this training include mockup training in shops for specific jobs or periodic briefings by supervisory personnel for routine work.
- Radiation levels in high radiation areas shall be identified by the use of signs that clearly show the areas with high and low radiation levels, along with the radiation intensity, and the date of the last survey.
- Records of the cumulative radiation exposure received in performing a work task should be used, as necessary, to improve methods of work performance in order to minimize personnel radiation exposure in future similar work.

### 6.4.2 Procedures and Work Instructions

Major work in an RCA shall be performed under the guidance of a task-specific procedure or work instruction. The License RSO may determine the need for a specific approved procedure or work instruction.

Procedures or work instructions should describe the task, radiological conditions, and radiological controls.

A pre-job briefing shall be held prior to beginning work under a procedure or work instruction to ensure that all personnel understand the task, radiological conditions, and radiological controls.

### 6.4.3 Radiation Work Permits

The Radiation Work Permit (RWP) shall be used to delineate conditions and protective measures to prevent inadvertent exposure of personnel to radiation or radioactive contamination. The radiological conditions associated with the work to be performed shall be recorded on the RWP. Also specified are the protective measures required by personnel entering the designated area. The following requirements establish the proper use of the Radiological Work Permit.

The RWP shall be obtained for work operations not specifically covered by an approved procedure or work instruction that are performed in an area where any of the following conditions exist or could potentially arise:

- Airborne radioactivity resulting in greater than 2.0 DAC hours daily intake
- Surface contamination in excess of applicable project release criteria or as specified in Attachment 3 if no project limits are established.
- Radiation levels that would require posting of the area, as specified in Section 6.5.2

Whenever the need for an RWP is in question, such as when soil is to be excavated adjacent to a radiologically controlled facility, the Project RSO shall be contacted to determine if potential radiological problems may be encountered. The Project RSO shall then determine if an RWP is required.

Signs indicating the need for the RWP should be conspicuously posted at the entrances to areas were the RWP is required.

Supervisors proposing to conduct work activities within posted radiation/contamination areas are responsible for initiating the issuing of RWPs. Generally, the initiator shall be the supervisor in charge of proposed activities.

The Project RSO shall discuss the proposed work activities and work areas with the supervisor. Additionally, the Project RSO shall review previous data and determine the current radiological status of the area prior to approval and issuance of an RWP. A re-survey of the area may be necessary if radiological knowledge of the area is inadequate to complete all sections of the RWP. Any further Health Physics survey requirements shall be specified on the RWP.

A radiation dose estimate should be made based upon the work requirements submitted to the Project RSO. For work in high radiation areas, a dose budget will be prepared by work task and included with the RWP.

Prior to beginning work, the Project RSO or designee shall hold a pre-job conference with the supervisor and all personnel working under the RWP. Items discussed shall include work scope, dosimetry and protective clothing requirements, survey results, stay time limits, and emergency actions. The workers shall sign the RWP signature form to indicate that they understand the requirements. Workers added to the RWP after the initiation of work shall be briefed by the Project RSO prior to starting work and shall sign the RWP signature form.

Those personnel entering an area under the direction of an RWP shall indicate by their counter-signature, on the RWP signature form, that they are aware of the instructions and conditions of the RWP and that they have received and understood the necessary briefing.

If, during operations under valid RWPs, the radiological conditions change, the scope of work is changed, or the scope of work is expected to change, another RWP shall be required and a pre-job conference shall be held.

The Project RSO shall determine the degree of monitoring required for a specific operation. This determination should be based on the potential for radiological problems and the experience of the personnel conducting the operation.

An RWP shall terminate seven calendar days following its initiation. If the work is to be continued, a new RWP shall be initiated. Long term RWPs may be used in specific situations with the written approval of the License RSO.

The Project RSO (or designee) shall maintain an indexed project RWP log. Records in the RWP log index shall include RWP no., date of issuance, date of termination, and reason for the RWP (work scope).

The Project RSO (or designee) shall ensure that all RWPs are terminated and collected upon their expiration, and shall maintain copies of all terminated RWPs in the on-site project file throughout the duration of the project and in accordance with Shaw E & I Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans, and Section 6.13 of this document.

The RWP may be used to detail chemical hazards and industrial hygiene hazards and requirements. The Project RSO shall review these requirements with Shaw E & I Health and Safety personnel. If the RWP is used for this purpose, the RWP supplement form will be prepared and utilized as follows:

- If industrial hygiene or occupational health hazards are identified, the RWP Supplement Form may be used to identify the hazards. This form is not intended to be a substitute for existing forms or procedures that provide better information and protection.
- When the RWP Supplement Form is used, it shall be attached to the RWP and kept with the RWP.

- The information in the RWP Supplement form shall be covered in the briefing associated with the RWP.
- On the RWP Supplement Form, place the RWP number with which it is associated.

### 6.4.4 Access Control Point

An access control point is a location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas. The dimensions and material requirements depend on the type of work to be performed, the number of personnel involved, and the location of the work. Shaw E & I Procedure T-RA-010, *Radiological Site Controls*, and the following items outline the basic considerations for establishing an access control point:

- Determine the extent of the area to be isolated and the location where entry and exit shall be controlled.
- Plan for physical boundaries to prevent inadvertent or unauthorized access to the contaminated area. Boundaries shall be conspicuously marked and posted. Existing walls and equipment may effectively be used as boundaries.
- Cover the floor of the contamination control point using paper or plastic sheet or other material provided for this purpose. The intent is to provide an easily removable walking surface within the contamination control point to prevent tracking of contamination from the area. Maintain a supply of the material to replace floor covering as necessary.
- Provide a "step-off pad" at the exit from the contamination control point. This pad is to be used when removing clothing during exit from the area.
- Provide easily accessible receptacles for radioactive waste and contaminated clothing, respirators, and equipment at the contamination control point. A supply of plastic bags shall be available as necessary for receiving contaminated equipment and tools. Radiation tags or labels shall be available to identify contaminated items being removed from the area.
- Provide radiation detection instruments for monitoring personnel and equipment. Frisking should be performed in a low radiation background and where the audible response of the frisker can be heard.
- Provide a means for recording stay times, as may be required, at the entrance of the areas for personnel. It may be necessary to provide a record of previous radiation exposure received by personnel entering an RCA so that maximum allowable time in the RCA can be determined.
- At the entrance to the access control point, information shall be posted concerning radiation and contamination conditions, precautions for entry, precautions for exit, step-off points, clothing and waste receptacles, and personnel monitoring. A copy of the applicable RWP shall be posted at the access control point.

- Radiological control personnel shall maintain the control point. The Project RSO shall assign a qualified person to the control point to ensure that personnel and equipment are adequately monitored prior to leaving the area and that all logging requirements of Shaw E & I Procedure T-RA-010, *Radiological Site Controls*, are met.
- In some instances where high-level contamination exists, it may be necessary to wear two sets of anti-contamination clothing. The outer garments should be removed at a designated location close to the contaminated work to minimize tracking of contamination to the access control point.
- Adequately trained personnel may be permitted to assist in frisking other personnel and themselves.
- Contaminated individuals shall be processed in accordance with Section 6.10.4.

### 6.4.5 Transient Shielding

Since incorrect installation, unauthorized movement, or removal of temporary shielding can result in large changes in work area radiation levels, control of transient shielding is essential. The following requirements will be adhered to when utilizing temporary or transient shielding:

- Transient shielding installation and removal should be controlled by written instructions. These instructions shall specify locations and amounts of transient shielding.
- After installation, transient shielding shall be inspected to ensure that it is properly located.
- Periodic radiation surveys conducted in accordance with Section 6.5.1 shall be reviewed by the Project RSO or radiological engineer to ensure that shielding maintains its effectiveness in reducing radiation dose rates. In reviewing these surveys, particular attention shall be paid to components that had radiation levels greater than 1 rem/h prior to shielding, since personnel could receive high radiation exposure in a short time if the shielding loses its effectiveness.
- Lead shielding shall not be used in radioactively contaminated areas or in association with radioactively contaminated materials without prior approval of the Shaw Project Manager or designee.

## 6.5 Radiation Survey and Posting Requirements

### 6.5.1 Radiation Surveys

Radiation surveys are performed as necessary to ensure that personnel do not exceed radiation exposure limits and to meet requirements for posting of radiation areas. These surveys are performed to determine whether abnormal radiation levels exist and to determine the extent and magnitude of radiation levels. The surveys in this section shall be the minimum performed. Surveys are to be performed and documented as stated in this section and Shaw E & I Procedure T-RA-009, *Radiation Exposure Rate Monitoring*.

Generally, radiation exposure surveys are required within the following periodicities:

- Radiation surveys shall be performed whenever operations are performed that might be expected to change existing radiation levels. Examples of such operations include movement or removal of shielding, processing of radioactive waste, and relocation of radioactive materials.

- Temporary boundaries (e.g., rope boundaries) of radiation areas shall be surveyed daily to ensure that radiation areas do not extend beyond posted boundaries.

- Gamma monitoring shall be performed at least weekly in occupied posted radiation areas and in radioactive material short-term storage areas. Long-term storage areas should be monitored at least monthly.

- When highly radioactive equipment (with a radiation level at 30 cm greater than 100 mrem/hr) is moved, gamma monitoring should be performed in spaces surrounding work areas (including the spaces above and below them, if applicable) where personnel are likely to be exposed to radiation.

- Potentially contaminated ducts, piping, and hoses outside radiological controlled areas shall be monitored at least monthly for gamma radiation when in use or at least annually when not in use (e.g., deactivated systems).

- Surveys of ventilation filters shall be performed whenever work is performed on these filters.

- Other surveys should be performed as necessary to control personnel exposure to gamma, beta, and alpha radiation. Such surveys should include the following: (1) a gamma monitoring during initial entry into a tank containing potentially radioactive piping; (2) gamma monitoring in spaces where significant radiation levels might exist from an adjacent operating facility; (3) beta as well as gamma measurements when personnel might come in contact with surfaces exposed to beta-emitting contamination (use of open-window G-M detectors is acceptable).

- Surveys shall be conducted when performing operations that could result in personnel being exposed to small, intense beams of radiation. These operations include working with spent fuel handling containers, removing shielding, or opening shipping/storage containers of radioactive equipment. When surveying areas or equipment where small, intense beams of radiation could be present, the instrument should be equipped with a means for producing an audible response (e.g., earphones). An audible response is necessary since the visible meter response is usually considerably slower. The probe should be moved slowly enough so that the instrument has a chance to give an audible increase for a large radiation level increase. If an audible increase is noted, the probe should be moved to the location producing maximum response, and the meter should be read. If general dose rates are sufficiently high such that a change in audible response is not detectable, slower monitoring rates should be used so that beams are detectable by observing the meter. The probe is moved at a speed that is determined by considering the size of the probe, the instrument response time, the possible intensity of the beam, and the general dose rates in the area. Particular attention shall be given to thoroughly scanning suspected areas such as portable shield sections and areas that are or are likely to be occupied. For equipment with complex shield design, surveyors and workers should be briefed on the equipment design so that areas most likely to have small beams can be given special attention.

- Gamma radiation surveys shall be performed monthly on a revolving basis in the areas of the work site where radioactive materials are not stored or handled. The survey should consist of a visual inspection and scans of accessible areas and lockers with either a G-M dose rate meter or a portable gamma scintillation meter (if available).

### 6.5.2 Posting of Radiation Areas

Specified below are requirements for the posting of areas where radiation or the potential for radiation may exist:

- *Radiation Area.* Any area within a controlled area accessible to personnel in which radiation exists at such levels that a major portion of the body could receive a dose equivalent greater than 5 mrem (50 microsieverts) in one (1) hour at 30 cm from the radiation source or from any surface through which the radiation penetrates shall be designated as a radiation area. To mark such areas, signs shall be conspicuously posted; signs shall contain the conventional magenta three-blade symbol on yellow background and the words "CAUTION RADIATION AREA"; signs are permitted to state the general area radiation level. In addition, "DOSIMETRY BADGE REQUIRED" shall be posted. No loitering is allowed in these areas.

- *High Radiation Areas.* Any area within a controlled area, accessible to personnel where a major portion of the body could receive a dose equivalent greater than 100 mrem (0.001 sievert) in one (1) hour at 30 cm from the radiation source or from any surface through which the radiation penetrates shall be designated as a high radiation area. Major portions of the body include any portion of the head and trunk. Such areas shall be posted and locked or guarded. The requirement to lock or guard a posted high radiation area does not apply to tanks or voids posted as high radiation areas if entry requires the removal of complex closures. Positive control shall be established for each individual entry into a high radiation area and shall be established in such a way that no individual is prevented from leaving the high radiation area. Prior to locking an unoccupied high radiation area, the area shall be inspected to ensure that no personnel remain inside. No loitering or entry by unauthorized personnel shall be allowed in these spaces. High radiation areas shall be conspicuously posted at all entrances into the area. Signs shall contain the conventional magenta three-blade symbol on yellow background and the words "CAUTION: HIGH RADIATION AREA." In addition, "CONTACT Project RSO PRIOR TO ENTRY" shall be posted. Instances in which high radiation areas are not controlled in accordance with the requirements of this section (e.g., locking personnel in a high radiation area or failure to lock or guard a high radiation area), shall be reported to the License RSO in accordance with Shaw E & I I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

- *Very High Radiation Areas/Exclusion Areas.* Any area within controlled areas, where access would result in personnel receiving an absorbed dose in excess of 500 rads (5 grays) in one (1) hour at 1 meter from the radiation source or from any surface through which the radiation penetrates shall be designated a very high radiation area. These areas shall be designated as Exclusion Areas, and personnel access shall be strictly controlled. Areas where general area radiation levels exceed one (1) R/hour shall be operated using an approved written work instruction. Posting of Very High Radiation Areas and/or Exclusion Areas shall at a minimum require the conventional magenta three-blade symbol on yellow background and the words "GRAVE DANGER: VERY HIGH RADIATION AREA." In addition, "CONTACT Project RSO PRIOR TO ENTRY" shall be posted. Instances in which very high radiation areas are not controlled in accordance with the requirements of this section (e.g., locking personnel in a very high radiation area or failure to lock or guard a very high radiation area) shall be reported to the License RSO in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

## 6.6 Limits and Procedures for Controlling Airborne Radioactivity

### 6.6.1 General

The basic criterion for airborne radioactivity is that internal radiation exposure resulting from inhalation of airborne radioactivity should be minimized. Levels of internal exposure to airborne radioactivity are measured in units of DAC-hours (Derived Air Concentration multiplied by hours of exposure).

Radioactivity in the form of airborne particulate, gases, or both can become airborne through sources such as the following:

- Radioactive system leaks
- Grinding or welding a contaminated component
- Decontamination operations
- Disturbing surface contamination in a work area
- Improper use of containment enclosures
- Inadequate vacuum cleaner and ventilation system control
- Inadequate application of procedures for venting and draining radioactive systems or components
- Damage or defect in radioactive instrumentation calibration and check sources
- Radon from radium sources and from trace amounts of natural radium impurities in construction materials

The Project RSO shall provide the continuous or periodic sampling required to detect and evaluate the levels of airborne radioactivity in work areas and exhaust air systems in accordance with Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

It should be noted that this monitoring is primarily concerned with the control of particulate airborne activity. For operations or materials that may result in the discharge of gaseous airborne activity, contact the License RSO for specific guidance.

### 6.6.2 Limits for Airborne Radioactivity

The Shaw E & I administrative limit for occupational exposure to airborne radioactivity is 2.0 DAC hours per day. The DACs are found in Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1, "Air Concentration Limits." Site-specific limits for occupational exposure to airborne radioactivity shall be determined during the project ALARA briefing (Shaw E & I Procedure T-RA-011, *USNRC License Implementation Procedure*).

Shaw operations should be controlled so that personnel are <u>not</u> exposed to airborne radioactivity levels that would require the use of respiratory protection equipment.

Any measurement that indicates the airborne radioactivity concentration to be in excess of 0.3 of the applicable DAC shall be investigated to determine the cause of the airborne radioactivity levels. Appropriate controls shall be implemented to maintain the airborne radioactivity levels ALARA.

### 6.6.3 Controlling Personnel Exposure to Airborne Radioactivity

Personnel exposure to airborne radioactivity is controlled using contamination containments and respiratory equipment as required below and in accordance with Shaw Health and Safety Procedure HS601, *Respiratory Protection Program*. In addition, many organizations have required the use of respiratory equipment for work in areas with high levels of surface contamination (e.g., 50,000 dpm/100 $cm^2$) because of the likelihood that this surface contamination could become airborne. In some circumstances, respiratory equipment might be necessary for work in areas where surface contamination exists at lower levels.

The following sections include discussion of the requirements associated with controlling personnel exposure to airborne radioactivity:

- Contamination containments shall be used to the maximum extent practicable to prevent personnel from being exposed to airborne radioactivity above the limits of Section 6.6.2. These containments are recommended during radiological work that has been known to cause or is expected to cause airborne radioactivity..
- The need for personnel to wear respiratory equipment in accordance with Section 6.6.7 and Shaw Health and Safety Procedure HS601, *Respiratory Protection Program,* in areas where airborne radioactivity exceeds the applicable limits of Section 6.6.2 shall be evaluated and documented prior to area entry. The evaluation shall include an assessment of the effects of respiratory equipment use on external dose due to decreased worker productivity.
- Personnel shall not be exposed to airborne radioactivity such that their daily intake exceeds 2 DAC-hour without prior approval of the License RSO.

- Signs shall be posted at entrances to areas where airborne radioactivity levels exceed or have the potential to exceed 30% of the DAC. These signs shall contain the conventional three blade magenta symbol on yellow background and the words "CAUTION: AIRBORNE RADIOACTIVITY AREA." The requirements to wear respiratory equipment shall also be included on a sign with the anti-contamination clothing requirements.

- When personnel not wearing respiratory equipment may be exposed to airborne radioactivity above the limits of Section 6.6.2, a ventilation system should be operated, which shall remove airborne particulate radioactivity to a controlled ventilation system or other system with a high efficiency particulate air (HEPA) filter. For example, during such operations as machining contaminated surfaces, vacuum cleaners fitted with HEPA filters or flexible ducts connected to a filtered ventilation exhaust shall provide suction from within about one foot of the work area. Experience has shown that some operations within containments, such as grinding on highly contaminated components, require exhausting the containment through a ventilation system with an installed high efficiency filter to prevent high airborne radioactivity outside the containment. Exceptions to this requirement are permitted with approval of the Project RSO or designee when use of a ventilation system shall cause the spread of radioactive contamination.

- HEPA filters shall be installed in the ventilation exhaust from radioactive work areas in which work in progress could cause the discharge of airborne radioactivity to the environment.

- HEPA filters shall be installed in the exhaust from contamination containments to prevent personnel from being exposed to high airborne radioactivity.

- HEPA filters shall be installed in vacuum cleaners used around loose surface contamination.

- Monitoring for airborne radioactivity shall be performed in accordance with Section 6.6.5 and Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

- Positive pressure breathing apparatus, air supply masks, or hoods shall be worn when airborne particulate activity exceeds 50 times the DAC limit of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1.

Personnel shall not enter areas where the airborne particulate activity level exceeds 1000 times the limit of DAC of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1, without License RSO approval. This restriction applies even to personnel wearing self-contained breathing apparatus or air supply respirators. If personnel entry is required to these areas, containment or filtered room ventilation shall be used to reduce airborne radioactivity levels to below 1000 times the DAC of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1.

Respirators shall be selected such that the ratio of the Protection Factor from Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation,* to the airborne level (in DACs) does not exceed 1.

### 6.6.4 High Airborne Radioactivity

High airborne particulate radioactivity associated with Shaw operations can result from many causes. It can be indicated by a continuous air monitor (CAM), by a portable air sample exceeding the applicable limit of Section 6.6.2, or by an indication of a radioactive system leak or rupture. General procedures for controlling personnel exposure to airborne radioactivity are contained in Section 6.6.3.

The procedures in this section shall be followed for controlling high airborne radioactivity when particulate radioactivity is above the limits of Section 6.6.2 in occupied areas.

#### 6.6.4.1 Immediate Actions

These actions should be performed nearly simultaneously; however, the steps below should be immediately emphasized with the completion of additional steps as soon as possible (i.e., as soon as the number of radcon personnel, operating conditions, and time allows).

- Stop operations that might be causing high airborne radioactivity until adequate control of airborne radioactivity is established.
- Evacuate unessential personnel from affected areas.
- Don respiratory equipment in affected areas.
- Secure unfiltered ventilation from the affected spaces to other spaces. Secure unfiltered ventilation to the environment from affected spaces. Ventilation systems that contain high efficiency filters in exhaust ducts do not need to be secured.
- Determine the extent of the airborne radioactivity by sampling the affected area and adjacent areas using portable air samplers.
- If the high airborne radioactivity is indicated by the alarm of a CAM that is monitoring a ventilation exhaust or a work area, check the recorder chart on the CAM panel and the meter indication to determine that the CAM alarm is not the result of circuit failure or an electrical transient. If the recorder chart shows circuit failure or if the meter indication is below the alarm setting, confirm airborne radioactivity is below the limit of Section 6.6.2 by taking a portable air sample. Measure gamma radiation at the CAM to determine if the CAM alarm was caused by high radiation levels external to the CAM. If radiation levels are high, determine the source of the high levels by conducting additional monitoring and confirm airborne radioactivity is below the limit of Section 6.6.2 by taking portable air samples. Action in the subsequent steps need not be taken if the alarm was caused by high external gamma radiation levels.

#### 6.6.4.2 Supplementary Action

The subsequent actions of this procedure need not be carried out if the airborne radioactivity is confirmed to be below the limit of Section 6.6.2:

- Attempt to identify the radionuclide causing the airborne radioactivity. For example, promptly measure the sample for alpha radioactivity and determine the approximate half-life or perform gamma energy analysis.
- In order to minimize the need for respiratory equipment, and to reduce personnel exposures to airborne radioactivity, consideration shall be given to ventilating the facility with additional HEPA filtered ventilation systems. When ventilating, avoid spreading airborne radioactivity to other spaces. Periodically monitor radiation levels on ventilation filters. To minimize contamination of the ventilation system while ventilating, operate the ventilation system in accordance with applicable procedures using the minimum number of fans to achieve stable conditions in the affected spaces.
- Perform gamma monitoring of ventilation filters and ducts and measure surface contamination in the vicinity of the ventilation exhaust discharge point.
- Measure and control surface contamination in areas affected by high airborne radioactivity.
- When resuming operations, take portable air samples to verify that the cause of high airborne radioactivity is corrected.
- Monitor evacuated personnel for contamination and decontaminate as necessary. A check of personnel exposed to high particulate radioactivity for internal radioactivity uptake may be required. Nasal smears may be taken.
- Prepare a report for any occurrence involving high airborne radioactivity (above the limits of Section 6.6.2) in areas occupied by personnel not wearing respiratory equipment, in accordance with Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. This report shall include the results of monitoring personnel for internally deposited radioactivity as required.

### 6.6.5 Monitoring for Airborne Radioactivity

The system used for monitoring airborne radioactivity shall have a Minimum Detectable Concentration (MDC) not greater than 10% of the applicable DAC. Refer to Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*, for MDC calculations. Site-specific MDC requirements shall be determined during the project ALARA briefing (Shaw E & I Procedure T-RA-011, *USNRC License Implementation Procedure*).

Airborne particulate monitoring shall be performed as follows:

- Monitoring should be conducted continuously using a CAM, or at least every four hours by “grab” sample, in the following situations:
  - (1) In radiological areas when radiological work is performed
  - (2) During radiological work that has been known to cause or is expected to cause airborne radioactivity

(3) In occupied areas where removable contamination exceeds 10,000 dpm/100 $cm^2$ beta-gamma or 500 dpm/100 $cm^2$ alpha. These portable samples are not required if continuous monitoring is performed. If the installed continuous air particle detector for a ventilation exhaust is inoperative and radioactive work is being performed, portable sampling shall be performed every four hours.

- Monitoring should be conducted before initially opening systems or entering tanks or voids that contain potentially radioactive piping.
- Monitoring should be conducted whenever airborne radioactivity levels above the limit of Section 6.6.2 are suspected.
- Personnel air samplers should be used whenever air sampling indicates levels > 0.1 DAC.

Records of the above airborne radioactivity monitoring may be required to serve legal purposes and therefore shall be maintained neatly and retained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13. Documentation of airborne radioactive measurements will be in accordance with Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

Portable air particulate sampling equipment shall be immediately available to sample air during abnormal conditions that could result in significant airborne radioactivity release.

### 6.6.6 Air Sample Counting

When handling air samples collected from areas known to or suspected of containing airborne radioactivity, care should be taken to prevent the spread of contamination and cross contamination of samples taken. If significant radon daughter concentrations are expected, the samples shall be counted initially and again 24 hours later to determine the actual long-lived alpha activity.

Scaler-Counters used for counting air activity shall be set up in accordance with manufacturer's instruction and Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.

Calculate the air sample concentrations in accordance with Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

### 6.6.7 Determination of DAC-Hours

A DAC-hour is a quantity of radioactive material equal to the quantity of material that would be inhaled if an individual occupied an area containing airborne activity at a concentration of one DAC (Derived Air Concentration), as found in Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table I (air), for a period of one hour.

Before an individual enters an airborne radioactivity area, the Project RSO shall determine the individual's expected daily intake, in DAC-hours, to ensure that the limit of 2 DAC hours is not exceeded.

The airborne concentration $[A]_{DAC}$ in DAC shall be determined by dividing the measured airborne concentration [A] by the concentration that equals 1 DAC.

$$[A]_{DAC} = [A] / DAC$$

An individual's expected daily intake ($I_e$) shall be determined by multiplying the planned number of hours worked ($t_w$) in an airborne radioactivity area by the measured airborne concentration ($[A]_{DAC}$).

$$I_e = [A]_{DAC} \text{ x } t_w$$

If ($I_e$) exceeds 2, and [A] cannot be reduced, respiratory protection equipment shall be evaluated for use, or the working time shall be reduced.

The actual intake ($I_a$), of each individual entering a posted airborne radioactivity area shall be recorded in accordance with Shaw E & I Procedure T-RA-008, *External Dosimetry Administration.*

### 6.6.8 Use of Respiratory Equipment

Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, lists concentration limits for continuous exposure to airborne radioactivity for personnel occupationally exposed to radiation. Additionally, NRC regulations permit upward adjustment of these limits for exposure periods of less than 40 hours per week. When airborne radioactivity exists above the limits of Section 6.6.2, the actions of Section 6.6.4 limit allowed exposure duration to shorter periods of time.

Shaw requires the use of respiratory equipment as a supplementary control to keep personnel exposures ALARA.

Prior to the use of respiratory protection equipment, each individual shall meet the requirements described below and in Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program*.

Prior to the use of respiratory protection equipment, each individual shall be certified by a licensed physician as capable of wearing respiratory protective devices.

Prior to wearing a mask, air-fed respirator, or hood in an area where airborne radioactivity exceeds the limit of Section 6.6.2, personnel shall be trained in the use of this equipment and shall have passed a respirator fit test as described in ANSI Z88.2, *Practices for Respiratory Protection*. As part of this training, personnel should demonstrate the proper procedure for putting on and removing masks, air-fed respirators, or hoods, including conducting leak checks for masks and air-supplied respirators (See Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program*).

The Project RSO is responsible for ensuring that the above requirements are met and documented for personnel using respiratory equipment. A copy of this documentation shall be maintained by the Project RSO in the project file.

The use, cleaning, and inspection requirements for respiratory equipment shall be met in accordance with Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program*.

### 6.6.9 High Efficiency Particulate Air (HEPA) Filter Requirements

HEPA filtered systems shall be tested prior to use, following each set up, and after each filter change. Acceptance criteria is a transmission of 0.05% or less of testing medium.

Great care shall be used in installing HEPA filters to ensure that the filter material separators are in the vertical position, tight seals are made around the edges of the filters, and the filters are not damaged during installation. Minor damage can greatly reduce the efficiency of these filters.

Used filters shall be disposed of as radioactive waste since loose surface contamination could be present on interior pleats.

Instructions in manufacturers' manuals shall be followed for system use and filter change-out.

### 6.6.10 Portable Ventilation Systems

A portable ventilation system can be constructed by adapting a portable electric blower with a HEPA filter. Such a system can be used during maintenance in a high airborne radioactivity condition to reduce airborne radioactivity without contaminating installed ventilation systems.

A vacuum cleaner with an installed HEPA filter can also be used effectively to reduce airborne radioactivity in a space by recirculating the air in the space through the high efficiency filter. Such a system must also be tested prior to use.

### 6.6.11 Release of Airborne Radioactivity to the Environment

Releases of airborne radioactivity to the environment may require a U.S. Environmental Protection Agency (EPA) permit. Such releases shall be evaluated for compliance with regulatory requirements (NRC, EPA, State, etc.), and the evaluation shall be documented. All unintentional releases of airborne radioactivity will be reported in accordance with Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

## 6.7 Surface Contamination

### 6.7.1 General

Radioactive contamination of surfaces (such as floors, equipment, clothing, and/or skin) may result from work operations, leaks of radioactive fluids, or gradual precipitation of airborne radioactive contamination onto exposed surfaces. The primary reason for limiting surface contamination is to minimize possible ingestion or inhalation of radioactivity. In addition, surface contamination is limited to minimize the buildup of radioactivity in the environment. In case of very high levels of surface contamination, control of external radiation exposure from this contamination may be necessary. Surface contamination is divided into two classes in this section: (1) loose contamination can be removed from surfaces by dry swipes and may be readily dispersible; (2) fixed contamination remains on affected surfaces and is not further reduced by normal non-destructive decontamination techniques.

Swipes are usually pieces of dry filter paper, which are wiped over a surface and then measured for radioactivity. Materials that have become radioactive through exposure to neutrons are treated similarly to those with fixed contamination when performing operations (e.g., machining) that may spread radioactivity.

Contamination control procedures should be considered in planning and performing all jobs. However, the extent of the contamination control procedures used should be consistent with the amount of radioactivity being handled. The extent of site-specific contamination control procedures shall be established during the ALARA briefing required in Shaw E & I Procedure T-RA-011, *USNRC License Implementation Procedure*.

### 6.7.2 Surface Contamination Limits in Uncontrolled Areas

Limits for loose and fixed contamination shall be established prior to commencing work in potentially contaminated areas. Established limits shall be at or below any established regulatory guidance, including license limitations. In determining these limits, the License RSO will consider the following:

- The scope of work to be performed
- The nuclide most likely to be encountered
- Engineering and customer considerations
- Applicable regulatory requirements

Surface contamination levels for uncontrolled surfaces should be kept as low as possible

### 6.7.3 Contamination Areas (CAs)

Areas where surface contamination exceeds the established limits, areas where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in excess of the limits shall be designated Contamination Areas (CAs) until such areas, equipment, or materials have been adequately covered or decontaminated to meet these limits. CAs will be established and controlled as follows:

- Access to a CA shall be limited to allow only personnel in appropriate anti-contamination clothing and dosimetry to enter. Choice of appropriate anti-contamination clothing is discussed in Section 6.9.5.
- Open wounds shall be adequately protected from contamination prior to a person working in a CA. Notify the Project RSO of all open wounds prior to entering the CA.

- Entrances to CAs and potentially contaminated areas shall be posted conspicuously with signs stating the access restrictions, requirements for anti-contamination clothing and masks, levels of loose surface contamination, and radiation dose rates. These signs shall contain the conventional magenta three-blade symbol on yellow background with the words "CAUTION" or "DANGER." If the entrance to a contamination area is not at a door, barriers shall be used to mark the affected area clearly.

- Smoking, eating, drinking, and chewing shall not be permitted in CAs or potentially contaminated areas. This provision is essential to minimize the possibility of transferring contamination from the hands or other areas to the mouth. For the same reason, hands should be kept away from the face, nose, mouth, and ears when in controlled surface contamination areas.

- Where operations such as grinding or machining are being performed without containment on contaminated components or equipment, the areas of the operations shall be considered subject to the spread of loose contamination and shall be posted as a "Contamination Area."

- Where surveys for loose contamination have not been made, but contamination is suspected, the area shall be posted as a "Contamination Area" pending the results of contamination surveys.

- Levels and extent of loose surface contamination inside controlled surface contamination areas shall be limited, to control possible airborne radioactivity, to facilitate limiting the spread of contamination, to simplify subsequent decontamination, and to minimize personnel radiation exposure.

- Personnel leaving a CA shall (a) remove their anti-contamination clothing and (b) monitor or be monitored for surface contamination by "frisk" or use of a personnel contamination monitor in accordance with Section 6.9.4 of this document.

## 6.8 Controlling Surface Contamination During Operations

This section identifies controls that may be necessary to ensure proper control of radioactive contamination during operations. These controls may be applicable to CAs, buffer areas surrounding CAs, or uncontrolled areas where a potential exists for the spread of contamination. To ensure that personnel shall have the necessary training and skills in controlling contamination, additional training should be considered for personnel conducting operations such as working in glove bags or containments. Additional training should include such topics as inspecting containment, monitoring containment integrity during operations, and identifying unexpected changes in ventilation system performance or airflow.

### 6.8.1 Use of Ventilation to Control Contamination

Ventilation should be controlled, whenever practical, during operations involving radioactivity to prevent spreading the radioactive contaminants through an area or to the environment. The basic methods of controlling contamination by ventilation are by providing clean supply air into the contaminated work area and by providing filtered exhaust ventilation close to the work or from a containment enclosure erected around work areas. In containment enclosures, the exhaust ventilation flow should always exceed the supply airflow, including discharges from pneumatic tools, such that a slight negative pressure is maintained within the enclosure.

HEPA filters (and HEPA system pre-filters) are normally installed in permanent ventilation systems servicing radiological work areas. These filters may become contaminated so that handling a used filter may spread contamination. Therefore, great care should be exercised when removing used filters. Filters may require replacement because of plugging (high differential pressure), high radiation level (in some areas contamination levels may cause significant personnel radiation exposure), or lack of effectiveness in removing particulate (usually caused by damage during or prior to installation). Filters may be significantly contaminated even if they are never used for radioactive work. Contamination has been measured in high efficiency filters from natural radioactivity in the air. Contaminated used filters are normally removed into plastic bags. Contamination in the adjacent duct shall be decontaminated prior to the subsequent new filter installation.

A buildup of detectable levels of surface contamination can occur through the deposition of activity from the air without having significant levels of airborne radioactivity. Therefore, even if the air particle detector has not alarmed, ventilation exhaust ducts or ventilation system ducts from radioactive work areas should be considered potentially contaminated. When these potentially contaminated systems are opened, they should be monitored and decontaminated as practical. One method of decontamination is to use a vacuum cleaner with a HEPA filter. For similar reasons, if a portable exhaust blower is used in a contaminated space, surface contamination should be checked on surfaces exposed to the filtered exhaust of this blower.

HEPA filtered air supplies are used to exhaust air from many work areas, particularly when welding or grinding. It may be preferable to locate the filter inside the areas to minimize the amount of ducting that becomes contaminated. The exhaust shall be directed so as to prevent stirring up contamination in the area in which it is used. When removing these air supplies, flexible ducts, and filters, precautions are required to prevent spilling contamination from them.

When HEPA filters are installed in ventilation systems for radiological areas, labels should be prominently affixed verifying proper installation of the filters. These labels should be located so that they are destroyed when the filters are removed.

Potentially contaminated air that has not passed through a high efficiency filter should not be discharged to locations occupied by personnel or where supply ventilation can return it to an occupied area.

Consideration should be given to controlling contamination that has been collected in ventilation equipment and systems not normally used for radiological work, including those systems in adjacent spaces that may become contaminated in the event of a spill. Prior to work on these items, radiation measurements should be taken, the items should be treated as contaminated, and radiological control precautions should be established to prevent spreading contamination.

### 6.8.2 Use of Enclosures for Controlling Contamination

The most effective means of controlling radioactive surface contamination is through the use of enclosures or containments around the contaminated item to keep the radioactive material inside. Containment should be used as much as practical when working on the surfaces of components that have been exposed to radioactive contamination. Plastic sheet, bags, or containment areas may be used to enclose clean material and to prevent contamination of clean items inside the enclosure. The following specific requirements shall be followed when working or handling contaminated equipment and materials:

- Instructions for using containment enclosures shall be readily available.
- Containment enclosures shall be inspected by the Project RSO or designee prior to use to determine if they are properly constructed and ready for use. Enclosures shall then be marked to certify this inspection was completed. In addition, containment enclosures shall be inspected daily when in use.
- Personnel using containment enclosures shall inform radiological control personnel of any damage to containment enclosures that occurs during work.
- When a containment enclosure is damaged or is unfit for use, the enclosure shall be conspicuously tagged to prevent its inadvertent use by personnel unaware of the problem.
- Containment enclosures shall not be removed or altered without approval of the Project RSO.

## 6.9 Monitoring for Surface Contamination

### 6.9.1 General Requirements

Surface contamination surveys of structures and equipment shall be performed and documented in accordance with Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*

Measurement instruments shall be set up and checked as required in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*. The Minimum Detectable Concentration (MDC) for contamination measurements should be less than 90% of the applicable limit, with a goal of less than 10% of the limit. If the 90% requirement is not achievable, the License RSO will be consulted to determine an appropriate course of action. If background levels are higher than stated above, equipment or personnel to be monitored for release shall be relocated to an area of lower radiation levels or the area shall be shielded to lower background levels.

When monitoring personnel, any indications above background shall be investigated as possible contamination.

### 6.9.2 Methods for Taking Smears for Loose Contamination

Smears should be taken by applying moderate pressure to a clean standard-sized dry smear, made of paper or other fiber material, over about one hundred square centimeters (an area about four inches by four inches) of the surface being monitored. In known contamination areas and where contamination is suspected, rubber gloves shall be worn when taking swipes to limit contamination of the hands. Rubber gloves need not be worn in uncontrolled areas for taking swipes if contamination is not expected.

When the item has less than 100 square centimeters of surface area, the pertinent levels should be reduced proportionally, and the entire surface area should be swiped. Contamination levels should be reported as "dpm/area" (where area is a best estimate).

### 6.9.3 Method for Monitoring Fixed Contamination

Fixed contamination may be measured with an appropriate rate meter and detector for alpha and beta/gamma contamination. Since these instruments alone do not differentiate between fixed and loose contamination, the measured fixed contamination levels are actually the total radioactivity and may include some loose contamination. For fixed beta-gamma contamination, levels are usually expressed in dpm per 100 $cm^2$. When searching for fixed contamination, or when trying to find the most highly contaminated portion of contaminated materials or areas, earphones or audible instrument response should be used. Visual meter indications respond slower than audible indication. When monitoring to demonstrate lack of residual contamination, a portable scaler is recommended to reduce the MDC for the measurement.

### 6.9.4 Method for Monitoring Personnel Contamination

Personnel monitoring shall be performed when leaving contaminated areas. Monitoring of personnel for surface contamination should be done with a personnel contamination monitor, or by personnel “frisking” using a portable alarming rate meter and an appropriate detector.

Frisking is performed by moving the detector slowly over the body with the probe within about one-half inch of the body surface, giving special attention to the face, throat, chest, back, abdomen, and hands and feet in order to obtain an indication of any internal deposited radioactivity. When monitoring personnel, earphones or audible instrument response should be used.

Frisking for alpha contamination is performed using an appropriate rate meter and detector in a manner similar to that described above except that light contact between the detector and surfaces being monitored should be maintained. Alpha friskers should have an alarm set point below the applicable contamination limit.

Monitoring of personnel by taking swipes for loose surface contamination on the skin or clothing shall not be done since swipes may tend to embed radioactive particles.

When personnel have been adequately trained in frisking procedures, requiring personnel to frisk themselves may be desirable.

If facial contamination is detected, or it is suspected that radioactive nuclides have been taken into the body even though no facial contamination is evident, the individual shall be monitored for internal radioactivity. Measurements of the radioactivity of nose and throat swabs may be used.

When personnel exceed the applicable contamination limits, notify the Project RSO and proceed with decontamination in accordance with Section 6.10.4.

Anti-contamination clothing (often referred to as anti-C clothing) will also be used, as required, to help keep personnel from spreading radioactive contamination outside controlled surface contamination areas and to keep the wearer's body free from contamination. Anti-contamination clothing is required when either surface contamination or airborne radioactive contamination may exceed prescribed limits.

### 6.9.5 Requirements for Wearing Anti-Contamination Clothing

The Project RSO shall determine the appropriate requirements for anti-contamination clothing, and these requirements shall be noted on the applicable RWP.

When first entering an area that may be contaminated, prior to determining the extent and level of contamination, full anti-contamination clothing shall be worn. Full anti-contamination clothing consists of hoods, coveralls, rubber and cloth gloves, booties, and shoe covers.

Full anti-contamination clothing shall be worn when working in highly contaminated areas (greater than 20,000 dpm/100 $cm^2$ $\beta$-$\gamma$ or 1,000 dpm/100 $cm^2$ $\alpha$). Full anti-contamination clothing may be required in areas with less contamination if personnel contamination is probable. In addition, clothing should be sealed with tape at points where contamination may enter. Full anti-contamination clothing is also necessary in other situations, such as when initially opening a radioactive system without containment.

A face shield, a waterproof apron, and rubber gloves should be worn during operations such as sampling of radioactive waste tanks and processed water tanks.

When working in very highly contaminated areas (greater than 50,000 dpm/100 $cm^2$ $\beta$-$\gamma$ or 5,000 dpm/100 $cm^2$ $\alpha$), double suits of anti-contamination clothing should be worn. Plastic or coated fabrics should be considered for use as the outer garment when double anti-Cs are required. Double suits limit the contamination that may penetrate the material during work, and they also improve the ease of controlling the spread of high levels of contamination. The outer suit is normally removed prior to leaving the region of very high contamination, and the inner suit is normally removed at the boundary of the CA.

When only the hands and arms are in contaminated areas such as a glove box, rubber gloves attached to the glove box may substitute for the anti-contamination clothing.

When working in a contaminated wet area or when contaminated liquid is likely to spray on the clothing, the outer clothing shall be waterproof.

In certain circumstances of low contamination levels, with Project RSO or designee approval, it may suffice for personnel to wear shoe covers, rubber gloves, and lab coats (without the other anti-contamination clothing). If wearing gloves without anti-contamination coveralls, care should be taken not to transfer contamination from the gloves to personal clothing.

It may be desirable to remove personal clothing before putting on anti-contamination clothing for reasons of comfort when working in high temperature spaces. Removing personal clothing is not usually required for adequate radiological control as long as the anti-contamination coveralls do not tear and the anti-contamination clothing is taken off properly after use.

Respiratory protection should be used in conjunction with anti-contamination clothing if the concentration of airborne radioactive particulate may exceed the limits of Section 6.6.2.

When reading a SRD in a CA, provisions should be made so that the dosimeter does not become contaminated. Use of a transparent plastic bag has been effective for this purpose.

### 6.9.6 Frequency of Surveys for Surface Contamination

Contamination surveys are performed as necessary to ensure that radioactive contamination is properly controlled at all times. These surveys are also performed to determine whether abnormal contamination levels exist and to determine the extent and magnitude of contamination in area under Shaw control. The surveys in this section shall be the minimum performed. Surveys are to be performed and documented as stated in this section and Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*.

Generally, contamination surveys are required within the following periodicities:

- Site-specific contamination survey requirements shall be determined prior to commencing work in potentially contaminated areas.
- Contamination surveys shall be performed at least daily in occupied areas surrounding CAs and particularly in the vicinity of exits from a CA. Surveys shall be performed at least daily in occupied CAs.
- Contamination surveys shall be performed at least weekly where appropriate in all occupied radioactive material areas where there is frequent handling or short-term storage of radioactive materials. Long-term radioactive material storage areas shall be surveyed at least monthly.
- Contamination surveys shall be performed monthly in work and storage areas outside areas where radioactive materials are stored or worked on.
- Contamination surveys shall be performed prior to release of potentially contaminated materials or equipment from radiological controls.
- Contamination surveys shall be performed during maintenance of components and piping that are associated with radioactive or potentially radioactive systems.
- Contamination surveys shall be performed in areas where radioactive liquid leaks have occurred or where airborne radioactivity has exceeded the concentrations of Section

6.6.2. Surveys are required to determine the need for anti-contamination clothing and to determine the extent of contaminated areas.

- Contamination surveys shall be performed upon initial entry into tanks or voids containing potentially radioactive piping and when opening ventilation exhaust ducting from radioactive work areas.
- Any normally uncontaminated system that is suspected of radioactive contamination shall be surveyed when opened for inspection, maintenance, or repair. Contamination control procedures should be used until the portion of the system being worked on is proven to be uncontaminated. Water drained or flushed from these systems shall be treated as radioactive and sampled as appropriate.
- Contamination surveys should be performed in plenums downstream of HEPA filters during routine filter replacement or at least annually, to determine radioactivity buildup in ducts downstream of filters.
- Prior to replacing filters on inlet ducts to a radiological work area, filters should be monitored to determine if radioactivity is present.
- Surveys for contamination fixed in paint should be performed prior to the removal of paint in potentially contaminated areas. These surveys should include counting paint scrapings for gross activity.

### 6.9.7 Instructions for Controlling Radioactive Spills

Since each spill shall require different detailed actions for effective control and recovery, personnel shall be trained to take appropriate supplementary actions depending on the location and potential consequences of the specific incident. For locations where spills are most probable or would have the worst consequences, each facility should train appropriate personnel in controlling and recovering from radioactive spills. Equipment for containing spills should be prepared in advance and located in work areas.

The steps detailed below shall be followed in the event of a radioactive spill.

#### 6.9.7.1 Immediate Actions - SWIMS

- **S**top the spill—If the spill is from a system that may have more material (either airborne particulate radioactivity or fluids) to leak out, promptly stop the leak if possible. If the spill is from an overturned container, try to set it upright if all the contents have not escaped. The amount of time spent stopping a difficult leak should depend upon the radiation levels involved, the possibility of inhaling airborne radioactivity from the spill, and the consequences of not making a prompt closure. In some cases, a prompt closure may not be necessary.
- **W**arn other personnel—Other personnel who may become contaminated by the spill or who may be able to help control it shall be warned immediately. Ensure radiological control personnel and the area supervisor are notified of the spill.

- **I**solate the spill—Keep unnecessary people away from the area affected by the spill to minimize the spread of contamination. This action may require closing doors, roping off the area, and verbally warning approaching personnel.

- **M**inimize personnel exposure to contamination and radiation—Personnel in the spill area should evacuate and contact radiological control personnel.

- **S**ecure ventilation in the spill area other than filtered exhausts—It may also be desirable to shut down exhaust systems in adjacent areas to ensure that air does not flow out of the spill area. Ventilation exhausts in the spill area should also be shut down, if necessary, to minimize the spread of high levels of radioactive contamination. Ventilation supplies should be shut down when exhausts are turned off.

If the spill is minor (for example, a few milliliters of water with low radioactivity spilled on a smooth surface), immediately cover the spill with the most convenient absorbent material available, such as absorbent paper or rags to soak up the liquid. Personnel shall be monitored and decontaminated as necessary.

The senior person in each area is in charge until relieved by the Project RSO. The person in charge should organize the personnel available and initiate action to control and correct the spill. It is important that this individual makes his/her presence and the fact that he/she is in charge known to all others at the scene. Upon arrival of the Project RSO, the status of corrective action taken or in progress shall be immediately brought to the Project RSO's attention.

### 6.9.7.2 Supplementary Actions

Steps below are actions to evaluate the extent of the problem, to recover from the spill, and to document the problem, as necessary. The designated supervisor shall consult with Radiological Control personnel to ensure the performance of specific portions of the steps below.

- Measure contamination on personnel who may have been affected, make contamination surveys in the area adjacent to the spill, measure airborne radioactivity inside and outside the spill area, and measure radiation levels in affected areas, particularly on ventilation filters. Monitor ventilation systems to determine if the spill has caused them to be contaminated. If it is suspected that radionuclides have been taken into the body or if facial contamination is detected, the personnel monitoring procedures shall be followed.

- Take subsequent radiological control and cleanup actions in accordance with appropriate radiological procedures. The designated supervisor shall minimize personnel radiation exposure and generation of radioactive waste consistent with the requirements to recover from the spill.

- Make appropriate reports and investigations in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

### 6.9.8 Records of Contamination

Records of abnormal spreads of radioactive contamination outside the radiologically controlled area shall be maintained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13 and shall be reported in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. These "abnormal" events include the following:

- Any occurrence that results in loose surface contamination greater than the applicable site-specific free release limits for uncontrolled areas
- Any spread of contamination in radiologically controlled areas or CAs that results in work being stopped for more than four hours or takes more than four hours to clean up

Records of surface contamination surveys shall be retained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13. The survey information shall be recorded on a standard form in accordance with Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*.

### 6.9.9 Criteria and Procedures for Releasing Previously Contaminated Facilities and Areas for Unrestricted Use

The criteria and procedures of this section shall be applied when releasing previously contaminated areas or radiologically controlled facilities for unrestricted use (e.g., use of the area is not controlled by radiological control procedures). Typical areas and facilities include facilities used for decontamination and repair or assembly of contaminated equipment, radioactive waste processing facilities and systems, exhaust ventilation systems for radioactive work areas, radioactive material storage areas, and outside areas accidentally contaminated.

Site-specific criteria and release requirements for previously contaminated facilities or areas shall be established prior to mobilization in compliance with requirements established by the cognizant regulatory agency.

Records of radiological investigations and surveys used to verify that facilities and areas meet the applicable release criteria will be maintain in a permanent project file in accordance with Section 6.13.

## 6.10 Radioactive Decontamination

Decontamination may be required for components, tools and equipment, work areas, clothing, or personnel. These include, in some cases, storage for decay, disposal without decontamination, or restricted use without complete decontamination. By the very nature of decontamination operations, the disposal of the waste radioactivity must be considered. Volumes of both solid and liquid wastes shall be minimized. Unauthorized chemicals shall not be used. Most radioactive contamination can be removed by normal cleaning. Wiping with a damp rag soaked with detergent shall usually provide satisfactory decontamination.

If large variations in surface contamination levels exist on highly contaminated surfaces, cleaning shall be from less contaminated toward more contaminated areas to prevent radioactivity from being spread to less contaminated areas. Cleaning solutions and cloths used in these decontamination operations shall be disposed of as radioactive waste. During decontamination operations, precautions shall be taken to limit the spread of contamination, such as taking care not to splash solutions, properly wearing anti-contamination clothing, and wearing masks as necessary. Filtered ventilation may be required to minimize the possibility of contamination being inhaled by personnel performing the decontamination.

### 6.10.1 Decontamination of Tools and Equipment

In decontaminating tools and equipment, appropriate radiological control shall be used to prevent the spread of contamination and to control airborne radioactivity and radiation exposure. The following applies to the decontamination of tools and equipment.

Tools and equipment that may be used again in contaminated areas may be temporarily stored in the contaminated area or in a contaminated tool room without decontamination if proper radiological controls and procedures are used. If certain tools are to be used solely in CAs, these tools should be durable and distinctively marked to indicate that they are always treated as potentially contaminated.

In some cases, the need for decontaminating tools may be minimized by taping some portions, such as the handles, prior to use and stripping off the contaminated tape after use. If tape is used to cover parts of tools, the residual adhesive remaining after tape removal shall be removed to minimize contamination that may be picked up in future uses of the tool. Large tools are often wrapped in plastic instead of tape. These tools need to be swiped or frisked at completion of decontamination to verify the effectiveness of the treatment.

Heavily contaminated tools can spread surface contamination within a controlled area. Therefore, such tools should be partially decontaminated as may be necessary several times throughout a work shift. Heavily contaminated tools can be readily identified without taking swipes by measuring their radiation level. The purpose of decontaminating these tools shall usually be to reduce their radiation levels rather than to remove all loose surface contamination.

When only a few tools require decontamination, wiping with cloths soaked in detergent is a convenient, effective procedure. This method is also useful when only a portion of a tool is contaminated. A disadvantage of wiping procedures is the large amount of solid radioactive waste produced.

Mechanical decontamination methods, such as using abrasives that remove some of the surface of the tool, can be useful in special circumstances where contamination is not removed by chemical cleaning. In such cases, control of possible airborne radioactivity is essential.

In decontaminating oily or greasy tools or equipment, consideration should be given to the fact that oil or grease may inhibit waste processing or disposal.

### 6.10.2 Decontamination of Areas

Contaminated areas shall first be isolated and radioactivity then removed (with care being taken to avoid the spread of contamination). In some cases, tape may be used to lift loose contamination from surfaces. If contamination levels are not sufficiently reduced, use of solvents, strong chemicals, or mechanical removal of some of the surface may be necessary. In all cases where liquids are used in decontamination, care shall be exercised to avoid spreading radioactivity and to minimize liquid waste. The areas shall be surveyed by methods detailed in an approved plan prior to release, to ensure surface contamination is below the established limits. On painted or covered surfaces, if washing does not remove the contamination, the paint or covering shall be removed. During the process of paint removal, control of airborne and surface contamination from dust and paint chips shall be necessary.

Contaminated areas should be decontaminated as soon as practical to minimize the spread of contamination and to facilitate removal before the contamination is fixed on the surface. If high radiation levels from the contamination contribute significantly to personnel radiation exposure during cleanup, it may be desirable to decontaminate the most heavily contaminated area first.

### 6.10.3 Decontamination of Anti-Contamination Clothing

Reusable anti-contamination clothing shall be laundered and monitored before reuse to minimize the possibility of spreading radioactive contamination to the wearer.

### 6.10.4 Decontamination of Personnel

Decontamination of personnel shall be performed in accordance with this section. The objectives of skin decontamination are to remove as much of the radionuclide as practicable in order to reduce the surface dose rate and to prevent activity from entering the body. An over-aggressive skin decontamination effort must be avoided since it may injure the natural barriers in the skin and increase absorption.

#### 6.10.4.1 Skin Contamination

When a worker has skin contamination, the following actions should be taken:

- Notify the Project RSO or designee immediately if there is evidence of skin breaks, ingestion of contaminated materials, or high dose rates associated with the contamination.
- Inspect the contaminated area to see if a visible "dirt" matrix of the contaminant is visible.
- First attempt to remove the material by dry (non-water) methods including soft brushing or lifting from the surface with the tacky side of masking tape. Re-monitor and record results.
- If measurable contamination still exists, wash with soap and warm water. Re-monitor the worker and record results after each decontamination attempt.
- Under no circumstances will decontamination methods be used that violate intact skin.

- The Project RSO or designee shall contact the License RSO to determine the need for additional evaluation or survey (such as nasal smears, dose assessment, etc.).
- Do not allow contaminated personnel to leave the project site without proper controls to preclude the spread of contamination.
- Incidents of personnel contamination shall be reported per Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

#### 6.10.4.2 Internal Deposition of Contamination

When it is suspected that a worker may have received an uptake of radioactivity, the following actions should be taken:

- The Project RSO or equivalent may permit the flushing of ears and eyes with cool, clean water to decontaminate those areas. If flushing is not successful, medical personnel shall direct additional decontamination efforts.
- Only medically qualified personnel shall probe the eyes, ears, nose, and throat of potentially contaminated personnel.
- Whole body counts and/or urinalysis may be required for personnel who may have inhaled or ingested radioactive material.
- The Project RSO or designee shall contact the License RSO as soon as possible to determine the need for additional evaluation or survey
- Incidents of personnel contamination shall be reported per Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

#### 6.10.4.3 Contaminated Open Wounds

Flushing of contaminated large open wounds is discouraged. However, when wounds are not substantial, i.e., cuts and scrapes, they may be rinsed with clean water. Medically qualified personnel shall direct varying techniques.

## 6.11 Procedures for Handling Radioactive Materials

This section presents procedures applicable to radiological safety considerations for controlling radioactive material associated with Shaw operations. Strict radiological control procedures are mandatory for such material to minimize the external and internal radiation exposure received by personnel and to prevent the uncontrolled spread of radioactivity to areas where the public might be affected.

### 6.11.1 Receipt of Radioactive Material

Radioactive material shall be received in accordance with the applicable operating license.

Radioactive material received by Shaw requires special control procedures to ensure that adequate radiological safety precautions are observed, both in unpacking and in subsequent use of the material. Potential radiological problems can include external exposure, surface contamination, and airborne radioactivity. Some packaging material requires disposal as radioactive waste. In addition, special precautions are required if damage has occurred during shipment.

The following procedures shall be used for radioactive material received at Shaw work sites:

- The Project RSO shall be familiar with the applicable radioactive material receipt conditions of the operating license.
- When received, the radioactive material shall be inspected. This inspection shall be performed as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.
- This inspection shall consist of verifying radiation and contamination levels on the outside of the package and verifying that the package was properly transferred. The package shall be opened solely for the survey purposes unless directed by the Project RSO. For packages that are shipped, this inspection shall verify that the package was shipped in accordance with US DOT, state, and federal regulations, and other federal and state requirements for notification and permitting.
- If damage to the radioactive material package has occurred, or removable surface contamination exceed the regulatory limits for transportation (10 CFR 71.87), or external radiation level exceed the regulatory transport limits (10 CFR 71.47), the Project RSO shall immediately notify the final delivery carrier and the NRC Operations Center by telephone., and investigate in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.
- Received packages shall be inventoried as soon as possible. Inconsistency between the observed contents and the contents indicated on the shipping document shall be brought to the attention of the shipper of the material. If the possibility exists that radioactive material has been lost in shipment, the Project RSO shall report this occurrence in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.
- Shipping containers and packing materials shall be surveyed and must meet the applicable release criteria prior to release for unrestricted handling.
- Following a satisfactory inventory, a receipt shall be returned promptly to the organization transferring or shipping the item, if requested.
- Records of the transfer of radioactive material and all associated survey documentation shall be maintained in the on-site project file throughout the duration of the project and in accordance with Section 6.13.

### 6.11.2 Packaging and Shipping Radioactive Materials

Radioactive materials shipped for disposal or to another location shall be appropriately packaged and treated as required by US DOT regulations, applicable federal and state regulations, and applicable disposal site criteria. Shipment of radioactive material shall be in compliance with Shaw E & I Procedure T-RA-003, *Shipment of Radioactive Materials*.

### 6.11.3 Radioactive Material Storage

In order to minimize the complexities of accounting for a large amount of radioactive material and the possibility of losing radioactive material, radioactive material shall be consolidated in as few areas as practical, and the amount of radioactive material in storage shall be minimized.

At a minimum, all radioactive material storage areas shall be posted in accordance with Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*.

#### 6.11.3.1 Fire Protection

Proper selection of a fire resistant storage area for radioactive material shall minimize the release of radioactivity to the environment in the event of a fire. The project health and safety plan shall include discussion of fire protection. However, the following additional fire protection practices shall be considered for storage of radioactive material to minimize the possibility of a fire and the spread of contamination in the event of a fire.

- Storage of radioactive material in fire-resistant containers is desirable to minimize contamination spread. In addition, containers of highly flammable radioactive materials shall be stored in areas segregated from other storage to reduce the risk of spreading a fire.
- Smoking shall not be permitted in radioactive material storage areas.
- An up-to-date list of locations where radioactive materials are stored shall be available to personnel who might be called to fight a fire in such areas. This list shall also identify unusual problems that may be present.
- Periodic inspections of radioactive material storage areas shall be made to identify fire hazards. Deficiencies shall be promptly corrected. A record shall be made of these inspections.
- Fire drills should be performed periodically with both fire fighting and radiological control personnel participating.
- Combustible materials shall be minimized inside radioactive material storage areas and should not be stored next to surrounding walls.
- Welding, burning, or other operations that may cause a fire shall not be conducted inside or next to radioactive material storage areas without prior authorization of the Project RSO or the designated representative. A fire watch with appropriate fire extinguishing equipment and materials shall be available during welding or burning operations.

#### 6.11.3.2 Contamination Control

Storage locations should be considered potentially contaminated. Personnel in these areas, particularly if they handle contaminated material, shall wear necessary anti-contamination clothing. Reasonable care shall be taken in packaging and storing contaminated items to prevent the spread of contamination and to ensure that entry to areas where such storage is permitted does not result in the contamination of personnel or other areas.

#### 6.11.3.3 Radiation Exposure Control

Storage of radioactive materials can result in possible personnel radiation exposure in the storage area and surrounding areas. For example, a component or bag of contaminated waste measuring one rem per hour, if stored at the entrance to the storage area would expose everyone who entered to high radiation levels. If stored in a far corner of the area, high radiation levels might be caused in surrounding areas. Facilities should store radioactive materials so as to minimize the radiation exposure of personnel entering or working in the area and of personnel in surrounding spaces. Radiation surveys of the storage area and of spaces immediately around the storage area shall be performed to ensure proper posting of radiation areas and to prevent inadvertent exposure of personnel in the storage space or surrounding spaces. When necessary, temporary shielding should be used to reduce radiation levels.

#### 6.11.3.4 Outdoor Storage

Radioactive materials should be stored where they are protected from adverse weather. Normally, radioactive material should not be stored outdoors except during short periods. However, protection from adverse weather should be considered in selection of these temporary storage locations. Large items that are designed for outdoor use, such as radioactive liquid collection tanks, may be stored outdoors. However, mechanical joints or capped pipes that may leak radioactive liquids shall be wrapped with weather resistant materials.

### 6.11.4 Loss of Radioactive Material

If radioactive material associated with Shaw operations is suspected of being lost, the following actions shall be taken:

- Immediately notify the Project RSO and License RSO, and conduct a search for the lost material. A primary purpose of this search is to ascertain that no persons shall receive inadvertent internal or external radiation exposure from this material.

- Follow up with the proper reports and investigation in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

## 6.12 Environmental Monitoring

Environmental monitoring consists of measurements, sample collection and analysis, and dose assessment to determine if radionuclides are being released to the environment from a facility or site. If so, the environmental monitoring is used to determine the extent of the release and the effect the release is having on the surrounding population. An environmental monitoring program generally consists of measurements and sample collection at the site boundary and at off-site locations. The types of samples and analyses are dependant on the radionuclides at the site and the possible release mechanisms. The License RSO and the customer shall specify the environmental monitoring requirements for the project.

### 6.12.1 Methods of Monitoring

An environmental monitoring program may provide for monitoring of direct radiation, air, water, soil, and vegetation.

- Direct radiation may be monitored by TLDs placed at the site boundary and at off-site locations.
- Air monitoring may consist of taking samples for airborne particulate at the site boundary and at off-site locations. The techniques may be similar to those used to monitor occupational airborne activity.
- Water monitoring may be performed by taking water samples from surface water bodies (i.e., lakes, ponds, and streams), surface runoff, and wells located both on and off site, and then analyzing those samples for radionuclide content.
- Surface soil samples may be collected and analyzed for radioactivity.
- A comprehensive program may also include sampling of flora and fauna.

### 6.12.2 Requirements

For those Shaw projects where the potential exists for releases to the environment, an environmental monitoring program shall be designed and implemented. If an environmental monitoring program is required, it shall be designed and implemented with the approval of the License RSO and shall include the following:

- Sampling Locations
- Types of Samples
- Sampling Frequency
- Types of Analyses
- Action Levels
- Required Actions

### 6.12.3 Records

All records of samples collected, analyses performed, results obtained, and actions taken shall be maintained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13.

## 6.13 Reports and Records

Reports and records shall be maintained as follows:

- The Project RSO shall submit a weekly written report to the License RSO detailing current radiological conditions, personnel exposure, and job progress.
- All radiological records generated shall be maintained in the on-site project file throughout the duration of the project.
- All radiological records designated for retention in the permanent project file by the Project Manager (or higher level of management) shall be prepared for release to Records Management in accordance with Shaw E & I Health and Safety Procedure HS700 *Policy and Guidance for Developing Radiation Protection Plans*.
- Following completion of the project, the Project RSO shall prepare a "Lessons Learned" report describing any problems/unique situations encountered and solutions/actions taken. This report shall be submitted to the License RSO, all Project Managers, all Project RSOs, and all Radiological Engineers.
- The Project RSO shall prepare the appropriate sections of the project final report including the final survey results and personnel exposure summary.

## 7. ATTACHMENTS

- Instruction on Radiation Exposure To The Unborn Child Acknowledgement Form
- Visitor/Contract Worker Exposure Record Form

## INSTRUCTION ON RADIATION EXPOSURE TO THE UNBORN CHILD

## ACKNOWLEDGEMENT FORM

All personnel receiving instruction in accordance with Section 8.2 shall sign the following statement prior to being issued dosimetry equipment:

---

**"The recommendation of the National Council on Radiation Protection and Measurements to limit radiation exposure to the unborn child to the very lowest practicable level, not to exceed 0.5 rem during the entire period of pregnancy, has been explained to me."**

**Signature**__________________________________________________

**Typed or Printed Name**__________________________________________

**Date**__________________________________________________________

# Visitor/Contract Worker Exposure Record Form

| Date | Name (Print) | Organization | TLD or SS# | Dose |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# RADIATION PROTECTION PROCEDURE

**Subject: Radiological Controls Portable Instrument Procedure**

## 1. PURPOSE

This procedure describes the methods and techniques to be used when using radiological instrumentation on field projects. Proper control, calibration, and quality control checks of portable instruments ensures that operating parameters demonstrate compliance with applicable data quality requirements and/or regulations. Also provided in this procedure are instructions for the documentation of instrument performance.

## 2. SCOPE

This procedure specifies standard practices for the performance of portable instrument operations. This document specifies the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these instrument operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls*
- National Council on Radiation Protection, Report No. 58, "A Handbook of Radioactivity Measurements"
- Manufacturer's Technical Manual(s)
- U.S. Nuclear Regulatory Commission, NUREG-1757, Vol. 2, "Consolidated NMSS Decommissioning Guidance" (DRAFT)
- U.S. Nuclear Regulatory Commission, NUREG 1507," Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"

## 4. DEFINITIONS

- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Contamination**—The presence of radionuclides that emit alpha particles (He-$4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.

- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Decay Chain**—A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Derived Concentration Guideline Level (DCGL)**—A derived, radionuclide-specific activity concentration within a survey unit corresponding to the release criterion. The DCGL is based on the spatial distribution of the contaminant and is derived from activity/dose relationships through various exposure pathway scenarios.

- **Direct Measurement**—A reading taken using a portable instrument directly on a surface, or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed location measurements and scans.

- **Frisking**—The process of searching a person's clothing or body with a radiation detection instrument prior to releasing that person from a radiologically controlled area.

- **Guideline Values**—A predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **Hot Spot**—A location within a radiologically controlled area in which the levels of radiation or contamination are noticeably greater than in the surrounding area.

- **Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Minimum Detectable Concentration (MDC)**—The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity

- **Monitoring**- The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Project Radiation Safety Officer (Project RSO)**— The Project RSO is designated by the License RSO as an Authorized User and by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including the providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Scanning**—A type of direct measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.

- **Shine**—Radiation from a source near a measurement location that interferes with a particular environmental measurement. While background is always a part of a gross measurement, in the case where shine is present, the significance and data quality of the measurement may be questionable.

- **Smear Sampling**—A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper, and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally $100 cm^2$.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Total Contamination**—Radioactive material, including both the fixed and removable contamination fractions, found on, or as a part of, an item or surface.

- **Transferable, Removable, or Loose Contamination**—Radioactive material that can be easily removed from a surface or item.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as Discipline Lead for control of this document. This individual is responsible for assuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

## 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users
- Maintain all required license records at the location specified on the license

## 5.3 Project Radiation Safety Officer

The Project RSO is designated by the License RSO as an Authorized User and is responsible to understand, implement, and properly document the performance of the Site Specific Radiation Protection Plan at a project location, as established by the License Radiation Safety Officer. The Project RSO shall report to the License RSO, on radiological matters. The Project RSO is responsible for the following:

- Ensuring that radiation surveys performed for the demonstration of compliance conform to the requirements of this procedure
- Maintaining an adequate inventory of functional, calibrated radiation survey instrumentation
- Storing and controlling the use of all radiation survey instrumentation
- Ensuring that the performance of radiation instrumentation is properly documented and conforms to the requirements of this procedure

## 5.4 Radiological Controls Technicians

Radiological Controls Technicians (RCT) are responsible to follow procedures established by the , or Project RSO, and shall ensure that the setup, use, and maintenance of radiation instrumentation is performed in accordance with this procedure. The RCTs shall also properly document radiation instrument use in accordance with this procedure.

# 6. PROCEDURE

## 6.1 Operational Requirements

The requirements in this section constitute the minimum requirements necessary to ensure the proper operation of portable radiological instruments used on field projects. A copy of the manufacturers operating instructions shall be available and instruments shall be operated in accordance these instructions.

Project specific requirements for instrument/detector operation verification shall be identified during the project planning.

## 6.2 Calibration

The calibration of Shaw E & I portable radiological instruments shall be performed by Shaw E & I personnel in accordance with approved procedures, by each instrument's manufacturer, or by other approved vendors as determined by the Shaw E & I Quality Assurance Department. When calibrated, each instrument shall have a label attached that indicates the calibration date, the next calibration due date, and the signature or initials of the person who performed the calibration.

Portable survey instruments, self-reading dosimetry (SRDs), counter-scalers, and air sampling equipment shall be properly calibrated prior to use. The Project RSO is responsible for ensuring that all portable radiological instruments, dosimeters, and air sampling equipment to be used at the project have a current calibration.

Copies of calibration records shall be maintained throughout the duration of the project in the permanent project file. The Shaw E & I Radiological Equipment Division shall retain the original calibration records.

A calibration status record should be generated for all project instruments and posted in the project office.

## 6.3 Ratemeter Pre-operational Requirements

Prior to the use of ratemeter-type instruments and detectors, the following inspections/operational verifications shall be performed:

### 6.3.1 Calibration Verification

All portable radiological instruments shall have an approved, current calibration label (See Section 6.2). Calibration verification shall be performed prior to the use of the instrument.

### 6.3.2 Physical Check

A physical check of radiological instruments is an inspection of the general physical condition of each instrument and detector. A physical check shall be performed prior to using a radiological instrument.

The physical check should include inspecting the instrument for loose or damaged knobs, buttons, cables, and connectors; broken/damaged meter movements/displays; dented or corroded instrument cases; punctured/deformed probe/probe window(s), cables, etc.; and any other physical impairments that may affect the proper operation of the instrument or detector. Any instrument or detector having a questionable physical condition shall not be used until the condition is properly corrected.

### 6.3.3 Battery Check

A battery check is performed to help ensure that there is sufficient voltage being supplied to the detector and instrument circuitry for proper operation. This check shall be performed in accordance with the instrument's technical manual.

### 6.3.4 High Voltage Check (HV)

The HV is adjusted during instrument calibration, additional adjustment for normal operation is not required. However, an HV check is required prior to each use in accordance with the instrument technical manual. An instrument with suspected HV problems shall be immediately reported to the Project RSO.

### 6.3.5 Response Source Check

A response source check is performed to ensure that the instrument will accurately respond to a known source of radiation. Obtain a check source of the proper size, type, and activity for the instrument/detector being used and perform the response source check as follows:

1. Determine the background radiation level. It must be low enough to allow a measurable response to the check source being used. Careful monitoring of changing background levels is necessary to obtain accurate instrument readings.

2. Begin with the instrument on the highest range/scale and energize the audible device, if applicable.

3. Slowly move the detector towards the check source and check the instrument for an increase in audible and/or visual response.

4. Change the range/scale of the instrument as appropriate to obtain a readable indication and to check each of the meter ranges/scales. If an appreciable response cannot be obtained (even in the lowest range), evaluate instrument performance by comparison to previous source check data for the instrument. If no previous source-check data is available, comparison should be made to the data associated with similar instruments in use. Notify the Project RSO of any instrument/detector response problems. Document the response on the Ratemeter Daily Instrument Check Sheet. Plot the response on the Control Graph at the bottom of the Ratemeter Daily Instrument Check Sheet.

5. The Project RSO or designee shall set up the control graph on the Ratemeter Daily Instrument Check Sheet such that lines indicate when an instrument is outside of the +/-20% variability.

6. Instruments with day-to-day responses that vary by more than 20% under identical conditions shall be removed from service. Notifying the Project RSO of such a condition is required.

A ratemeter-type instrument and detector used to perform measurements for the documentation of a release survey must meet the requirements of Section 6.4 for scaler-type instruments.

Ratemeter instrument inspections, performance verifications, and corrective actions shall be recorded on the Ratemeter Daily Instrument Check Sheet prior to use.

## 6.4 Scaler Pre-operational Requirements

Prior to the use of scaler-type instruments and detectors, the following inspections/operational verifications shall be performed in addition to those required in Section 6.3 for ratemeter-type instruments (i.e., calibration verification, physical check, battery check, HV check). Where a calculator Standard Deviation Function is used or when a spreadsheet program is used in the pre-operational checks, it should be noted on the affected paperwork.

### 6.4.1 Background Measurement (Initial Project Set-up)

1. Ensure that the sample holder tray is empty and clean. The detector/sample holder geometry should be set up in the same configuration as that to be used when counting samples to produce the most accurate results.

2. Select the desired counting time. The selected time must be consistently used to perform all source and sample/swipe counting operations. The counting time directly influences the Minimum Detectable Concentration (MDC) obtained for the instrument. Although the counting time must be long enough to obtain the desired MDC, it must be short enough to be practical. The background measurements should be performed in conjunction with the MDC calculations in Section 6.4.3.

3. Perform the background measurement for the selected time period ($t_b$) and record the total counts measured on the Scaler Instrumentation Check Sheet.

4. Repeat the background measurement ten times. Record the total counts observed for each measurement on the Scaler Instrumentation Check Sheet.

5. Calculate the average background counts ($\overline{C_b}$) and the standard deviation ($SD_b$):

$$\overline{C_b} = \frac{\sum_{i=1}^{N} C_{b_i}}{N} \qquad\qquad SD_b = \sqrt{\frac{\sum_{i=1}^{N} (C_{b_i} - \overline{C}_b)^2}{N - 1}}$$

Where:

| | | |
|---|---|---|
| $\sum_{i=1}^{N}$ | = | Summation of item 1,2,3…N |
| $\overline{C_b}$ | = | Average number of background counts |
| $SD_b$ | = | Standard deviation of the background counts |
| $N$ | = | Number of measurements |
| $C_{b_i}$ | = | Background counts 1, 2, 3 … N |

6. Record the average background ($\overline{C_b}$), background count time ($t_b$), and the standard deviation ($SD_b$) on the Scaler Instrumentation Check Sheet.

<u>Daily</u>: (unless otherwise directed by the RCS or designee): perform a single background count ($C_b$). Analyze this value to the using the following formula:

$$C_b = \overline{C_b} \pm 2SD_b$$

Where:

$\overline{C_b}$ = Average background counts.

$SD_b$ = Standard deviation of the average background counts.

If the background measurement is satisfactory, continue. If the background measurement does not meet this criterion, immediately notify the RCS. Record the background measurement on the Scaler Daily Instrument Check Sheet.

7. Divide $\overline{C_b}$ by $t_b$ to determine the average background count rate in cpm ($\dot{C}_b$), and record the result on the Scaler Instrumentation Check Sheet.

### 6.4.2 Instrument Efficiency ($E_i$)

Determine the detector efficiency with a source of known activity of the nuclide to be monitored (or with a source of known activity of a nuclide with energy decay products similar to those of the nuclide to be monitored), as follows:

1. Correct the source activity for radioactive decay (when necessary) as follows:

$$A = A_o e^{-\lambda T} \quad Where: \lambda = \frac{0.693}{t_{\frac{1}{2}}}$$

Where:

A = Present source activity.

$A_o$ = Source activity at initial assay.

$\lambda$ = Decay constant for the source isotope.

T = Time elapsed since initial source assay.

$t_{1/2}$ = Source isotope half-life.

NOTE: Time units must be consistent (days, hrs., mins., etc.)

2. Count the source for the same time period ($t_s$) selected during the background measurements (See Section 6.4.1, step 2).

<u>Initially</u>: At project set-up or as otherwise directed by the project specific work plans or instructions, or the RCS, count the source ten times and calculate the average net counts ($\overline{C_n}$), the standard deviation of the average gross counts ($SD_g$), and the standard deviation of the average net source counts ($SD_n$):

$$\overline{C}_g = \frac{\sum_{i=1}^{N} C_{g_i}}{N} \qquad \overline{C}_n = \overline{C}_g - \overline{C}_b$$

$$SD_g = \sqrt{\frac{\sum_{i=1}^{N} (C_{g_i} - \overline{C}_g)^2}{N-1}} \qquad SD_n = \sqrt{(SD_g)^2 + (SD_b)^2}$$

Where:

| | | |
|---|---|---|
| $C_{g_i}$ | = | Gross Source Counts (total counts observed including background) 1 through N |
| $\overline{C_b}$ | = | Average background counts. |
| $\overline{C_g}$ | = | Average gross counts. |
| $\overline{C_n}$ | = | Average net counts. |
| $SD_n$ | = | Standard deviation of the average net counts. |
| $SD_g$ | = | Standard deviation of the average gross counts. |
| $N$ | = | Number of measurements. |
| $SD_b$ | = | Standard deviation of the average background counts. |
| $\sum_{i=1}^{N}$ | = | Summation of item 1,2,3…N. |

Record the gross counts ($C_{g_i}$, where i =1 to N), $\overline{C_n}$ and the standard deviations ($SD_n$ and $SD_g$) on the Scaler Instrumentation Check Sheet.

3. Divide $\overline{C_n}$ by $t_s$ to determine the average net count rate ($\dot{C}_n$) and record the rate on the Scaler Instrumentation Check Sheet.

4. Initially (at project set-up): Calculate the detector efficiency ($\varepsilon_i$) as follows:

$$\varepsilon_i = \frac{\dot{C}_n}{A_c} = \frac{cpm}{dpm}$$

Where:

| | | |
|---|---|---|
| $\dot{C}_n$ | = | Average net cpm. |
| $A_c$ | = | Actual, decay corrected activity (dpm). |

Daily (unless otherwise directed by the RCS or designee): perform a single source count ($C_g$). Analyze this value to the using the following formula:

$$C_g - C_b = C_n = \overline{C_n} \pm 2SD_n$$

Where:

$\overline{C_n}$ = Average net counts.

$C_n$ = Net Source Counts

$C_b$ = Daily Background counts.

$SD_n$ = Standard deviation of the average net counts.

If the source count is satisfactory, continue. If the source count does not meet this criteria, immediately notify the RCS. If the source count falls between $\pm 2SD_n$ and $\pm 3SD_n$, the RCS shall investigate and consult with the PHP before using the instrument. Record the source count on the Scaler Daily Instrument Check Sheet.

The efficiency will only be recalculated as directed by the RCS.

5. Record the calculated efficiency on the Scaler Instrumentation Check Sheet.

### 6.4.3 Calculation of Minimum Detectable Concentrations (MDC)

The calculated MDC is determined to ensure that the detector being used will detect the presence of activity at or above the allowable limit under a given set of counting conditions. The MDC is the concentration that a specific instrument and technique can be expected to detect 95 percent of the time under actual conditions of use. MDC is based on the estimated detector efficiency, sample quantity, and the counting time.

MDC of each instrument shall be determined upon initial set-up of the counting system and as needed following modification, calibration, repair, or replacement (i.e., new detector, cables, calibration, etc.). An MDC may be required to be determined on specific materials that exhibit a different background than at initial set-up. The RCS shall be contacted to determine if an MDC determination is necessary for specific materials.

For scanning building surfaces, the $MDC_{scan}$ should be determined using the following equations (using a value recommended in Appendix A of U.S. Nuclear Regulatory Commission, NUREG-1757, Vol. 2, “Consolidated NMSS Decommissioning Guidance,” for the index sensitivity d’ of 1.38, which is for 95 percent detection of a concentration equal to $MDC_{scan}$ with a 60 percent false-positive). The background collection times shall be at least 1 minute, to ensure consistent data collection.

For static measurements of surface concentrations by either direct measurement or by a smear sample, the $MDC_{static}$ should be determined using the equation from NUREG-1507. The sample collection times should be the same as the selected background times in Section 6.4.1, step 2, if practical. The RCS shall consult with the PHP for all other conditions.

6. Calculate the $MDC_{scan}$ in dpm/100cm$^2$:

$$MDC_{scan}\left(building\ \ surfaces\right) = \frac{5994 + 1.38\sqrt{C_{bscan}}}{\sqrt{p\varepsilon_i\varepsilon_s A t_{scan}}}$$

Where:

| | | |
|---|---|---|
| 5994 | = | Conversion factor to convert to dpm/100cm$^2$ |
| 1.38 | = | Index of sensitivity d' |
| $\overline{C_{bscan}}$ | = | Average background counts in time interval $t_{scan}$ |
| $p$ | = | Surveyor efficiency (0.5) |
| $\varepsilon_i$ | = | Instrument Efficiency for the emitted radiation |
| $\varepsilon_S$ | = | Source Efficiency in emissions/disintegration (0.25) |
| $A$ | = | Probe's sensitive area, in cm$^2$ |
| $t_{scan}$ | = | Sample count time, time interval of the observation while the probe passes over the source in minutes. |

7. Record the calculated $MDC_{scan}$ on the Scaler Instrumentation Check Sheet.

8. Calculate the $MDC_{static}$ in dpm/100cm$^2$:

$$MDC_{static} = \frac{3 + 4.65\sqrt{\overline{C_{bstatic}}}}{K\,(t_{static}\;)} = \frac{3 + 4.65\sqrt{\overline{C_{bstatic}}}}{\varepsilon_i * \varepsilon_s * (A/100) * (100\,cm^2) * t_{static}}$$

Where:

| | | |
|---|---|---|
| $\overline{C_{bstatic}}$ | = | Average background counts during time interval $t_{static}$ |
| $t_{static}$ | = | Sample counting time, time interval in min. the probe is in direct contact with the surface or smear |
| $K$ | = | $\varepsilon_i*\varepsilon_S*(A/100)*(100cm^2)$ A calibration constant (best estimate) to convert counts/min to dpm/100 cm$^2$. |
| $A$ | = | Probe's sensitive area, in cm$^2$ |
| $\varepsilon_I$ | = | Instrument Efficiency for the emitted radiation |
| $\varepsilon_S$ | = | Source Efficiency in emissions/disintegration (0.25) |

9. Record the calculated $MDC_{static}$ on the Scaler Instrumentation Check Sheet.

The calculated $MDC_{static}$ should be less than 50 percent of the appropriate DCGL, and while there is no specific recommendation of $MDC_{scan}$, it should be no more than 50 percent of the appropriate DCGL if possible. If the desired MDC cannot be attained, then inspect the instrument for equipment problems (contaminated detector or sample holder, loose cables/connectors, etc.) and notify the RCS. If no equipment problems are found, parameters such as sample quantity, count time, or background radiation levels may have to be adjusted appropriately to obtain an acceptable MDC. If reasonable adjustment of these parameters (as directed by the RCS) does not result in an acceptable MDC, a more suitable instrument/detector shall be required.

### 6.4.4 High Voltage Plateau (HVP)

The high voltage plateau is performed during instrument calibration and should not be required under normal operating conditions. However, following any equipment modification or replacement (i.e., new detector, cables, etc.) or whenever there is a noticeable degradation of instrument/detector performance (e.g., decreasing efficiency, erratic results, etc.), the high voltage plateau shall be investigated. If necessary, a new HVP shall be performed in accordance with the specific instrument's Manufacturer's Technical Manual.

### 6.5 Potential Detection Problems

In reviewing the instrument/detector performance records, the RCS should be notified when the following observations indicate detection problems:

- Background drift in a continuous direction either up or down.
- Alpha background greater than 0.5 counts per minute.
- A ratemeter-type instrument that does not zero.
- A battery check that does not respond.
- Failure to indicate response on a ratemeter-type instrument during a response check.

### 6.6 Solutions to Potential Detection Problems

If the above problems are encountered, the RCS has the following options:

- Remove the instrument/detector from service, tag it as out of service, and replace it with a comparable instrument/detector
- If no replacement is immediately available, contact the Task Manager to determine an appropriate mode of corrective action.

### 6.7 Records

The RCS shall be responsible for maintaining instrument/detector physical checks and performance verification records identified in Section 6.1 through 6.6. Equivalent forms that meet the intent of the forms in this procedure may be used with the approval of the RCS or designee. In addition, all instrumentation problems and corrective actions shall be recorded on the appropriate data sheets and in the RCS daily log.

Specific document forms to record actual field sampling data shall be required. These forms may vary from project to project, and the use of such forms shall be determined by the RCS and the Project Manager/Supervisor with approval by the Task Manager.

All records, daily logs, forms, and memos shall be maintained in the on-site project file throughout the duration of the project.

All radiological records designated for retention in the permanent project file by the Project Manager (or higher level of management) shall be prepared for release to Document Control.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject: Airborne Radioactive Particulate Monitoring**

## 1. PURPOSE

This procedure describes two techniques for determining the concentration of airborne radioactive particulates. The techniques differ only in sample collection; the analytical technique for determining the concentration from the filter media is the same for either sample collection method. The procedure should be used to do the following:

- Demonstrate compliance with the intake limits for workers specified in applicable federal or state regulations
- Meet the posting requirements for airborne radioactivity areas specified in applicable federal or state regulations
- Determine whether precautionary measures such as process or engineering controls, increased surveillance, limitation on working times, provision of respiratory protective equipment, or other precautions should be considered
- Determine whether exposures to radioactive materials are being maintained as low as reasonably achievable

This procedure also describes the method for calculating working level (WL) determinations and conversions to Derived Airborne Concentrations (DAC) for radon daughter. Also provided are instructions for the documentation of airborne radioactivity concentrations and radon working levels.

## 2. SCOPE

This procedure specifies standard practices for the performance of airborne radioactivity particulate monitoring and radon working levels. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing airborne monitoring operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection against Radiation*
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls*
- Shaw E & I Standard Operating Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000

- Burak, T.B., E.D. Franco and R.F. Holub, 1982, "An Evaluation of Working Level Measurements Using a Generalized Kusnetz Method," *Health Physics* 42:459-467, Pergamon Press


## 4. DEFINITIONS

- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.

- **Annual Limit on Intake(ALI)**—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Decay Chain**—A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Direct Measurement**—A reading taken using a portable instrument directly on a surface, or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed location measurements and scans.

- **Derived Air Concentration (DAC)**—The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

- **Derived Air Concentration hours (DAC hours)**—The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

- **Filter Ratio**—The ratio of the size of the counted filter section to the size of the original collected filter.

- **Guideline Values**—A predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Minimum Detectable Activity (MDC)**—The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, $L_D$, multiplied by an appropriate conversion factor to give units of activity.

- **Monitoring**-The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Project Radiation Safety Officer (Project RSO))**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Survey Unit**—A predefined geographical area, or location within a facility, that forms the boundary for a specific radiological evaluation or survey.

- **Working Level (WL)**—Any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of $1.3 \times 10^5$ MeV of potential alpha particle energy.

## 5. RESPONSIBILITIES

### 5.1 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users
- Maintain all required license records at the location specified on the license

### 5.2 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.3 Project Managers

Project Managers are responsible to identify any radiological safety issues associated with projects under their cognizance. Further, Project Managers are responsible for ensuring that appropriate radiological controls are established on projects under their cognizance in order to ensure the protection of workers, the general public, and the environment and to maintain exposures to ionizing radiation As Low As Reasonably Achievable (ALARA).

### 5.4 5.4 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to understand, implement, and properly document the performance of the requirements of this procedure for a specific project, as established by the License RSO. The Project RSO is responsible for the following:

- Ensuring that airborne monitoring performed for the demonstration of compliance conforms to the requirements of this procedure
- Maintaining an adequate inventory of functional, calibrated airborne monitoring instrumentation
- Storing and controlling the use of all airborne monitoring instrumentation
- Ensuring that the performance of airborne monitoring equipment is properly documented and conforms to the requirements of this procedure

### 5.5 Radiological Controls Technicians

Radiological Controls Technicians (RCT) are responsible to follow procedures established by the Project RSO, and shall ensure that the setup, use, and maintenance of radiation instrumentation is performed in accordance with this procedure. The RCTs shall also properly document radiation instrument use in accordance with this procedure.

## 6. PROCEDURE

### 6.1 Prerequisites

Project-specific airborne monitoring equipment shall be identified during the project planning.

Prior to conducting airborne radioactive particulate monitoring, the RCT conducting the monitoring shall ensure that the following prerequisites are met:

- Project-specific radiological survey and data collection requirements and data quality objectives are established in written project documents and are understood by the RCTs performing surveys.
- All required survey supplies and material are available for use on site. These materials include the following:
  - Completed and approved Activity Hazard Analysis for the monitoring to be performed
  - Radiation Work Permit (RWP) prepared and approved in accordance with Shaw E & I Standard Operating Procedure T-RA-010, *Radiological Site Controls* (if entering radiologically controlled areas to perform monitoring)
  - Airborne Radioactivity Sample / Monitor Report Forms
  - Appropriate radiation dosimetry
  - Properly calibrated instrumentation or analytical equipment capable of measuring the contaminant(s) of interest
- Previous radiological surveys and airborne monitoring results for the area of interest have been checked, if available, to determine radiation and contamination types and levels in the areas to be surveyed and to determine whether conditions of safety have changed since the last survey.
- Appropriate action levels or guideline values are established and required actions or reporting requirements are understood by RCTs performing monitoring.

### 6.2 Sampling Instructions

Air samples may be of two general types: grab samples and environmental samples. Grab samples are typically a quick sample of a fixed volume of air around a worker or work area. Environmental samples are typically samples collected over an extended period of time. The type of samples needed for the project should be determined during project planning.

#### 6.2.1 Area Samples

The procedure for collecting area samples is as follows:

1. Select an air-sampling unit and install the appropriate diameter filter in the filter head. The sampler shall be calibrated in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.
2. Select a suitable location for sampling. Choose the location based upon an evaluation of the operation being performed. The ideal location shall approximate the breathing zone of a worker and shall be between the source of the potential airborne material and the location of the worker(s).
3. Determine the time and flowrate necessary to sample a volume sufficient to ensure that an adequate Minimum Detectable Concentration (MDC) is obtained in accordance with Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual* and Shaw E & I Procedure T-RA-005, *Field Project Radiological Controls*.

4. Turn on the air-sampling unit; adjust the flowrate to a calibrated value; and record the time, initial flowrate, and initials of the technician on the Airborne Radioactivity Sample/Monitor Report or Radon DAC radioactivity Sample/Monitor Report, as appropriate.

5. Record the exact location of the air sampling unit and the nature of the work being performed. Record any other pertinent comments.

6. Periodically check the air-sampling unit for proper operation.

7. Record the final flowrate and time, and turn off the air-sampling unit. Remove the air filter and place it in the sample envelope.

### 6.2.2 Lapel Samples

The procedure for collecting lapel samples is as follows:

1. Select a lapel air sampler and install a 25mm or 37mm diameter filter (as appropriate) in the filter cassette head. Calibrate the flowrate and record on the appropriate report form.

2. Determine the time and flowrate necessary to sample a volume sufficient to ensure that an adequate MDA is obtained. Due to the low flowrate of lapel air sampling pumps, it is usually necessary to operate the pump a minimum of four (4) hours. A six (6) to eight (8) hour sample, if possible, is preferable.

3. Select a worker with a high potential for exposure to airborne radioactive materials. Instruct the worker regarding the wearing of the lapel sampler. Ensure that the filter head is positioned in the breathing zone.

4. Record the name of the worker and the nature of the work being performed. Record any other pertinent information.

5. Turn on the air-sampling pump; adjust the flowrate to the calibrated value; and record the time, initial flowrate, and initials of the issuing technician.

6. Periodically, check the work area and air-sampling unit for proper monitoring and operation.

7. Record the final flowrate and time, and turn off the air-sampling unit. Remove the air filter and place it in the sample envelope.

## 6.3 Counting Instruction

### 6.3.1 Airborne Radioactive Particulate Determination

1. As appropriate, it may be necessary to have a minimum of 72 hours from the end of sample collection before counting the sample (to allow for the decay of short-lived radon daughters). An initial count or 24-hour decayed count may be performed for informational purposes. If radon is not a problem, an immediate count of the air sample is appropriate.

2. Using an appropriately calibrated Scaler-Counter, set up in accordance with Shaw E&I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*, count the sample for the pre-determined count time. This count time is established during instrument setup based on the required MDC for the nuclide(s) of interest.

3. Preserve the sample for potential recount by placing the sample in an appropriate individual sample storage container. Mark the container with the sample number and the date and time that the initial count was made.

4. Calculate the airborne radioactive particulates (activity) and the Minimum Detectable Concentration (MDC), using the following equations:

$$Activity(\mu Ci/ml) = \frac{(Sample\ cpm - Bkg\ cpm)}{(2.22E6\ dpm/\mu Ci)(Vol)(E)(F_a)}$$

Where

Vol = Volume of sample, in ml, calculated by multiplying the average flow rate by the runtime by the appropriate conversion factor into ml.

Average flow rate ($\overline{f}$ ) = (initial flowrate + final flowrate) / 2

Volume (ml) = (Runtime in min) ($\overline{f}$ in cfm) (2.83E4 ml/ft$^3$)

Volume (ml) = (Runtime in min) ($\overline{f}$ in lpm) (1000 ml/l)

Volume (ml) = (Runtime in min) (ml)

E = Detection efficiency of counting equipment

$F_a$ = Filter absorption, 0.8 for α and 1.0 for β –γ

2.22E6 dpm/ μCi = Conversion from dpm to microcuries

NOTE: When the selected air sampling unit has a filter diameter larger than 2 inches, an appropriate sample must be removed from the larger filter to accommodate sample counting equipment. The removed sample should be taken from the middle of the original filter. In this case, the calculated activity must be adjusted by multiplying the activity by the Filter Ratio (FR), the ratio of the size of the counted filter section to size of the original collected filter.

Where

$T_b$ = Background count time in min

$T_s$ = Sample count time in min

5. Record the results on the Airborne Radioactivity Sample/Monitor Report and in the Airborne Radioactivity Sample Log. If the results are greater than 10% of the most restrictive Derived Air Concentration (DAC) of a nuclide of concern, notify the Project RSO.

6. The Project RSO shall routinely review the airborne radioactivity sample log to note any trends of increasing airborne activity at various work locations.

$$MDC = \frac{2.71 + 4.65\sqrt{(Bkg\ cpm)(T_b)}}{(2.22E6\ dpm/\mu Ci)(Vol)(E)(F_a)(T_s)}$$

### 6.3.2 Radon Working Level Determinations

1. After decay time of forty (40) to ninety (90) minutes, count the sample for alpha activity in accordance with Shaw E & I SOP T-RA-006, *Radiological Controls Portable Instrument Procedure*. Count for a minimum of 5 minutes, or as required, to achieve an MDC of 0.01 WL. Record the results using the Radon DAC Radioactivity Sample/Monitor Report.

2. Calculate the activity and MDC values as defined in Section 6.3.1, step 3.

3. Calculate the atmospheric concentration of radon daughters as a fraction or multiple of the working level using the following equation:

$$DAC(\%DAC) = \frac{(Sample\ cpm - Bkg\ cpm)}{(E)(VPM)(T_{SC})(T_s)(K)(3)}$$

Where

| | |
|---|---|
| E | = Detection efficiency |
| VPM | = Air flow rate (LPM) |
| $T_{SC}$ | = Sample collection time |
| $T_s$ | = Sample count time in min |
| K | = Kusnetz conversion factor (Kusnetz Conversion Factor Chart) |
| 3 | = Conversion factor from WL to DAC (0.33 WL = 1 DAC) |

4. Record the results on the Radon DAC Radioactivity Sample/Monitor Report and in the Airborne Radioactivity Sample Log.

### 6.4 Records

#### 6.4.1 Sample Log

All samples generated as result of this procedure shall be logged using the Airborne Radioactivity Sample Log form. The samples shall be numbered as follows: a six-digit number representing the date followed by a two digit sequential number for samples collected on that date.

#### 6.4.2 Record Retention

All forms generated as a result of this procedure shall be maintained throughout the duration of the project and then retained in accordance with Shaw E & I Health and Safety Procedure HS700, Policy and Guidance for Developing *Radiation Protection Plans*.

## 7. ATTACHMENTS

- None

# RADIATION PROTECTION PROCEDURE

## Subject: External Dosimetry Administration

## 1. PURPOSE

This purpose of this procedure is to provide guidelines for the establishment and implementation of a dosimetry administration program on field projects involving the potential for exposure to ionizing radiation. This procedure will prescribe the manner in which dosimetry and exposure data will be managed on projects, including assigning responsibilities for establishing and implementing dosimetry programs.

## 2. SCOPE

This procedure provides standard practices for dosimetry administration programs. It provides the minimum required steps and quality checks that employees and subcontractors are to follow in establishing and implementing such programs. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans.*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation.*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers.*
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Standard Operating Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring.*

## 4. DEFINITIONS

- **Action Level—**A predetermined exposure that, when reached, or measured, requires that a specific, predefined set of follow up protocols go into effect to minimize personal exposure and to control sources of radiation.
- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Alpha Radiation(α)**—Alpha particles ($He\text{-}4^{++}$) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.

- **Annual Limit on Intake (ALI)**—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Attenuation**—The process by which a beam of radiation is reduced in intensity when passing through some materials, including air. It represents a combination of absorption and scattering processes that lead to a decrease in flux density as the beam passes through matter.

- **Background Radiation—**Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Radiation(β)—**Beta particles ($e^-$) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Biological Effect**—The net biological change caused by a specific quantity of absorbed dose to body tissues, measured in Rems or Sieverts.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Committed Dose Equivalent (CDE)**—The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. Committed dose equivalent is expressed in Rem.

- **Committed Effective Dose Equivalent (CEDE) -** The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues and is expressed in Rem.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Deep Dose Equivalent (DDE)**—Applies to external whole-body exposure; the dose equivalent at a tissue depth of 1 cm.

- **Dose**— A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

- **Dose Equivalent (DE)**—The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The unit of dose equivalent is rem.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Effective Dose Equivalent (EDE)**—The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

- **Exposure**—Being exposed to ionizing radiation or to radioactive material.
- **External Dose**—That portion of the dose equivalent received from radiation sources outside the body.
- **Gamma Radiation(γ)**—High energy, short wavelength photons emitted from radionuclides while undergoing decay, or emitted by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.
- **Gray**—A unit of absorbed dose equal to 1 Joule/kilogram or 100 rads.
- **High Radiation Area**—An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.
- **Intake (or Uptake)**—Radionuclides entering the body by any exposure pathway, primarily inhalation, absorption, or ingestion means.
- **Investigation Level**—The level of exposure above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Monitoring-**The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses
- **National Voluntary Laboratory Accreditation Program (NVLAP)**—Accredits testing and calibration laboratories that are found competent to perform specific tests or calibrations, or types of tests or calibrations. NVLAP is a U.S. Government entity administered by the National Institute of Standards and Technology (NIST), an agency of the Department of Commerce.
- **Neutron Radiation(n)**—An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.
- **Rad**—A unit of absorbed dose equal to 0.01 Joule/kilogram or 0.01 Grays.
- **Radiation Area**—An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Radiological Work Permits (RWPs)**—A work document that contains the necessary controls and protective measures to prevent inadvertent exposures to radiation and radioactive contamination while performing work in radiologically controlled areas.

- **Radiologically Controlled Area (RCA)**— Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.

- **Rem**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor. One Rem is equal to 0.01 Sievert.

- **Restricted Area**—An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

- **Roentgen**—A unit of exposure equal to the amount of gamma or X-rays required to produce 1 electrostatic unit (esu) of charge in 1 cc of dry air at standard temperature and pressure.

- **Self-Reading Dosimeter (SRD)**—Radiation monitoring device used to provide a direct readout of gamma and/or x-ray exposure.

- **Shallow Dose Equivalent (SDE)**—Applies to the external exposure of the skin or an extremity, taken as the dose equivalent at a tissue depth of 0.007 centimeters.

- **Sievert**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Gray multiplied by a quality factor. One Sievert is equal to 100 Rems.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Total Effective Dose Equivalent (TEDE)**—The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

- **Thermoluminescent Dosimeter (TLD)**—Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

- **Very High Radiation Area**—An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

- **Whole Body** - For purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee

- **X-ray Radiation—**High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and to pose a substantial external radiation hazard.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following

- Assess the need for a dosimetry monitoring program
- Identify the appropriate dosimetry and to employ proper practices for its use.
- Establish specific requirements for a project exposure-monitoring program, including the establishment of investigative and action levels.

### 5.3 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to implement established exposure monitoring requirements for a specific project, as established by the License RSO. The Project RSO is responsible to ensure that the proper collection and documentation of radiation exposure history data is available and maintained in on-site records. The Project RSO is also responsible for the issuance and collection of dosimetric devices on project sites within the appropriate periodicity (generally monthly).

### 5.4 Site Radiation Workers

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of dosimetry data. This includes proper wearing of, and maintaining control of, dosimeters in compliance with established site procedures.

## 6. PROCEDURE

Once the need for a project dosimetry program is established by the License RSO, radiation workers will be issued an appropriate dosimetry badge per Sections 6.2 and 6.3 prior to entry into any controlled area where they are likely to receive a measurable occupational dose. In addition to requiring a dosimetry badge, any personnel entry into radiologically controlled areas of the site must satisfy the requirements of the project bioassay and training program, as appropriate, except for casual visitors as described in Section 6.2.1.

External dosimeters, such as TLDs and SRDs, monitor external radiation dose; internal doses are monitored in accordance with Shaw E & I Procedure T-RA-013, *Bioassay and Internal Dose Monitoring*.

NOTE: Project personnel may participate in an existing client dosimetry program, in lieu of establishing a program, if the requirements of that client program, upon evaluation by the License RSO, are equivalent, or exceed, the requirements of this procedure.

### 6.1 Radiation History Reports

All personnel with prior radiological work experience shall complete a Personnel Dosimetry Record. If current records are not provided by an individual, the individual shall provide a completed Request for Report Of Radiation Dose History form to obtain their past reports of radiation history. In addition, they shall make available a copy of their dose history on NRC Form 4, or equivalent, and NRC Form 5, or equivalent. The Project RSO or equivalent shall review these forms when completed and maintain these forms in the project records. Copies of all dose history records will be forwarded to the Health & Safety Department at the completion of the project, or once per quarter, whichever is more restrictive.

## 6.2 Issuance of TLD Badges

All permanently assigned site personnel will be issued an appropriate dosimetric device prior to entry into any Radiologically Controlled Area (RCA). Other workers will be supplied and required to use individual monitoring devices under any of the following conditions:

- The workers are adults likely to receive, in 1 year from sources external to the body, a dose in excess of 400 mrem Total Effective Dose Equivalent (TEDE).
- The workers will be entering a high or very high radiation area.
- The workers are likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI of 10 CFR Part 20, “Standards for Protection Against Radiation.”

A NRC Form 4 and NRC Form 5, or equivalent, shall be obtained for each individual assigned a TLD badge. A Personnel Dosimetry Record shall be completed for each individual issued a TLD with the following information:

- Individual's name
- Date of Birth
- Sex
- Social Security Number
- Individual’s Home Address

### 6.2.1 Visitors

Visitors shall be issued dosimetry badges as deemed appropriate by the Project RSO or equivalent, taking into consideration radiation and contamination levels, duration of visit, and other pertinent information. For groups of visitors, at least one dosimeter shall be issued to an individual in each group. Visitors shall not be allowed to enter areas where they may exceed one half of the applicable limits of 10 CFR Part 20, “Standards for Protection Against Radiation”.

Visitors may be exempted from the requirements of the bioassay, dosimetry, and training programs at the discretion of the Project RSO or equivalent, under the following conditions:

- The visit is a "one-time" occurrence
- The location to be visited is not an RCA, and has very low potential for airborne contamination
- The visitor is escorted at all times by an individual with a dosimeter

### 6.2.2 Dosimeter Use

Dosimeters shall be worn on the front of the body between the shoulders and the waist, unless otherwise specified by the Project RSO or equivalent.

Dosimeters shall be exchanged and returned to the vendor for processing, monthly, quarterly, as required by the Project RSO with the concurrence of the License RSO, or as specified in site-specific plans or work instructions. Monthly or quarterly TLD reports should be returned to the Project RSO, or a designee. Results shall be recorded on the Personnel Dose Record Form, Personnel Internal Dose Record Form, and Personnel Internal Dose Assessment Form.

A control dosimeter, of the same type as issued dosimetric devices, and all other badges (when not being worn by personnel) shall be stored in areas known to have low backgrounds not affected by radiation emanating from the site. If necessary, a shielded container shall be provided for the storage of all badges when not in use. The Project RSO will designate the appropriate daily storage location for dosimeters not in use, as well as the location of the control dosimeter.

Dosimeters are not to be taken home at the end of the workday.

In the event of a lost dosimeter, a calculated dose shall be utilized for an individual's dose record using the Loss of Personnel Dosimetry Report form. Results from co-worker dose and calculations of individual dose through reconstruction of the individual's work history leading to the potential dose shall be reviewed during the evaluation. Report all lost dosimeters to the Project RSO or equivalent, immediately, verbally and in writing using the Loss of Personnel Dosimetry Report.

Visitor dosimeters, if not self-reading dosimeters, will be processed at the time of regular badge exchange, unless otherwise authorized by the Project RSO or equivalent.

Dosimeters shall only be issued to one individual, and shall not be reissued until processed.

The Project RSO or equivalent shall record any unusual occurrences or conditions that may relate to personnel dosimetry data on the Personnel Contamination/Dose Report Form.

### 6.3 Administrative Personnel Dose Guidelines

Personnel doses shall not exceed the guidelines established in Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*, and the limits of 10 CFR Part 20, "Standards for Protection Against Radiation," The Project RSO or equivalent may establish more restrictive project-specific administrative limits.

An investigation shall be conducted and documented by the Project RSO or designee if any person receives, or is suspected of receiving, a dose that exceeds the established administrative limit.

If an overdose is suspected, the individual's personnel dosimetry shall be processed immediately. Bioassay samples shall be initiated, and internal dose calculations shall be performed, if necessary. The individual shall be restricted from entering the RCA until the Project RSO, and the License RSO, can determine that no administrative or legal dose limits will be exceeded. The Project RSO shall initiate an investigation and report the incident in accordance with Shaw E & I Health and Safety Procedure HS020, "Accident Prevention Program: Reporting, Investigation, and Review."

### 6.4 Dosimetry Vendors and Processors

Laboratories supplying and process dosimetry shall be accredited by the National Institute of Standards and Technology (NIST) by participation in the National Voluntary Laboratory Accreditation Program (NVLAP). The Project RSO shall verify accreditation prior to selecting a dosimetry vendor for the project.

### 6.5 Personnel Dosimetry Records

On-site individual dose files shall be maintained for all personnel who are monitored for external and/or internal dose.

The following records shall be included in each individual's dose file:

- Personnel Dosimetry Record
- Request for Report of Radiation Dose History, as required
- NRC Form 4 or equivalent
- NRC Form 5 or equivalent
- Personnel Contamination/Dose Report Form, as required

- Loss of Personnel Dosimetry Report, as required
- Personnel Dose Forms or equivalent (Personnel Dose Record Form, Personnel Internal Dose Record Form, Personnel Internal Dose Assessment Form)

The Personnel Dosimetry Record form shall be initiated at the site for all subcontractor personnel working at the site. These records shall then be forwarded to the Project RSO or equivalent for inclusion into the project files.

### 6.6 Records Retention

All forms generated as a result of this procedure shall be maintained throughout the duration of the project and then retained in accordance with Shaw E & I Health and Safety Procedure HS700, *Radiation Protection Program*.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject: Radiation Exposure Rate Monitoring**

## 1. PURPOSE

This procedure describes general methods and techniques to be used when performing radiation exposure rate monitoring as part of a radiation survey. Radiation monitoring is performed, in conjunction with an assessment of the overall radiological conditions and other potential hazards, in order to demonstrate compliance with applicable regulations. Radiation monitoring is also used to determine external radiation levels in work areas so that personnel radiation dose can be minimized. The monitoring data helps determine the need for area control and postings, personal dosimetry requirements, and the requirements for Radiation Work Permits (RWPs) in order to maintain exposures ALARA.

## 2. SCOPE

This procedure provides standard practices for the performance of radiation exposure rate measurements as part of a radiation survey. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these measurements. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers*
- Shaw E & I Procedure T-RA-005, *Field Project Radiological Controls*
- Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*
- Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*
- Shaw E & I Procedure T-RA-010, *Radiological Site Controls*

## 4. DEFINITIONS

- **Action Level—**For radiation monitoring, a predetermined rate of exposure that, when reached, or measured, requires that a specific, predefined set of follow-up protocols go into effect to minimize personal exposure and to control sources of radiation.
- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and

socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Radiation (α)**—Alpha particles ($He\text{-}4^{++}$) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.

- **Attenuation**—The process by which a beam of radiation is reduced in intensity when passing through some materials, including air; represents a combination of absorption and scattering processes that lead to a decrease in flux density as the beam passes through matter.

- **Background Radiation—**Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Radiation(β)—**Beta particles ($e^-$) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Biological Effect**—The net biological change caused by a specific quantity of absorbed dose to body tissues, measured in Rems or Sieverts.

- **Calibration—**The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.

- **Contamination—**The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Dose**— A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Exposure**—Being exposed to ionizing radiation or to radioactive material.

- **External Dose**—That portion of the dose equivalent received from radiation sources outside the body.

- **Flux—**A term applied to the amount of some type of radiation crossing a certain point, or area, per unit time. The unit of flux is particles (or gamma energy) per $cm^2$ per second.

- **Gamma Radiation (γ)—**High energy, short wavelength photons emitted from radionuclides while undergoing decay, or by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.

- **Gray—**A unit of absorbed dose equal to 1 Joule/kilogram or 100 rads.

- **Hot Spot—**A location within a radiologically controlled area in which the levels of radiation or contamination are noticeably greater than in the surrounding area.

- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Monitoring-** The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses**.**

- **Neutron Radiation (n)—**An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.

- **License Radiation Safety Officer (License RSO)**—An individual who, by virtue of education, certifications, or experience, is qualified to provide planning for, and oversee the proper implementation of, radiological controls measures for work activities involving the potential for exposure to ionizing radiation.

- **Quality Factor**—A unit less number assigned to a particular type (and energy) or radiation in producing biological effect. Quality factors are used to derive equivalent dose from absorbed dose. Gamma, X-ray, and Beta radiation are assigned a quality factor of 1. Alpha and Neutron radiation have quality factors between 2 and 20.

- **Rad**—A unit of absorbed dose equal to 0.01 Joule/kilogram or 0.01 Grays.

- **Radiation Worker—**An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Project Radiation Safety Officer (Project RSO)** — Individuals who, by virtue of training and/or experience, have been authorized by the License RSO to use or directly supervise the use of radioactive materials under the requirements of USNRC Service License.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Rem—**A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor. One Rem is equal to 0.01 Sievert.

- **Roentgen**—A unit of exposure equal to the amount of gamma or X-rays required to produce 1 electrostatic unit (esu) of charge in 1 cc of dry air at standard temperature and pressure.

- **Shine—**Radiation from a source near a measurement location that interferes with a particular environmental measurement. While background is always a part of a gross measurement, in the case where shine is present, the significance and data quality of the measurement may be questionable.

- **Sievert**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Gray multiplied by a quality factor. One Sievert is equal to 100 Rems.

- **Survey—** An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Survey Unit**—A predefined geographical area, or location within a facility, that forms the boundary for a specific radiological evaluation or survey.

- **X-ray Radiation—**High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and pose a substantial external radiation hazard.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (License RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the License RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users

Maintain all required license records at the location specified on the license.

### 5.3 Project Radiation Safety Officer

Project RSO's are responsible to understand, implement, and properly document the performance of the activities in accordance with the conditions of the license and all procedures, and program requirements that are incorporated by reference, on Shaw E & I projects where the license is in use. Project RSO's must be approved by the license RSO and shall report directly to the License RSO in matters involving the implementation of the USNRC license

The Project RSO is responsible to implement the radiation monitoring requirements for a specific project, as established by the License RSO. The Project RSO is responsible to ensure the proper collection and documentation of radiation survey data on the project site.

### 5.4 Radiological Controls Technicians

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of survey data. This includes performing operational checks on monitoring instrumentation, performing measurements, and documenting results in compliance with established procedures and convention.

## 6. PROCEDURE

### 6.1 Prerequisites

Prior to conducting radiation exposure rate monitoring, the RCT conducting the survey shall ensure that following prerequisites are met:

- Project-specific radiological survey and data collection requirements, and data quality objectives, are established in written project documents and are understood by the RCTs performing surveys.
- All required survey supplies and material are available for use on site. These materials include the following:
  - Completed and approved Activity Hazard Analysis for the monitoring activity to be performed

- Radiation Work Permit (RWP) prepared and approved in accordance with Shaw E & I Procedure T-RA-010, *Radiological Site Controls* (if entering radiologically controlled areas to perform surveys)
- Radiation/Contamination Survey Report Forms
- Appropriate radiation dosimetry
- Properly calibrated instrumentation or analytical equipment capable of measuring the radiation(s) of interest

- The appropriate monitoring instrument has been selected and calibrated and is operating properly in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- The previous surveys of the area of interest have been checked, if available, to determine radiation and contamination types and levels in the areas to be surveyed and to determine whether conditions of safety have changed since the last survey.
- A survey map of the area of interest has been obtained or prepared, using a survey record form, providing a graphical representation of the area or item to be monitored.
- Appropriate action levels or guideline values have been established, and required actions or reporting requirements are understood by RCTs performing surveys.
- For systematic measurements, appropriate reference and sample grids have been established based on data quality requirements.

## 6.2 Measuring Exposure Rates

Generally, radiation exposure rate measurements include the following types of measurements:

- Initial Entry – Entry into areas with exposure rates that are unknown (if required due to lack of available radiological data).
- General Area – Measurements taken to determine radiation levels in work areas to allow ALARA planning and to determine the need for radiation shielding to limit exposures.
- Area Posting – Measurements taken to determine or verify regulatory area posting requirements.
- Beta Exposure – Measurement of dose from Beta radiation.

### 6.2.1 Initial Entry Surveys

Initial entry survey shall be conducted prior to, and during, initial entry into work areas where there is a potential for substantial external exposure to ionizing radiation. The following steps shall be taken to ensure exposures are maintained ALARA:

- Using a detection instrument with an audible response, turn on the portable detection equipment and adjust the instrument to its highest range setting. If the instrument is over-ranged at the highest setting, immediately exit the area and obtain an instrument capable of detecting higher exposure rates.
- If the instrument is not over-ranged, adjust the instrument range setting until an accurate measurement can be seen on the meter face.
- Document data on a Radiation/Contamination Report Form
- Once an exposure rate is established, by audible response and meter reading, conduct general area and area posting surveys as described below.

6.2.2 General Area Measurements

For measurement of the general area gamma radiation level, take measurements at approximately 1 meter from surfaces or above ground. This should be done with the beta shield in the "closed" position. Repeat measurements as necessary to verify data. Document data on a Radiation/ Contamination Report Form.

6.2.3 Area Posting Measurements

For measurement of the gamma radiation level in support of posting requirements, take measurements at 30 centimeters from the radiation source or from any surface that the radiation penetrates. This should be done with the beta shield in the "closed" position. Upon completion of the monitoring activities, post the work area as required by the applicable regulatory reference. Repeat measurements as necessary to verify data. Document data on a Radiation/Contamination Report Form.

6.2.4 Beta Exposure Rate Measurements

For measurements of beta dose rates, perform measurements at the location where the worker may be exposed, with the beta shield both open and closed. For instruments without a beta shield, the active area of the detector will be covered with an appropriate shielding material for the closed measurement. Record the results. Beta measurements should be taken no more than 1 centimeter from the surface. To obtain true Beta dose, subtract the closed window reading from the open window reading and multiply the result by the predetermined beta calibration factor for the instrument used. The net result is the exposure from Beta radiation. Repeat measurements as necessary to verify data. Record data on the Radiation/Contamination Report Form.

### 6.3 Quality Control Measurements/Samples

In order to ensure the level of data quality required by the purpose of the survey being performed, quality control measurements and samples will be collected as part of the monitoring process. Specific requirements for performance, collection, and analysis will be established prior to performing any monitoring activities. The RCT performing each survey will be given instruction regarding the QC sample requirements for the sampling activity being conducted.

### 6.4 Waste Management

Waste streams associated with monitoring and sampling activities include used personal protective equipment (PPE) (tyvek and gloves) and used smears. If not suspected of being contaminated, these items will be disposed of as trash. If radiological contamination is suspected, based on monitoring data, PPE and contaminated smears will be bagged and disposed of as radioactive waste.

## ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

## Subject: Radiological Site Controls

## 1. PURPOSE

This procedure describes how access to radiologically impacted sites, radiologically controlled facilities, or other areas, is restricted to only those personnel authorized to enter such areas. Access to these areas is controlled for the purpose of minimizing radiation exposures to site workers, visitors, and the general public.

## 2. SCOPE

This procedure specifies standard practices for the control of radiologically impacted areas. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when accessing these controlled areas. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans*.
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls.*
- Shaw E & I Standard Operating Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- Shaw E & I Standard Operating Procedure T-RA-008, *External Dosimetry Administration*.
- Shaw E & I Standard Operating Procedure T-RA-012, *Surface Contamination Monitoring.*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000

## 4. DEFINITIONS

- **Access Control Point**—A location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas.
- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and

socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.
- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.
- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.
- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.
- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.
- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.
- **Frisking**—The process of searching a person's clothing or body with a radiation detection instrument prior to releasing the person from a radiologically controlled area.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Monitoring**-The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**— The Project RSO is designated by the License RSO as an Authorized User and by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including the providing direction to radiological controls technicians.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Radiologically Controlled Area (RCA)**—Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.
- **Smear Sampling**—A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper, and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally $100 cm^2$.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.
- **Transferable, Removable, or Loose Contamination**—Radioactive material that can be easily removed from a surface or item.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program which includes selection of controlled areas, personnel protective equipment, and appropriate exit contamination survey instrumentation.

### 5.3 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to understand, implement, and properly document the performance of the requirements of this procedure for a specific project, as established by the License RSO. The Project RSO is responsible for the following:

- Ensuring that radiological surveys performed for the demonstration of compliance conform to the requirements of this procedure
- Maintaining an adequate inventory of functional, calibrated radiation survey instrumentation
- Storing and controlling the use of all dosimetry
- Ensuring that the performance of site controls is enforced and conform to the requirements of this procedure

### 5.4 Radiological Controls Technicians

Radiological Controls Technicians (RCTs) are responsible to follow procedures established by the License RSO, or Project RSO, and shall ensure that site controls are performed in accordance with this procedure.

### 5.5 Individuals

Individuals requiring entry into controlled areas are required to obey any written postings and verbal instructions provided to them by radiological controls personnel and to enter, or egress, areas only through properly identified and posted access control points.

## 6. PROCEDURE

All personnel entering a Radiologically Controlled Area (RCA) at a project site or a Shaw E & I controlled facility shall do so only at the designated access control points. Personnel who have regular job assignments at a project site shall be issued a personnel dosimeter, if required, per Shaw E & I Standard Operating Procedure T-RA-008, *External Dosimetry Administration*. Visitors shall be issued a dosimeter, and/or escorted at the discretion of the Project Radiation Safety Officer or equivalent.

All personnel shall log in at the Access Control Point using the Radiation Work Permit (RWP) Signature Form in accordance with Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls*.

All personnel shall don the appropriate personnel protective equipment as specified in the RWP.

Upon exiting the RCA, all personnel shall be surveyed for contamination in conformance with Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring* (i.e. by frisking). The time of exit shall be recorded on the RWP signature form. Doff personal protective equipment (PPE) in accordance with Posted Decon/PPE Removal Procedures.

All materials and/or equipment shall be surveyed for contamination in conformance with Shaw E & I Standard Operating Procedure T-RA-012, *Surface Contamination Monitoring* (i.e. by frisking and smear surveys).

Personnel and equipment decontamination shall be performed in accordance with Shaw Health and Safety Procedure HS700, *Radiation Protection Program* and 29 CFR 1910.120.

All personnel dosimeters, if issued, shall be left at the Access Control Point or in an area designated by the RCS or equivalent.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject:** **USNRC Service license Implementation Procedure**

## 1. PURPOSE

This purpose of this procedure is to establish a formal procedure for the implementation of the Shaw E & I U.S. Nuclear Regulatory Commission (USNRC) Service License.

## 2. SCOPE

This procedure specifies regulatory and programmatic requirements for the implementation of the USNRC License on Shaw E & I field projects. The procedure is intended to provide guidance to potential license users in requesting implementation.

## 3. REFERENCES

- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls.*
- Shaw E & I Standard Operating Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*

## 4. DEFINITIONS

- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Authorized Users/ Project RSO**—Individuals who, by virtue of training and/or experience, have been authorized by the License RSO to use or directly supervise the use of radioactive materials under the requirements of USNRC Service License.
- **Controlled Materials**—Any licensable radioactive material controlled by Shaw E & I at a project location under NRC Service license.
- **Inventory**—Licensable radioactive materials that are in the position of Shaw E & I (company-wide) prior to the beginning of a project, and materials controlled by Shaw E & I (company-wide) during the course of a project.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Licensed Material**—Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under the NRC Service License.

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Radiation Safety Officer ( License RSO)**—The representative of the licensee, identified by name in the NRC license, who is responsible for implementation of the license and the associated radiation safety program. The License RSO also maintains all required records associated with license implementation.
- **Reciprocity**—Mutual agreement between two entities, in the context of this document between a USNRC agreement state and the licensee, allowing the licensee to conduct licensed activities under the jurisdiction of the agreement state.
- **US NRC License**— US NRC license possessed by Shaw Environmental, Inc. allowing the licensee to perform the following:
  - Decontamination of facilities, equipment, and containers
  - Solidification and treatment of wastes
  - Packaging for transport
  - Any activity related to site characterization
  - Transport, in packages or containers approved for use under the provisions of 10CFR Part 71, for transfer to licensees authorized to receive the materials

  These activities may only be conducted on temporary job sites anywhere in the United States where the USNRC maintains jurisdiction for regulating the use of licensed material.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (License RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the License RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users
- Maintain all required license records at the location specified on the license

### 5.3 Project Manager

The site-specific Project Manager (PM) is responsible to maintain operations such that license requirements are met at all times. The PM will consult with the License RSO and the project authorized license user when planning licensed activities.

### 5.4 Authorized Users/Project Radiation Safety Officer

Authorized Users/Project RSO's are responsible to understand, implement, and properly document the performance of the activities in accordance with the conditions of the license and all procedures, and program requirements that are incorporated by reference, on Shaw E & I projects where the license is in use. Authorized Users/Project RSO's must be approved by the license RSO and shall report directly to the License RSO in matters involving the implementation of the USNRC license.

## 6. PROCEDURE

Prior to implementation of the USNRC Service license, a proposed authorized license user shall prepare an ALARA License Implementation Review Form (Attachment 1). This form will be reviewed and approved by the license RSO.

The License RSO will review the qualifications of proposed project authorized license users to ensure that each user is qualified, in accordance with the requirements of the license, to act as a license user. The License RSO will approve each proposed authorized license user in writing on the ALARA License Implementation Review Form.

Prior to NRC notification of intent to implement the license, the License RSO and all authorized users will conduct a pre-notification briefing, in accordance with the "Field Project ALARA Briefing Data/Check-off Form (Attachment 2)," which shall be used as an agenda and to document this briefing.

### 6.1 Notifications to USNRC Prior to Initiating Activities

At least 3 days before initiating activities at a temporary job site, the license RSO shall notify the USNRC, in writing, of the following information:

- Estimated type, quantity, and physical/chemical form(s) of licensed material
- Where the job site is located
- Description of project activities, including waste management and disposition
- Estimated project start date and duration
- Identification of, and contact information for, key project personnel

This information shall be sent by the License RSO to:

Regional Administrator
USNRC Region I
Attn: Chief Nuclear Materials Licensing/Inspection Branch
475 Allendale Road
King of Prussia, PA 19406-1415

### 6.2 Use of Multiple Licenses

If more than one USNRC or Agreement State license will be in use on the project site, a written agreement is required between Shaw and the other licensee specifying which licensee activities shall be performed under the other licensee's cognizance and which licensee activities shall be performed under Shaw supervision pursuant to the conditions of the NRC Service License. This agreement shall include a commitment by the licensee and the customer to ensure safety, and any commitments by the licensee to help the customer clean up the site if there is an accident.

NOTE: IF APPROVED BY THE RADIATION SAFETY OFFICER, REASONABLE ACTIONS MAY BE TAKEN IN AN EMERGENCY THAT DEPART FROM THE CONDITIONS OF THE LICENSE WHEN THE ACTION IS IMMEDIATELY NEEDED TO PROTECT PUBLIC HEALTH AND SAFETY, AND NO ACTION CONSISTENT WITH ALL LICENSE CONDITIONS THAT CAN PROVIDE ADEQUATE OR EQUIVALENT PROTECTION IS IMMEDIATELY APPARENT.

## 6.3 Notification to USNRC at the Completion of Activities

At the completion of activities involving the USNRC license at each job site location, the License RSO, or designee shall notify:

Regional Administrator
USNRC Region I
Attn: Chief Nuclear Materials Licensing/Inspection Branch
475 Allendale Road
King of Prussia, PA 19406-1415

Included in the notification shall be status of the temporary job site and the disposition of the licensed material.

## 6.4 Other Notifications, Approvals, and Licenses

In accordance with the requirements of 10 CFR 30.36(d), the License RSO shall promptly notify the USNRC in writing of a decision not to complete actions that require the implementation of the USNRC license at the facility.

Implementation of the USNRC license in Agreement States shall be with the written approval of the state regulating agency and the above notifications of the USNRC.

Upon entering a facility where the customer has a USNRC or Agreement State license, copies of all licenses shall be obtained by the RSO or designee.

Notification of local police, fire, and medical facilities of the activities being undertaken should be done upon project initialization to discuss applicable hazards.

## 6.5 Authorized User/Project RSO Responsibilities

Authorized users of the USNRC license, as approved, in writing, by the License RSO for specific field projects, are responsible for the following actions:

- Ensuring that proper radiological control measures are invoked, in accordance with approved procedures, which minimize personnel exposures and generation of wastes
- Ensuring appropriate accountability of radioactive materials possessed under the license
- Notifying the License RSO of unexpected and unusual situations at the project, and any incidents or accidents that occur
- Ensuring that project documentation is accurate and complete throughout the project for all activities undertaken
- Ensuring that appropriate licensing documents and applicable regulations are on hand at the project site, including all applicable Shaw operations, safety, and radiation protection procedures
- Notifying the License RSO of all regulatory agency inspections, scheduled or otherwise

- Escorting regulatory agency personnel on the project site, as applicable
- Maintaining general contact with local regulatory representatives to ensure that these agencies are fully appraised of the project progress
- Ensuring proper transportation and disposition of all radioactive materials for which possession was taken during the project

An authorized license user shall remain on the project site when activities involving radioactive material covered by the license are being performed.

## 6.6 Radioactive Material Tracking

In order to stay within the limits established by the NRC for the maximum amount of radioactive materials that may be possessed by Shaw at any one time, as described by condition number 8 in the NRC license, the following procedures must be observed.

- Prior to the beginning of each field project, the project manager will consult with the License RSO regarding the approximate amounts of radioactive materials that will be controlled under the NRC license at the site. If the amounts discussed will approach 50-percent of the allowable limit, the License RSO will evaluate the amount of materials being controlled under the license at other sites and determine if a potential exists for the license limits to be exceeded.
- At the beginning of each field project, the Authorized User/Project RSO will review the current inventory of licensed materials controlled under the NRC license. The Authorized User/Project RSO should report to the License RSO any additions to the inventory that may result in the license limits being approached as they occur. The Authorized User/Project RSO should also be made aware of changes to the inventory that may have occurred on another site as needed. Radioactive material, which may be controlled only temporarily under the NRC license, may not be added to the inventory.
- To track radioactive materials that are controlled under the NRC license at a project site, Licensed Radioactive Material Tracking Sheets will be used to ensure license limits are not exceeded. The tracking sheets will be initiated, controlled, and maintained on site by the project Authorized User/Project RSO. Upon completion of the project, the tracking form will be sent to the license RSO. The following steps are required to complete the tracking sheets:

  1. Enter the project information (location, number, Authorized User/Project RSO)
  2. Identify the type of licensed material to be tracked by the sheet (A, B, C, or D) (only one type per sheet)
  3. Identify the maximum amount of the material allowable by the license
  4. Identify, or estimate, the amount of material in current inventory
  5. Enter all additions and reductions of controlled materials and maintain a running total, including inventory changes from other sites

  If the running total reaches ¾ of the maximum amount of the material allowable by the license, the authorized user will inform the License RSO prior to each subsequent addition of controlled materials.

  At the end of the project, the tracking forms will be maintained by the license RSO.

## 6.7 Records

All records generated in accordance with this procedure shall be made available to the customer and USNRC upon request. At the completion of activities at temporary job sites, the records shall be transferred to the customer for retention until the site is released for unrestricted use. Copies shall be provided to the license RSO and retained for a minimum of five (5) years.

## 7. ATTACHMENTS

- ALARA License Implementation Review Form
- Field Project ALARA Briefing Data/Check-Off Form
- Licensed Radioactive Material Tracking Sheet

**Attachment 1**

# ALARA LICENSE IMPLEMENTATION REVIEW FORM

This form is required prior to implementation of USNRC Service License.

ALARA Meeting Date:_____________________Completed by:_____________________

ALARA Meeting members present:

Radiation Safety Officer ______________________________________

Proposed Authorized User/Project RSO ______________________________________

Project Name and Number:______________________________________________________

1. Scope of work (including location, schedule requirements and risk vs. SHAW experience, capabilities and present capacity for added work).

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

2. Radionuclides of concern and their activity__________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

3. Total radioactivity level involved__________________________________________________

4. Physical form and characteristics of the radioactive material (soil, dusty, wet, surface contamination, water, gas, etc.).

_______________________________________________________________________________

_______________________________________________________________________________

5. Man REM estimate for the work. ___________________ person-REM

6. USNRC Region involved, contact person Region _______

Contact person, phone number_______________________________________________________

7. State regulatory agency involved, contact person

State Agency, phone number_________________________________________________

Contact person, phone number _______________________________________________

8. Waste disposal issues and options.

_______________________________________________________________________________

_______________________________________________________________________________

9. Presence or absence of hazardous materials.

_______________________________________________________________________________

_______

10. Is an emergency plan required? ____________________

# ALARA LICENSE IMPLEMENTATION REVIEW FORM

If an emergency plan is not required has written

USNRC approval been received? ____________________

11. Licensing issues.

If the customer holds an NRC or Agreement State license do we have a written agreement between the licensee and the customer specifying which licensee activities shall be performed under the SHAW license? ____________________

12. Authorized radioactive materials license user for the project.

____________________________________________________________

Submitted by:

Proposed Authorized User________________________________Date_______________________

APPROVAL:

Radiation Safety Officer___________________________Date_______________________

# Field Project ALARA Briefing Data/Check-Off Form

Project Name:_____________________________ Number:_____________ Start date:__________________

Location:_______________________________ Project RSO:_______________________________________

Client's Rad Con Dept.______________________ Title/Ph.#:________________________________________

Authorizing Radioactive Materials License for Project____________________________________________

1. Project Scope:_________________________________________________________________________________________________________________________________________________________

2.

| Known or Potential Radioactivity Source(s) | Expected Level(s) and Type(s) - Nominal/Max. Radiation ( /hr) | Contam. (dpm/ $100cm^2$) | Airborne (µCi/ml) |
|---|---|---|---|
| ________________ | ______/______ | _______/_______ | _____/_____ |
| ________________ | ______/______ | _______/_______ | _____/_____ |
| ________________ | ______/______ | _______/_______ | _____/_____ |

3. Required Instrumentation (List MFR./Model#, inst. type; B; Qty. etc.)

Contamination Survey(s):________________________________________________________

Inventory/Avail.:__________________________________________________________

Radiation Survey(s):____________________________________________________________

Inventory/Avail.:__________________________________________________________

Airborne Monitoring:____________________________________________________________

Inventory/Avail.:__________________________________________________________

Counter-Scaler(s):______________________________________________________________

Inventory/Avail.___________________________________________________________

Check Source(s)/Misc. Equip.:____________________________________________________

Inventory/Avail.:__________________________________________________________

4. Project Control/Release Limit(s):

| | Contamination | Radiation |
|---|---|---|
| - Personnel | __________ | N/A |
| - Equipment | __________ | __________ |
| - Other/Routine | __________ | __________ |
| - Project Site (at completion) | __________ | __________ |

5. Discussion Points: Initials _____

a) Work area layout - boundaries, exits/control point(s), etc. _______
(attach basic diagram of Project Site Set-up if necessary)

## Field Project ALARA Briefing Data/Check-Off Form

b)Radiation, Contamination, Airborne activity levels/controls _______

c) Baseline Survey requirements (yes/no if yes explain):________________________________

____________________________________________________________________________

d)Special work area requirements (e.g. CSCA, containments, etc.):______________________

____________________________________________________________________________

e)Monitoring requirements (type, frequency, duration, etc.):_____________________________

____________________________________________________________________________

____________________________________________________________________________

f) Personnel Monitoring Requirements(s) Dosimetry: Initials ________

Responsible Party/Processing Vendor _______________/_____________ _______

Type/Qty.:___________________ Inventory:________________

Radiation Worker Examinations NRC Form 4 for each worker

Internal: Bioassay ___________ Whole Body Count __________ _______

Notes:_________________________________________________________________

g)Properties of expected Radionuclides - effects on personnel _______

Special Precautions:____________________________________________________

h)General Worker Training requirements: _______

____________________________________________________________________________

Visitors:_________________________________________________________________

I) Handling/Packaging of Waste/Broker: _______

____________________________________________________________________________

j) Necessary postings, barriers, etc.: _______

Caution Radioactive Material, Contaminated Area,

Radiation Area, Airborne Radioactivity Area:

k)Environmental monitoring: _______

6. Notes:___________________________________________________________________

____________________________________________________________________________

An ALARA briefing in has been conducted this _______________ day of___________________________,

with:1. __________________________________; 2. ______________________________;

3. _______________________________________

.

## Field Project ALARA Briefing Data/Check-Off Form

RSO Approved: ________________________________________ Date _____________________

# LICENSED RADIOACTIVE MATERIALS TRACKING SHEET

| LICENSED RADIOACTIVE MATERIALS TRACKING SHEET | | Page _____ of _____ |
|---|---|---|
| **Location:** | | **Project Number:** |
| | | **Project RSO:** |
| **Licensed Material:**<br>(Select one per sheet)<br><br>A - Byproduct materials with<br>atomic numbers 1 through 92<br>B - Source material<br>C - Byproduct materials with<br>atomic numbers 93 and above<br>D - Special nuclear material<br>(U-235, U-233 or plutonium) | (Enter letter above) | **Maximum allowable limits:**<br><br>A - 100 curies total<br>B - 5,000 kilograms total<br>C - 10 curies total<br>D - 350 grams U-235<br>200 grams U-233<br>200 grams plutonium<br>(or any combination of these provided that the sum of the ratios of the quantities does not exceed unity) |

| | | |
|---|---|---|
| 1 | Maximum amount allowable by license: | |
| 2 | Amount currently in inventory: | |
| 3 | Balance permitted by license (line 1 - line 2) | |

Material quantity adjustments: Additions input "###" - Reductions input "<###>"
When total equals three-quarters of the maximum amount allowable by license, contact the RSO.

| DATE | TIME | MATERIAL DESCRIPTION | ADJUSTMENT | TOTAL |
|---|---|---|---|---|
| | | Amount currently in inventory (line 2 above) or the total from the previous tracking sheet. | 0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

End of material tracking for project (Yes/No) ? __________
If "No," go to page _____ of _____
If "Yes," return forms to license RSO.

# RADIATION PROTECTION PROCEDURE

**Subject: Surface Contamination Monitoring**

## 1. PURPOSE

This procedure describes general methods and techniques to be used when performing surface contamination monitoring as part of a contamination survey. Contamination surveys including an assessment of overall radiological conditions and other potential hazards are performed and documented to demonstrate compliance with applicable regulations and to determine the following:

- Protective clothing and respiratory protection requirements for Radiologically Controlled Areas (RCAs)
- Proper radiological postings
- Contamination levels for release of items and materials from RCAs
- Residual contamination levels in remediated areas prior to release from regulatory controls
- Effectiveness of contamination control and decontamination methods

## 2. SCOPE

This procedure provides standard practices for the performance of surface contamination surveys for radioactive contamination. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these surveys. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document.

## 3. REFERENCES

- Shaw E&I Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000
- Shaw E & I Procedure T-RA-005, *Field Project Radiological Controls*
- Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*
- Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*
- Shaw E & I Procedure T-RA-010, *Radiological Site Controls*

## 4. DEFINITIONS

- **Action Level—**For contamination surveys, a predetermined quantity of contamination that, when reached, or measured, requires that a specific, predefined set of follow up protocols go into effect to minimize the spread of contamination or reduce risk of exposure to radiation.

- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha emitting radionuclides may also emit gamma radiation photons during decay.
- **Anti-Contamination Clothing (Anti-Cs)—**Personal Protective Equipment (PPE) worn by radiation workers to prevent the contamination of the workers' skin or clothing when working in contaminated areas.
- **Background Radiation—**Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.
- **Beta Contamination—**The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.
- **Biased Measurements**—Radiological measurements or samples conducted at locations based on the professional judgement of the surveyor.
- **Calibration—**The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.
- **Contamination—**The deposition of unwanted radioactive material on surfaces or in media.
- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.
- **Decay Chain—**A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.
- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.
- **Direct Measurement—**A reading taken using a portable instrument directly on a surface, or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed-location measurements and scans.
- **Fixed-Location Measurements—**Direct measurements performed by placing a detector at a fixed location on, or near, the surface being evaluated.
- **Frisking—**The process of searching a person's clothing or body with a radiation detection instrument prior to release of that person from a radiologically controlled area.
- **Guideline Values—**For surface contamination surveys, a predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **Hot Spot—**A location within a radiologically controlled area in which the levels of radiation or contamination are noticeably greater than in the surrounding area.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Minimum Detectable Concentration (MDC)**—The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity.
- **Monitoring**-The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Random Measurements**—Radiological measurements performed at randomly selected locations within a facility or survey unit.
- **Scanning**—A type of direct measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.
- **Shine—**Radiation from a source near a measurement location that interferes with a particular environmental measurement. While background is always a part of a gross measurement, in the case where shine is present, the significance and data quality of the measurement may be questionable.
- **Smear Sampling—**A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper, and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally $100cm^2$.
- **Survey—**An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation..
- **Survey Unit**—A predefined geographical area, or location within a facility, that forms the boundary for a specific radiological evaluation or survey.
- **Systematic Survey**—Radiological surveys performed at systematically selected fixed measurement or smear sampling locations on a pre-determined sampling grid.
- **Total Contamination—**Radioactive material, including both the fixed and removable contamination fractions, found on, or as a part of, an item or surface.
- **Transferable, Removable, or Loose Contamination—**Radioactive material that can be easily removed from a surface or item.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer (License RSO)

The License RSO is responsible to assess levels of contamination in project work areas and to determine the need for, and periodicity of, surface contamination surveys. The License RSO is also responsible to establish specific requirements for project surface contamination survey including the selection of parameters to be measured, instrumentation, and appropriate data quality objectives. The License RSO shall also establish action levels for surface contamination on project sites.

### 5.3 Project Radiation Safety Officer (Project RSO)

The (Project RSO)is responsible to implement established surface contamination monitoring requirements for a specific project, as established by the License RSO. The Project RSO is responsible to ensure the proper collection and documentation of data on the project site.

### 5.4 Radiological Controls Technicians

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of contamination survey data. This includes performing operational checks on survey instrumentation, collecting and analyzing smear samples, performing measurements, and documenting results in compliance with established procedures and conventions. Site workers are also responsible to properly wear PPE and Anti-Cs and to obey site work rules designed to maintain exposures ALARA.

## 6. PROCEDURE

### 6.1 Prerequisites

Prior to conducting surface contamination surveys, the RCT conducting the survey shall ensure that following prerequisites are met:

- Project-specific radiological survey and data collection requirements, and data quality objectives, are established in written project documents and are understood by the RCTs performing surveys.
- All required survey supplies and material are available for use on-site. These materials include the following:
  - Appropriate smear sample media and smear envelopes
  - Scintillation vials and cocktail (for liquid scintillation analysis)
  - Gloves, appropriate anti-contamination clothing, and other PPE as required based on identified hazards
  - Completed and approved Activity Hazard Analysis for the survey activity to be performed
  - Radiation Work Permit (RWP) prepared and approved in accordance with Shaw E & I Procedure T-RA-010, *Radiological Site Controls* (if entering radiologically controlled areas to perform surveys)

- Radiation/Contamination Survey Report Forms
- Appropriate radiation dosimetry
- Properly calibrated instrumentation or analytical equipment capable of measuring the radiation(s) of interest at, or below, the specified MDA (10-50% of MDA recommended)

▪ The appropriate survey instrument has been selected and calibrated and is operating properly in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*

▪ The previous surveys of the area of interest have been checked, if available, to determine radiation and contamination types and levels in the areas to be surveyed and to determine whether conditions of safety have changed since the last survey.

▪ A survey map of the area of interest has been obtained or prepared, using a survey record form, providing a graphical representation of the area or item to be surveyed.

▪ Appropriate action levels or guideline values have been established, and required actions or reporting requirements are understood by RCTs performing surveys.

▪ For systematic measurements, appropriate reference and sample grids have been established based on data quality requirements.

**6.2 Scan Surveys**

Scan surveys are generally conducted as an investigative tool to identify areas that require further evaluation by fixed measurement or sampling. These surveys may be quantitative or qualitative with regard to the quality of data collected. Scan surveys shall be conducted as follows:

1. Verify that the instrument has been calibrated and has been set up in accordance with the manufacturer's technical manual, project quality requirements, and Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure,* prior to use.
2. Determine the required scan rate necessary to meet required MDAs based on the contaminant of interest and selected instrument (10-50% of action levels or guideline values is recommended). MDA determination shall be documented in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.
3. With the instrument in operation, at the pre-determined scan rate, move the detector over the surface being evaluated. Using the audible response of the instrument, document instrument readings as required by the survey-specific data quality objectives.
4. "Flag," or mark, any locations or areas that exceed established action levels. Take any required corrective, or protective, action required by project plans and procedures. Levels exceeding these values will also be noted on the survey map(s).

**6.3 Fixed-Measurement Surveys**

Fixed-measurement surveys may include random, systematic, or biased measurement locations. These surveys are performed to provide quantitative measurement of the total contamination on a surface. Fixed-measurement surveys shall be performed as follows:

1. Verify that the instrument has been calibrated and has been set up in accordance with the manufacturer's technical manual, project quality requirements, and Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure,* prior to use.
2. Determine the required measurement count time necessary to meet required MDAs based on the contaminant of interest and selected instrument (10-50% of action levels or guideline values is

recommended). MDA determination shall be documented in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.

3. Place the detector directly on the surface to be surveyed at the desired location. With the instrument operating in "Scaler" mode, take a measurement at the selected sample point for the required count time.

4. Document the direct surface contamination reading measured at the location on the survey data forms.

## 6.4 Smear Sampling

Smear sampling surveys may include random, systematic, or biased measurement locations. These samples are performed to provide quantitative measurement of the removable contamination on a surface. Smear sampling shall be performed as follows:

1. Select smear materials based on the type of smear survey being performed and the instrumentation to be used in analysis of radioactive content on the smear samples.

2. If wet smear sampling techniques (some Tritium contamination smears) are required for liquid scintillation analysis, obtain prepared scintillation vials with 3 to 5 milliliters of deionized water added to each vial. Place the unused smears into the prepared vials.

3. For dry smears, place each individual smear into an envelope or small clean plastic bag (smears with individual "fold-over" covers do not require separate envelopes or bags).

4. At each sample point, remove a single smear from its container (if required) and wipe the smear over an area of approximately 100 $cm^2$ by wiping a square area of approximately 4 inches by 4 inches or an "S" pattern approximately 16 inches long.

5. Once the smear sample is collected, quickly place smear into an individual prepped scintillation vial or bag/envelope. For "foldover" type smear, fold the cover in half to cover the sample.

6. Mark the vial, envelope, or "foldover" cover containing the smear with a unique number identifying the sample location and the sample number. Transport the smear sample to the counting station or on-site laboratory for analysis.

## 6.5 Quality Control Measurements/Samples

In order to ensure the level of data quality required by the purpose of the monitoring being performed, quality control measurements and samples will be collected as part of the survey process. Specific requirements for performance, collection, and analysis will be established prior to performing any monitoring activities. The RCT performing each survey will be given instruction regarding the QC sample requirements for the sampling activity being conducted.

## 6.6 Waste Management

Waste streams associated with monitoring and sampling activities include used PPE (tyvek and gloves) and used smears. If not suspected of being contaminated, these items will be disposed of as trash. If radiological contamination is suspected, based on monitoring data, PPE and contaminated smears will be bagged and disposed of as radioactive waste.

# 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject: Bioassay and Internal Exposure Monitoring**

## 1. PURPOSE

The purpose of this procedure is to establish guidelines for the establishment and implementation of bioassay and internal dosimetry programs on field projects involving the potential for exposure to ionizing radiation. This procedure will prescribe the manner in which bioassay programs will be established on projects including assigning responsibilities for establishment and implementation of such programs.

## 2. SCOPE

This procedure provides for standard practice for bioassay and internal dosimetry programs. It provides the minimum required steps and quality checks that employees and subcontractors are to follow in establishing and implementing such programs. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document.

## 3. REFERENCES

- Shaw E&I Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000
- NUREG/CR 4884, 1990, *Interpretation of Bioassay Results*
- Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*
- International Commission on Radiological Protection, Publication 30, *Limits on Intakes of Radionuclides by Workers*
- International Commission on Radiological Protection, Publication 54, *Individual Monitoring for Intakes of Radionuclides by Workers*
- US Nuclear Regulatory Commission, NUREG/CR-4884, *Interpretation of Bioassay Measurements*

## 4. DEFINITIONS

- **Action Level**—A predetermined radionuclide concentration that, when reached, requires that a specific, predefined set of follow up protocols go into effect which may include re-analysis of the original sample, collection of additional bioassay samples, and dose assessments.
- **Acute Exposure—**The uptake of a relatively large amount of radioactive material (or exposure to large amounts of ionizing radiation) over a short period of time.

- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Annual Limit on Intake (ALI)**—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Baseline Bioassay—**A bioassay measurement obtained from a bioassay program participant prior to beginning or resuming work with radioactive material. The sample is taken in order to establish a pre-exposure baseline.

- **Bioassay—**The measurement, or assay, of kinds, quantities or concentrations and in some cases, the locations of radioactive materials within an individual worker. Bioassay is generally determined by in vitro methods, such as urine analysis, sampling of other body fluids (such as blood), tissue analysis, or by fecal sample. Bioassay may also be performed by direct (in vivo) measurement using specialized radiation detection equipment.

- **Biological Half-Life—**The time required for any biological system, such as the human body, to eliminate half of its body burden of a radionuclide, or set of nuclides, by natural processes.

- **Body Burden—**The amount of radioactive material which if deposited in the total body will produce the maximum permissible dose rate to the body organ considered the critical organ.

- **Committed Dose Equivalent (CDE)—**The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. Committed dose equivalent is expressed in Rem.

- **Committed Effective Dose Equivalent (CEDE)—**The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues and is expressed in Rem.

- **Derived Air Concentration**—The concentration of a radionuclide in air which, if breathed by an individual for a working year of 2,000 hours, would result in an intake of one ALI.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Effective Half-Life—**The time required for the amount of a radionuclide deposited in a living organism to be diminished by half as a result of radioactive decay and biological elimination.

- **Intake (or Uptake)—**Radionuclides entering the body by any exposure pathway, primarily by inhalation, absorption, or ingestion means.

- **Investigation Level**—The level of CDE or intake above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.

- **In Vivo—**"In the living body." For the purposes of an internal dosimetry program, in vivo bioassay measurements are performed by measuring radionuclide body burden within the body using specialized detection instrumentation and monitoring techniques.

- **In Vitro—**"In the glass." For the purposes of an internal dosimetry program, in vitro bioassay measurements are performed by analysis of bodily fluids or tissues removed from the body and analyzed in a laboratory environment.
- **Non-Routine Bioassay—**Any bioassay measurement that is not required to be performed as part of the routine bioassay program requirements, but that is required for confirmation of a suspected intake of radionuclides, to estimate the absorbed dose, or as a result of a known uptake.
- **Project Health Physicist**—An individual who, by virtue of education, certifications, or experience, is qualified to provide planning for, and oversee the proper implementation of, radiological controls measures for work activities involving the potential for exposure to ionizing radiation.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.
- **Recording Level**—The level of committed dose equivalent or intake above which the result is of sufficient interest to be worth keeping and interpreting.
- **Routine Bioassay Sample—**A bioassay measurement taken on a predetermined, periodic schedule, to establish a worker's internal exposure status relative to previous exposure periods.
- **Termination Bioassay Sample**—A bioassay measurement taken at the end of an individual's participation in activities that could result in an intake of radionuclides. This measurement is taken in documenting body burden at cessation of exposure.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The License Radiation Safety Officer (License RSO) assigned to a project involving potential for worker exposure to radiation or radionuclides is responsible to assess the need for an internal exposure monitoring program for a specific project based on the License RSO's assessment of internal exposure potential. The License RSO is also responsible to establish specific requirements for a project internal exposure monitoring program including the establishment of investigative and action levels.

### 5.3 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to implement the established internal exposure monitoring program for a specific project, as established by the License RSO. The Project RSO is responsible to ensure the proper collection and documentation of bioassay measurements and, if appropriate, DAC-hour exposure data derived from airborne radioactivity concentrations in work areas.

### 5.4 Site Radiation Workers

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of bioassay samples. Site workers are also responsible to properly wear respiratory protection equipment and to obey other site work rules designed to maintain internal exposures ALARA. Workers shall report all incidents and unplanned events that could be reasonably expected to result in internal exposure.

## 6. PROCEDURE

Prior to mobilization of field projects involving the potential for internal radiation dose to project personnel, the assigned Project Health Physicist shall determine the need for an internal dosimetry program for the project. The License RSO will also determine specific bioassay requirements consistent with the requirements of this procedure and Shaw Health and Safety Procedure HS700. Any project where workers have the potential to receive an internal dose that equals or exceeds 10% of a regulatory limit shall implement an internal dosimetry program. The following sections describe specific methodologies and requirements that may be included as part of project internal dosimetry programs.

### 6.1 In Vivo Monitoring

In vivo measurements of radionuclide body burden should be performed when practical since such measurements provide a more accurate assay of radioactivity present in the body. This is primarily because some radionuclides of interest may be retained in the body as insoluble compounds that will not appear in analysis of excreta, alone. In some cases, however, in vivo measurements may not be sufficient, or even appropriate. This is the case with some radionuclides, such as Tritium, or some other alpha or beta emitters that cannot be seen due to instrument sensitivity. In vivo measurements are also impractical for measurement of radionuclides with relatively short effective half-lives, due to the limited availability and access to appropriate measurement equipment. In vivo measurement equipment is, in general, only available at major DOE laboratories, along with a few environmental laboratories and university campuses. It is important to identify the availability and accessibility of measurement capability prior to establishing a project-specific program.

When in vivo measurement is appropriate and available, individual baseline measurements shall be performed prior to performance of any work activity that presents the potential for internal exposure. In vivo measurement shall be by whole body analysis conducted in a low background environment. After the baseline analysis, additional analysis shall be performed after termination of the work assignment with exposure potential, or as required by the License RSO.

Non-routine in vivo measurements shall be performed whenever there is a reason to suspect that an employee may have sustained an internal deposition of radioactive material in excess of an administrative or regulatory limit, or if a measurement result exceeds the action level for remeasurement.

### 6.2 In Vitro Bioassay

An in vitro sampling routine shall be established for projects requiring an internal dosimetry program whenever in vivo measurement is deemed impractical or inappropriate, or as a means to augment or verify the effectiveness of in vivo monitoring. Normally, in vitro sampling will be for urine bioassay. In some cases, however, fecal, or other types of samples may be required.

**Note: Universal bloodborne pathogen precautions shall be taken when preparing and handling unsealed bioassay samples. Samples that require invasive procedures such as phlebotomy (blood sampling) shall be performed only by qualified medical personnel.**

All personnel who will perform work that presents any internal exposure potential shall submit a bioassay sample prior to beginning such work, after termination of the work assignment, and as required by the project internal dosimetry program. Additional non-routine samples may be required by the License RSO during work on a project. Instructions regarding the collection of routine and non-routine samples shall be provided to workers prior to collection of samples.

Non-routine bioassay samples shall be requested whenever there is a reason to suspect that an employee may have sustained an internal deposition of radioactive material in excess of an administrative or regulatory limit, or if a bioassay result exceeds the action level for resampling.

### 6.3 Urine Bioassay Collection Instructions

Prior to supplying sample containers to workers for bioassay sample collection, each worker shall be given specific instruction on sample collection procedures and precautions. Most projects requiring internal dosimetry will utilize urine bioassay for data collection. These samples will be collected, prepared, and handled in accordance with the instructions of the analytical laboratory performing the analysis. In general, however, sampling will be conducted in accordance with the following requirements:

- Samples shall include each urine void for a 24-hour sampling period. Minimum acceptable volume for a 24-hour sample should be 1000 mL.
- Samples shall be collected in a clean container, either provided by the laboratory or approved by the License RSO for use.
- Workers shall wash hands carefully prior to each void.
- For baseline samples, no entry into radiologically controlled areas shall be made prior to completion of the sample. For termination samples, no entry into radiologically controlled areas shall be made during, or after completion of, sample collection.
- For non-routine sampling involving personnel contamination incidents, decontamination activities shall be completed prior to voiding.
- Termination samples should be collected at least 36 hours but not more than 96 hours after leaving a project site.
- Urine samples shall be collected and preserved in a manner that minimizes the loss of activity on the walls of the container. For example, uranium urine samples require several drops of 1N nitric acid in the sample bottle prior to sampling. Additional instruction for sample prep will be provided, if required, by the analytical laboratory.
- Unused sample containers shall be maintained in an area that is free from contamination.
- After sample collection, precautions shall be taken to assure the integrity of and prevent leakage from the containers or cross-contamination of the samples.
- Universal bloodborne pathogen precautions shall be used when handling unsealed samples.

If a non-Urine routine bioassay sample is required, based on radionuclides of concern or other constraints, a written collection procedure will be established prior to collection of any samples.

### 6.4 Sample Documentation

The on-site Project RSO, or a designee, shall assign control numbers to the bioassay samples as they are received. The control numbers shall be in sequential order and documented.

Bioassay samples shall be documented and controlled in accordance with the chain-of-custody requirements of the analyzing laboratory. Additionally, bioassay samples shall be documented using a project-specific data form. This form shall include the following information:

- The project name and number.
- Quantity Shipped: Total number of bioassay samples shipped, use additional forms, as necessary.
- The date samples were shipped to the lab and the method used (e.g. UPS, Fed Ex, etc.).
- Special Instructions: Indicate any comments or instructions deemed necessary for completeness. Identify any samples that are suspected of being highly contaminated.
- Employee Name: Include the full name of each individual.
- Employee Social Security Number: Include the social security number of each individual.
- Control Number: Include the bioassay sample control number as recorded from the log.
- Date Collected: The date the bioassay sample was collected.

  **NOTE: Samples should not be held for shipment greater than five (5) working days without chemical preservation**
- Collection Time: Provide the time that sample collection started and stopped. Urine samples should include the first void of the day.
- Analyses Requested: Refer to the purchase requisition, which should state the contractual requirements. Add any additional information, as necessary.
- Sample Type: List the type of bioassay sample collected.
  - UR = urine
  - FC = feces
  - NS = nasal swipe
  - OT = other (specify, e.g. wound, eye, ear, sputum)
- Purpose: List the reason for collecting the sample.
  - IN = initial sample
  - FN = final sample
  - RT = routine
  - RS = resample
  - SP = special sample (incident report may be required)

## 6.5 Quality Control

Each batch of urine samples should be analyzed concurrently with at least two control urine specimens (one blank and one spike). Blank control samples should be prepared on site and shipped with the batch of samples. Spike samples should be prepared in the laboratory.

The analytical laboratory shall perform the Quality Control (QC) checks and shall report the results of these QC analyses along with the other sample results.

If the average deviation (actual-reported/actual) for the spiked samples that accompany a particular batch is less than 0.7, this batch of samples shall be rerun.

If the repeat analysis does not meet the above criteria, an investigation of the procedures for spiking and the procedures for laboratory analyses shall be made.

## 6.6 Laboratory Results

The analytical laboratory should complete and report results of routine analysis within the turn-around-time (TAT) specified by the License RSO and identified on the laboratory chain of custody form. Results exceeding preset action levels should be reported by telephone to the on-site Project RSO or License RSO as soon as they are identified.

Results shall be evaluated against predefined recording and investigation levels in order to determine the need for additional analysis or assessment of internal dose. Results above investigation level shall be reported to, and evaluated by, the License RSO.

## 6.7 Recording Levels and Investigation Levels

Results of the bioassay program are used to evaluate dose due to internal deposition of radionuclides. Results must be evaluated against pre-established levels to ensure the proper management of internal dose based on administrative and regulatory limits. As part of development of an internal dosimetry program, the License RSO shall derive radionuclide-specific Recording Levels and Investigation Levels that are appropriate for contaminants of interest.

Data indicating intake at or above established Investigation Levels shall be investigated to determine the cause and to prevent the recurrence in keeping with the ALARA principle.

## 6.8 Non-Routine Bioassay

Whenever an intake is suspected that may result in internal dose above administrative control levels or regulatory limits, prompt bioassay follow-up is required. Such an intake shall be suspected if any of the following criteria are exceeded:

- Exposure to airborne radioactivity is greater than or equal to 1 DAC-hour in an 8-hour shift.

  **NOTE: If a person is wearing respiratory protection, the appropriate Protection Factor (PF) will be applied to the exposure to determine if it equalled or exceeded 1 DAC-hour.**

- Personnel contamination on skin or clothing is greater than or equal to 1000 dpm/100 $cm^2$ alpha contamination or greater than or equal to 5000 dpm/100 $cm^2$ beta-gamma contamination.
- Measurable nasal or saliva contamination.
- Any wound that occurs within a contaminated area.
- A routine bioassay measurement in excess of the investigation limit.
- At the discretion of the License RSO.

When any of the above conditions are met, the on-site Project RSO or License RSO shall perform and document, or ensure the performance and documentation of, additional in-vitro and/or in-vivo bioassay measurements necessary to document internal dose, and to ensure that the intake is not ongoing. The Project RSO shall identify potential uptakes that occur in the workplace under his or her area of responsibility.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject: Health Physics Policy Manual**

## 1. PURPOSE

The purpose of the Shaw E & I Radiological Services Health Physics Policy Manual is to define management policies and procedure requirements for the radiologically safe performance of operations. This Manual also establishes policy that all occupational radiation exposure be maintained As Low As Reasonably Achievable (ALARA). The provisions of this Manual shall be implemented by specific procedures, which may be more restrictive than the requirements herein. This manual is intended to supplement existing Shaw E & I policies as well as applicable Federal and State rules and regulations.

## 2. SCOPE

This procedure specifies standard practices for the performance of radiological operations. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing radiological operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations*
- Code of Federal Regulations, 29 CFR Section 1910.1096, *Ionizing Radiation*
- National Council for Radiation Protection and Measurements (NCRP) Report Number 39, *Basic Radiation Protection Criteria*
- Code of Federal Regulations, 29 CFR Section 1910.134, *Respiratory Protection*
- U.S. Environmental Protection Agency, EPA-400-R-92-001, *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*
- Shaw E&I Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*

## 4. DEFINITIONS

- **ALARA**—An acronym for “As Low As Reasonably Achievable.” Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and

socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Action Level**—A predetermined radionuclide concentration that, when reached, requires a specific, predefined set of follow up protocols go into effect, which may include re-analysis of the original sample, collection of additional samples, and dose assessments.

- **Alpha Radiation ($\alpha$)**—Alpha particles (He-4++) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.

- **Annual Limit on Intake (ALI)** — The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Beta Contamination ($\beta$)**—Beta particles (e-) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Bioassay**— The measurement, or assay, of kinds, quantities or concentrations and in some cases, the locations of radioactive materials within an individual worker. Bioassay is generally determined by in vitro methods, such as urine analysis, sampling of other body fluids (such as blood), tissue analysis, or by fecal sample. Bioassay may also be performed by direct (in vivo) measurement using specialized radiation detection equipment.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.

- **Committed Dose Equivalent (CDE)**— The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. Committed dose equivalent is expressed in Rem.

- **Committed Effective Dose Equivalent (CEDE)**— The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues and is expressed in Rem.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Declared Pregnant Woman**—A woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Deep Dose Equivalent (DDE)**—Applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm.

- **Derived Air Concentration (DAC)**— The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

- **Dose**— A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.
- **Exposure**— Being exposed to ionizing radiation or to radioactive material.
- **Gamma Radiation(γ)**—High energy, short wavelength photons emitted from radionuclides while undergoing decay, or by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.
- **In Vitro**—"In the glass." For the purposes of an internal dosimetry program, in vitro bioassay measurements are performed by analysis of bodily fluids or tissues removed from the body and analyzed in a laboratory environment.
- **In Vivo**—"In the living body." For the purposes of an internal dosimetry program, in vivo bioassay measurements are performed by measuring radionuclide body burden within the body using specialized detection instrumentation and monitoring techniques.
- **Intake (or Uptake)**—Radionuclides entering the body by any exposure pathway, primarily inhalation, absorption, or ingestion means.
- **Investigation Level**—The level of exposure above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Lens Dose Equivalent (LDE)**—The external exposure of the lens of the eye, taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm$^2$).
- **Licensed Material**—Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under NRC license number 10-25362-01.
- **Minimum Detectable Concentration (MDC)**— The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity
- **Monitoring**- The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses
- **National Voluntary Laboratory Accreditation Program (NVLAP)**—Accredits testing and calibration laboratories that are found competent to perform specific tests or calibrations, or types of tests or calibrations. NVLAP is a U.S. Government entity administered by the National Institute of Standards and Technology (NIST), an agency of the Department of Commerce.
- **Neutron Radiation (n)**—An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.
- **Planned Special Exposure**—An infrequent exposure to radiation, separate from and in addition to the annual dose limits.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Radiological Controls Supervisor (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Radiological Work Permits (RWPs)**—A work document that contains the necessary controls and protective measures to prevent inadvertent exposures to radiation and radioactive contamination while performing work in radiologically controlled areas.

- **Radiologically Controlled Area (RCA)**— Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.

- **Rem**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor.

- **Self-Reading Dosimeter (SRD)**—Radiation monitoring device used to provide a direct readout of gamma and/or x-ray exposure.

- **Shallow Dose Equivalent (SDE)**—Applies to the external exposure of the skin or an extremity, taken as the dose equivalent at a tissue depth of 0.007 centimeter.

- **Survey**— An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Thermoluminescent Dosimeter (TLD)**—Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

- **Total Effective Dose Equivalent (TEDE)**—The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

- **Total Organ Dose Equivalent (TODE)**—The sum of the deep-dose equivalent (for external exposures) and the 50-year committed dose equivalent to a tissue or organ.

- **Transferable, Removable, or Loose Contamination**—Radioactive material that can be easily removed from a surface or item.

- **X-ray Radiation**—High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and pose a substantial external radiation hazard.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice. The Director will establish and maintain all necessary management oversight and implement a management review process to ensure implementation of applicable Manual requirements.

## 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program

## 5.3 Project Radiation Safety Officer

The Project RSO is designated by the License RSO as an Authorized User. Each Project RSO is responsible for the on-site implementation of this Policy Manual at their respective projects or locations.

## 5.4 Managers, Supervisors

All managers and supervisors are responsible to ensure compliance with the applicable portions of this policy manual by employees under their direction.

## 5.5 Individuals

Each individual performing assigned duties within the Shaw E & I organization is responsible for compliance with this Policy Manual including all applicable implementing procedures.

# 6. PROCEDURE

## 6.1 Prerequisites

No operational or related activities shall proceed unless the applicable requirements of this Manual are properly implemented through the use of Standard Operating Procedures or Site-Specific Plans and Work Instructions.

## 6.2 Limitations

The requirements of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Code of Federal Regulations, 10 CFR Part 19, *Notices, Instructions, and Reports to Workers: Inspection and Investigations*, and Code of Federal Regulations, 29 CFR Section 1910.1096, “Ionizing Radiation” will be met without exception, as they apply to specific projects and situations.

## 6.3 Personnel Training Policy

All personnel performing Shaw E & I operations or activities shall have received the necessary training to perform their jobs in a safe, effective, and regulatory compliant manner. Training must be provided that meets both the letter and intent of all federal, state, and local statutes and that imparts to personnel the necessary knowledge to meet the needs of our customers as well as the expectations of management, and which meets or exceeds industry standard training requirements.

### 6.3.1 Pre-Work Training

All Shaw E & I personnel, or employees of subcontractors under the direction of Shaw E & I personnel, whose work assignments will involve direct working contact with licensed radioactive materials or who will work within areas that require posting or boundary controls due to a radiological hazard in accordance with the posting requirements of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Code of Federal Regulations, 29 CFR Section 1910.1096, “Ionizing Radiation,” shall receive pre-work training. The training shall be conducted in accordance with NUREG 1556 and shall include the following elements:

- Principles of radiation protection
- Use of protective clothing and respiratory protection equipment
- Specific job precautions and requirements
- Emergency alarms and responses
- The requirements of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Code of Federal Regulations, 29 CFR Section 1910.1096, "Ionizing Radiation," as they apply to specific licenses, projects, and situations
- Applicable sections of State radiation protection regulations
- Requirements as stated in National Council for Radiation Protection and Measurements (NCRP) Report Number 39, "Basic Radiation Protection Criteria"

### 6.3.2 Refresher Training

All personnel who perform work as described in Section 7.1 of this document shall receive annual refresher training. In addition, instructions for specific job precautions or requirements shall be administered as needed to meet project requirements or ensure personnel safety.

### 6.3.3 Pre-Work Training Exemption

Visitors may be exempted from pre-work training requirements, provided such personnel are accompanied at all times by an escort who has had the training, as specified in Section 6.3.1.

### 6.3.4 Radiological Controls Technicians

All radiological controls technicians assigned to work on Shaw E & I projects will be properly trained and technically competent in the area of Health Physics as evidenced by education, training, or experience. Specific training requirements will be established in the Radiation Protection Plan for each project or operation. Requirements for the Acceptance and Use of Radiological Controls Technicians are provided in Attachment 1 of the procedure.

## 6.4 Occupational Radiation Exposure Policy

All potential occupational exposures to ionizing radiation during Shaw E & I activities shall be managed in such a way as to ensure that exposures are As Low As Reasonably Achievable (ALARA).

### 6.4.1 ALARA Planning

Pre-work planning is essential to ensuring that all radiological work is conducted in a manner that minimizes personnel exposure to ionizing radiation and complies with this ALARA Policy. All such planning should be performed by personnel who are experienced and knowledgeable in health physics principles, practices, and procedures; and who are familiar with those design features and operations of nuclear facilities and waste handling equipment that affect the potential for exposures of personnel to radiation

Exposure planning, including assessing the need for dosimetry and bioassays, shall be performed for projects with the potential for internal and/or external occupational radiation exposure. A written ALARA plan shall be prepared, and dose budgets established, for all operations and activities where there is a potential for personnel to exceed the administrative limits specified in Section 6.4.2.

### 6.4.2 Administrative Limits

In addition to maintaining exposures as low as reasonably achievable, occupational radiation doses shall be administratively controlled in a manner that ensures that no person receives exposure in excess of any regulatory limit. In order to ensure that no regulatory limits are exceeded, an administrative exposure limit will be established at 80% of regulatory limits with a goal of 10% or less of the regulatory limits. No Shaw E & I or subcontractor employee may ever be authorized to receive annual occupation radiation dose in excess of the following:

- 4.0 REM Total Effective Dose Equivalent (TEDE)
- 12.0 REM Lens Dose Equivalent (LDE)
- 40.0 REM Shallow Dose Equivalent (SDE) or Total Organ Dose Equivalent (TODE)

In addition to these limits, guideline levels are established to ensure exposure is consistently minimized on all projects. A set of monthly and quarterly administrative guideline levels, which are significantly below the limits established above, are given in Attachment 2 of this procedure. These levels are established to ensure proper exposure planning and to prevent any single individual from receiving their annual dose limit in a fraction of the year. Personnel are authorized to receive doses up to Level I without additional approval. Personnel shall not receive doses in excess of the Levels I and II monthly administrative level or the Level III quarterly administrative level without the appropriate approval. Approval by both the Project RSO, or equivalent, and the Project Manager responsible for the project on which the employee would exceed the limit are necessary to authorize exposures above the Level I administrative limits at their particular projects. Review by the License RSO is necessary to authorize exposures above the Level II administrative limits. The written approval of the Director of Radiological Services is necessary to authorize exposures above the Level III administrative limits.

Extensions beyond the Level II or Level III limits shall be granted in increments of no more than 0.250 REM. Requests for all exposure limit extensions shall be made by the appropriate Project Manager or designee prior to any operation that might cause any person to exceed a guideline level.

### 6.4.3 Radiation Exposure Equalization

In instances where an individual's quarterly cumulative dose reaches 1.0 REM Total Effective Dose Equivalent (TEDE), 3.0 REM Lens Dose Equivalent (LDE), 10.0 REM Shallow Dose Equivalent (SDE), or 10.0 REM Total Organ Dose Equivalent (TODE), equalization of exposures among project personnel within the limitations imposed by job classifications and personnel availability shall be practiced.

### 6.4.4 Other Limitations on Exposure

In addition to the requirements noted above, the additional limitations specified below shall be considered during project planning and execution.

- Individuals under 18 years of age shall not be occupationally exposed.
- Minors and members of the public shall not receive doses exceeding 100 mREM per year and should not receive more than 80 mREM per year.
- Employees shall not participate in Planned Special Exposures unless planned exposures are reviewed and approved by the Shaw Corporate RSO and Federal Technical Services Radiological Controls Hub Director.
- Prior to receiving occupational radiation exposure, newly hired or contracted individuals shall provide a signed statement documenting their radiation exposure for the current year. For exposures received while working under a radioactive materials license, an NRC Form 4 or equivalent will be required.
- The dose to an embryo/fetus during the entire pregnancy due to the occupational exposure of a declared pregnant woman shall not exceed 0.4 REM.

- Individuals shall enter Radiation Areas only if their current dose accumulation is less than the applicable limit of Administrative Exposure Limits table.
- Visitors shall not be allowed to receive a dose greater than 10 mREM per visit.

### 6.4.5 Emergency Exposures

In emergency situations, volunteers may accept exposures in excess of previously stated regulatory and administrative limits under the following circumstances in accordance with U.S. Environmental Protection Agency, EPA-400-R-92-001, *Manual of Protective action Guides and Protective Actions for Nuclear Incidents*:

#### 6.4.5.1 Life Saving Actions

This applies to search for and removal of injured persons, or entry to prevent conditions that would probably injure numbers of people. Planned doses shall not exceed 25 REM TEDE per volunteer.

#### 6.4.5.2 Valuable Equipment Emergency Actions

This applies to entries to protect facilities, to prevent further releases of radioactive material, or to control fires. Planned doses shall not exceed 10 REM TEDE per volunteer.

## 6.5 PERSONNEL MONITORING POLICY

All occupationally exposed workers who are likely to be exposed to airborne radioactivity concentrations in excess of 10% of applicable regulatory limits or who may receive more than 10 mREM in any calendar week of external whole body radiation exposure or permitted unescorted access to posted Radiation Areas shall be appropriately monitored for exposure to ionizing radiation.

### 6.5.1 Bioassay and Whole Body Counting

Workers subject to the Personnel Monitoring Policy (as determined above) shall submit bioassay samples and/or receive whole body counts as required by site-specific radiation protection plans.

### 6.5.2 External Monitoring

For all individuals subject to the Personnel Monitoring Policy, at least one of the following personnel monitoring devices or methods shall be used to monitor external occupational radiation exposures:

- Thermoluminescent dosimeters (TLDs)
- Self-reading dosimeters (SRDs)
- Film badge dosimeters
- Direct positive monitoring of the work area prior to and during the work activity and administrative assignment of exposure base on work area radiological conditions levels

### 6.5.3 Termination

All personnel subject to the Personnel Monitoring Policy will be requested to submit bioassay samples and/or receive whole body counts upon completion of their work assignments as prescribed by site-specific radiation protection plans.

### 6.5.4 Requirements

The monitoring of external and internal occupational dose of Shaw E & I personnel shall comply with applicable regulatory requirements.

### 6.5.5 Personnel Radiation Exposure History

Newly hired employees or contract workers shall provide, to the Shaw E & I Health and Safety Department, a complete radiation exposure history, as described in Section 6.4.4 of this document, prior to receiving any occupational exposure from Shaw E & I activities.

### 6.5.6 Action Levels

Action levels for the various techniques used in the personnel monitoring shall be stated in site-specific radiation protection plans and will reflect, as a minimum, the requirements of this Policy Manual and the recommendations of current regulatory standards.

### 6.5.7 Personnel Monitoring and Dosimetry Data

All monitoring data collected on an individual shall be considered private information. Personnel exposure information shall not be released except as required by regulation or license condition, or at the written request of the individual.

### 6.5.8 Dosimetry Processing

Personnel dosimeters that require processing and that are used to document personnel external dose shall be processed by a dosimetry processor that is NVLAP accredited and that is approved for the type of radiation(s) most similar to those that the personnel being monitored have been exposed to.

### 6.5.9 Monitoring for Intake

Personnel whose estimated intake may exceed 40 DAC-hours since their most recent bioassay shall be monitored for intake by bioassay or whole body count.

### 6.5.10 Visitors

Visitors entering a posted area shall be appropriately monitored. External monitoring may be performed with self-reading dosimeters and may be performed individually or with a single dosimeter for a group of visitors.

## 6.6 Survey Policy

Surveys shall be performed and documented as necessary to evaluate radiation levels, concentrations, or quantities of radioactive material and radiological hazards to ensure compliance with federal and/or state regulations. These surveys will be performed with instruments and equipment that has been calibrated as required by ANSI Standard N323 prior to use, and to the radiation being measured. Detection sensitivity (minimum detectable concentration) for these survey instruments shall be less than or equal to 90% of the applicable limit, with a goal of not more than 10% of the limit.

## 6.7 Contamination Control Policy

Proper site controls and contamination control procedures shall be established to preclude the spread of contamination into uncontrolled areas.

### 6.7.1 Contamination Areas

Contamination Areas shall be posted and bounded areas furnished with step-off pads wherever it is practical. The following restrictions shall apply to Contamination Areas:

#### 6.7.1.1 Entries

All entries into posted contamination areas shall require a radiation work permit approved in accordance with the site-specific radiation protection plan.

6.7.1.2 Smoking, Eating, and/or Drinking

Smoking, eating, and/or drinking shall not be allowed in any area that is posted as contaminated.

6.7.1.3 Breaches of Intact Skin

Personnel who have breaches of intact skin (e.g., open wounds, sores) should be excluded from participating in work activities in Contamination Areas. The Project RSO, or equivalent, may allow entry, if appropriate bandaging has been applied to the wound and if there is no other medical reason to restrict entry into the Contamination Area.

6.7.1.4 Personal Clothing and Articles

Personnel working in areas where substantial contamination is present should not wear personal clothing, jewelry, or other personal items other than socks and underwear into those areas.

### 6.7.2 Designation of Radiation/Contamination Areas

The Project RSO, or equivalent, shall have the responsibility and authority for posting and/or removing the boundaries for Radiation/Contamination Areas.

### 6.7.3 Item Control

Contamination status shall control the movement and/or use of items removed from contaminated areas.

### 6.7.4 Contamination Limits

Site or project-specific contamination limits shall be established in the radiation protection plan. These limits shall be below regulatory limits to ensure proper control.

### 6.7.5 Item Tagging

Items that are contaminated in excess of the applicable limit(s) and that are removed from contaminated areas shall be appropriately wrapped, tagged to denote conditions, and appropriately isolated.

### 6.7.6 Unconditional Release

Items shall not be released for unrestricted use from any radiological area if radioactive contamination is detected in excess of acceptable levels.

## 6.8 RESPIRATORY PROTECTION POLICY

Appropriate respiratory protection measures shall be taken during all Shaw E & I activities to limit the exposure of personnel to airborne radionuclides to levels that are not only within applicable regulatory limits but also ALARA.

### 6.8.1 Controls

Process or engineering controls shall be used to the extent practicable to reduce airborne radioactive material so that respirators are not needed.

### 6.8.2 Respiratory Protection Policy

All personnel who, while carrying out their work assignments, are likely to be exposed to airborne radioactive materials at levels exceeding 30% of the more restrictive Derived Air Concentration (DAC) of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation* shall do so only with appropriate respiratory protection.

### 6.8.3 Evaluation

If airborne radionuclide concentrations exceed 30% of the DAC, the need for respiratory protection equipment will be evaluated and documented prior to beginning work. Planned exposures greater than 12 DAC-hours per week should be avoided.

### 6.8.4 Protection Factors

The regulatory protection factors for respiratory protection devices are found in Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*. Respirators used in a work area shall have a protection factor greater than the number of DACs present in that work area.

### 6.8.5 Respiratory Protection Training

All personnel who are subject to this policy shall be medically qualified to use a respirator, fitted for the appropriate respiratory protective device, and shall have received applicable training in compliance with Code of Federal Regulations, 29 CFR Section 1910.134, *Respiratory Protection* prior to respirator use. Refitting and retraining shall be carried out at least annually.

### 6.8.6 Respiratory Protective Device Leak Check

Individually worn respiratory protective devices shall be tested for operability immediately prior to being worn into a potential airborne radioactivity contaminated environment.

### 6.8.7 Working Concentration Limits

Work activities shall not be carried out under conditions where air sample data show the concentration of airborne radioactive material exceeds 1000 times the applicable DAC limit without the review and written approval of the Federal Technical Services Radiological Controls Hub Director.

### 6.8.8 Physical/Emotional Discomfort

All personnel who are required to wear respiratory protective devices must be instructed that, should they experience physical and/or emotional discomfort that may be caused by wearing a respiratory protective device, they may leave the area at any time for relief.

### 6.8.9 Airborne Radioactive Materials Sampling

In areas of known or suspected airborne radioactive material concentrations exceeding 30% of the appropriate DAC, the following air sampling requirements shall be imposed to ensure the adequacy of prescribed respiratory protection devices:

- Prior to the start of work activities, airborne radioactive material concentrations shall be determined.
- Once work activities have begun in posted Airborne Radioactivity Areas, at least one air sample per shift shall be collected from the area(s) and the concentration of airborne radioactive materials determined.

  NOTE: ADDITIONAL SAMPLING MAY BE NECESSARY SHOULD WORK ACTIVITIES CHANGE.
- The need for continuous sampling shall be evaluated as necessary by the Project RSO.

### 6.8.10 Exemption from Airborne Radioactive Materials Sampling

Exemption from the provisions of Section 6.8.9 may be granted for a specific area when the history of airborne radioactivity concentrations in the area is adequately documented and indicates that significant personnel radiation exposures would be received during air sample collection.

### 6.8.11 Unidentified Airborne Radioactive Material Concentrations

In instances where there are unidentified radionuclides contributing to the airborne conditions, the most limiting DAC for radionuclides likely to be present shall be applied to the unidentified component(s) when respiratory protective devices are being prescribed.

### 6.8.12 Facial Hair

Any person who is required wear a respiratory protective device and who cannot, because of facial hair, obtain a proper respiratory protection device fit shall be excluded from entering posted Airborne Radioactivity Areas until an approved fit can be obtained.

### 6.8.13 Respiratory Protective Device Maintenance

A respiratory protective device maintenance program, consisting of cleaning, sanitizing, and inspection, shall be implemented in compliance with Code of Federal Regulations, 29 CFR Section 1910.134, *Respiratory Protection*. Respiratory protective devices worn by an individual shall not be reissued for general use until the maintenance program requirements have been performed.

## 6.9 Radiation Work Permit Policy

All personnel who are required to enter posted Radiologically Controlled Areas, Contamination Areas, and/or Airborne Radioactivity Areas shall do so only in compliance with an approved Radiation Work Permit (RWP).

### 6.9.1 RWP Content

An RWP shall contain a brief description of the scope of the task and descriptions of the hazardous conditions in the work area, the personal protective equipment (PPE) requirements, and special precautions.

The RWP shall have a unique identifier for tracking, a reference to surveys performed that are applicable to the area covered under the RWP, and a list of workers authorized to enter the RWP area.

### 6.9.2 RWP Issue

RWPs shall be issued by the cognizant radiological controls organization for any Shaw E & I work site. An RWP will be issued for all work activities carried out within posted RCAs, Contamination Areas, and/or Airborne Radioactivity Areas.

### 6.9.3 RWP Authorization

An RWP shall not be valid until all authorizing supervision signatures have been entered on the RWP form.

### 6.9.4 RWP Briefing

Prior to starting work covered by an RWP, all individuals shall be briefed on the conditions in the area, PPE requirements, and any special precautions associated with area radiological conditions.

### 6.9.5 RWP Termination

Any one, or combination, of the following can terminate RWPs:

#### 6.9.5.1 Work Completion

Work activities for which the RWP was issued are completed.

**6.9.5.2 Expiration**

RWP authorization shall be limited to a specific time period established in the site-specific radiation protection plan. Generally, that period should not exceed seven calendar days from the time of issue, and the RWP will be automatically terminated at the end of that time period. Specific site or area radiological conditions may dictate more or less frequent termination.

**6.9.5.3 Withdrawal of Authorization**

The cognizant radiological controls authority for a site or facility and any other authorizing supervisor who signed a specific RWP shall have the prerogative of withdrawing their specific authorization, thus terminating the RWP, at any time.

## 6.10 Radioactive Source Control Policy

All radioactive sources will be properly controlled and managed in full compliance with Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation* or the applicable state regulations, if applicable, and in such a manner as to ensure proper inventory controls and prevent release of radionuclides to the environment.

### 6.10.1 Requisition

Prior to ordering, all requisitions for radioactive sources shall be approved by the appropriate licensing authority or, for generally licensed or exempt quantity sources, the site Project RSO.

### 6.10.2 Receipt of Radioactive Sources

Upon arriving at a facility or project site, any package suspected of containing or known to contain radioactive sources shall be surveyed by competent Radiological Controls personnel. If the material is a Type A quantity of material, receipt of radioactive source will be in compliance with Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*.

### 6.10.3 Source Inventory

The license user or designee shall inventory all licensable quantities of radioactive laboratory and calibration sources whose possession is authorized by a radioactive materials license at least quarterly.

### 6.10.4 Leak Testing

All beta/gamma sealed sources in active use shall be leak tested at least semi-annually. In-use alpha-emitting sources shall be tested for leakage at least every 3 months. All licensable sealed radioactive sources that have been stored (out of use) for a period exceeding six months shall be leak tested prior to use.

### 6.10.5 Radioactive Source Shipment

Prior to release from a project site or facility, all shipments containing radioactive sources shall be cleared by the Project RSO.

### 6.10.6 Radioactive Source Disposal

The disposal of all radioactive laboratory and calibration sources whose possession is authorized by a radioactive materials license shall require the approval of the license RSO, or designee.

## 6.11 Effluent and Radioactive Material Release Policy

Releases or transfer of radioactive material, including air or liquid effluent, from a licensed facility, shall be documented. This documentation shall include the following:

- Quantity and radionuclide
- Chemical and physical form
- Point and rate of release
- Release survey forms
- Radioactive Shipment Manifest (if appropriate)

### 6.12 Environmental Monitoring Policy

Appropriate environmental monitoring shall be performed during Shaw E & I activities at all facilities/sites where the potential exists for release to the environment of radioactive material.

#### 6.12.1 General Environmental Monitoring

Environmental monitoring shall include the following, as appropriate:

- Air sampling
- Groundwater and surface water sampling
- Direct radiation monitoring
- Flora and fauna sampling
- Soil sampling

#### 6.12.2 Specific Environmental Monitoring

A site-specific environmental monitoring program shall be developed for each facility/site, to include the following:

- Locations to be sampled
- Media to be sampled
- Frequency of sampling
- Radioassays to be performed
- Actions to be taken as well as action levels

### 6.13 Health Physics Log Book Policy

A Health Physics Log Book, or equivalent, shall be established and maintained for each project site or facility. The Log Book, or equivalent, shall contain, at a minimum, daily records of the activities performed in radiological areas, the personnel involved, the radiological controls applied, any problems that are identified, and any corrective actions taken.

Entries shall be in ink and shall be signed by the individual making the entry. Corrections to the Log Book, or equivalent, shall be done with a single line through the material being corrected. The person making the correction shall write their initials and the date of the correction near the correction.

### 6.14 Records Policy

All records required or created as a result of Shaw E & I activities will be established and maintained in a manner that is consistent with regulatory requirements and the requirements of project-specific Quality Assurance Plans.

The following records shall be maintained on site during operations.

- Personnel Radiation Exposure Records
- Personnel Training Records
- Radiation/Contamination Survey Records
- RWP Records
- Effluent Records
- Environmental Monitoring Records
- Instrumentation Records
- Radioactive Source Control Records
- ▪ Radiological Controls Record Retention
- Personnel radiation exposure records

## 7. ATTACHMENTS

Attachment 1 - Acceptance Criteria for Radiological Controls Technicians

Attachment 2 - Administrative Exposure Limits Table

# ATTACHMENT 1

**Subject: Qualification and Use of Radiological Controls Technician**

## 8. PURPOSE

This document describes the qualification requirements for Radiological Controls Technicians and the method to be used to verify that those requirements are met.

## 9. DETERMINATION OF TECHNICIAN NEED

The Project Manager (PM) and the License RSO, will determine the number and type of technicians required to staff a particular project. This determination should be made as far as possible in advance of the project mobilization, preferably during the bid and proposal stage. Technicians are grouped in two categories based on the amount of responsibility they may assume.

### 9.1 Senior Radiological Controls Technicians

A Senior Technician (SRCT) is a technician that may assume all responsibilities for radiological control on a project except for the authority and responsibility of the Project RSO. Examples of a SRCT's responsibilities include: performing radiation and contamination surveys, performing air sampling and analysis, providing job coverage, responding to radiological emergencies, performing personnel decontamination, performing release surveys, performing incident investigations, performing instrument checks, conducting pre-job briefings, supervising radiological work performed by work crews, and supervising other Technicians.

### 9.2 Radiological Controls Technicians

A Radiological Controls Technician (RCT) may only assume limited responsibilities unless they are under the direct supervision of a SRCT or Project RSO. Examples of RCT responsibilities include: manning an access control point, issuing dosimetry, performing clean area routine surveys, surveying laundry and respiratory protection equipment, decontaminating equipment, performing instrument checks, and manning a counting room. RCTs may also assist, under direct supervision, SRCTs in the performance of their assigned tasks. All paperwork and records produced by RCTs must be reviewed and countersigned by a SRCT or Project RSO.

## 10. ACCEPTANCE CRITERIA FOR TECHNICIANS

### 10.1 Senior Radiological Controls Technician

SRCT must have at least 36 months of documented direct, hands-on radiological controls experience or equivalent education in radiological controls from a college, university or technical school.

### 10.2 Radiological Controls Technicians

RCT must have at least 12 months of documented direct, hands-on radiological controls experience.

### 10.3 Client Specific Requirements

In addition to the minimum experience and education requirements defined above, additional nationally recognized training and qualification requirements, such as DOE Radiological Controls

Technician, or US Navy Article 108 Radiological Control Monitor, or other client-mandated training requirements may be imposed on a project-specific basis.

## 11. QUALIFICATION OF TECHNICIANS

**11.1** The Project Manager or Project RSO will review candidate resumes.

**11.2** If the candidate meets the qualification and project-specific selection criteria, he/she is considered qualified to staff the project without further approval.

**11.3** If the candidate does not meet the criteria, the PM may request that the candidate be evaluated by the License RSO for exemption from the requirements. The License RSO may administer written or oral examinations to determine if the candidate may be qualified. Exemptions may not be granted for customer specific requirements such as Department of Energy Radiological Control Technician Qualification, Naval Reactors Article 108, or ANSI Standard requirements.

**11.4** A file must be kept for each successful candidate. This file shall contain the resume, qualification certificates, if appropriate, and any testing or evaluation results. At the end of the project, the PM and the Project RSO will execute a written evaluation of the contract technician and for placement into their file.

ADMINISTRATIVE EXPOSURE LIMITS

| LEVEL | ACCUMULATED DOSE (REM) | CATEGORY | CALENDAR PERIOD | APPROVALS REQUIRED FOR EXTENSION |
|---|---|---|---|---|
| I | 0.125 | TEDE | Quarter | Project RSO, or equivalent, and Project Manager |
| | 0.375 | LDE | Quarter | " |
| | 1.250 | SDE, TODE | Quarter | " |
| II | 0.25 | TEDE | Quarter | License RSO Review, Project Manager Approval |
| | 0.750 | LDE | Quarter | " |
| | 2.5 | SDE, TODE | Quarter | " |
| III | 1.0 | TEDE | Quarter | License RSO Review, Radiological Controls Director Approval |
| | 3.0 | LDE | Quarter | " |
| | 10.0 | SDE, TODE | Quarter | " |
| MAXIMUM LIMIT | 4.0 | TEDE | Annual | No Extension Allowed |
| | 12.0 | LDE | Annual | " |
| | 40.0 | SDE, TODE | Annual | " |

TEDE = Total Effective Dose Equivalent

LDE = Lens Dose Equivalent

SDE = Shallow Dose Equivalent

TODE = Total Organ Dose Equivalent

# RADIATION PROTECTION PROCEDURE

**Subject:** **Shipment of Radioactive Materials**

## 1. PURPOSE

This purpose procedure is to establish procedures for the safe shipment of radioactive materials, including mixed waste, by Shaw Environmental & Infrastructure (Shaw E & I) Radioactive Materials Brokers.

## 2. SCOPE

This procedure is applicable to all personnel who ship or assist in the shipment of radioactive materials as defined by the United States Department of Transportation (USDOT). This document outlines the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these operations. The direction provided by this document may be amended to comply with specific regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document.

## 3. REFERENCES

- Code of Federal Regulations, 49 CFR, *Transportation.*
- Code of Federal Regulations, 40 CFR, *Protection of Environment.*
- Code of Federal Regulations, 10 CFR, *Energy*.
- US Department of Transportation, *USDOT Emergency Response Guidebook*.
- Shaw E & I Health and Safety Procedure HS811, *DOT 24-Hour Emergency Number*.

## 4. DEFINITIONS

- **Broker—**Any individual who performs one or more of the following functions for a waste generator:
  - Arranges for transportation of the waste
  - Collects and/or consolidates shipments of waste
  - Processes waste in some manner

  This definition shall not apply to a carrier whose sole function is to transport waste
- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Disposal Site—**For the purposes of this procedure, any facility licensed for the purpose of disposing of low level radioactive waste
- **Disposer—**The site that receives radioactive or mixed waste for disposal.
- **Hazardous Material—**Any material that is determined by the Secretary of Transportation of the United States to present a hazard when transported in commerce.
- **Ionizing Radiation—**Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Function-Specific Training—**Training, specific to job function, provided in accordance with Title 49, Code of Federal Regulations, Part 172, Subpart H to all HAZMAT employees.
- **HAZMAT Employee—**An employee who loads, unloads, or handles hazardous materials; is responsible for the condition of containers used to transport hazardous materials; prepares hazardous materials for transportation; is responsible for the safety of hazardous materials; or operates a vehicle used to transport hazardous materials.
- **Hazardous Waste—** Any material that is subject to the Hazardous Waste Manifest Requirements of the U.S. Environmental Protection Agency specified in 40 CFR part 262.
- **International Air Transport Association (IATA)—**IATA is the trade association of the world's international airline industry and serves as the body that develops the international air transport working standards.
- **International Maritime Organization (IMO)—**IMO is a technical organization and specialized agency of the United Nations. Its main concern is to improve the safety of maritime operations, and thus it serves as the body that develops international maritime standards.
- **Low-Level Radioactive Waste—**Wastes containing source, special nuclear, or byproduct material that is acceptable for disposal at a low-level radioactive waste disposal facility.
- **Low-Level Radioactive Waste Compact—**A group of states that have formed a compact, as defined by the Federal Low Level Radioactive Waste Policy Amendments Act, for the purpose of managing the disposal of low-level radioactive waste within the compact states.
- **Mixed Waste—**Wastes containing materials that are, by definition, radioactive waste as defined by the United States Nuclear Regulatory Commission (USNRC) and hazardous waste as defined by EPA.

- **Monitoring-** The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **NORM Waste—**Wastes that contain only naturally occurring or accelerator-produced radioactive materials. These materials are regulated by state law and are not low-level radioactive waste.

- **TSD Facility—**A Treatment, Storage, or Disposal Facility as defined by EPA in accordance with Code of Federal Regulations, 40 CFR.

- **Radiological Controls Technician (RCT)—**An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Survey—** An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice. The Director will establish and maintain all necessary management oversight and implement a management review process to ensure implementation of applicable Manual requirements.

### 5.2 Radioactive Materials Broker

The Broker is responsible for the safe and proper shipment of radioactive materials, including the following activities:

- Identifying appropriate Proper Shipping Names
- Selecting packaging
- Packaging Materials
- Preparing USDOT shipping papers and required waste manifests
- Supervising loading of materials, if shipment is exclusive use
- Performing radiological surveys of waste packages and conveyance, as required to meet USDOT regulations

## 6. PROCEDURE

### 6.1 Prerequisites

Individuals performing any function related to the transport of hazardous materials shall be trained in accordance with the requirements of Title 49, Code of Federal Regulations, Part 172, Subpart H.

Individuals shipping radioactive materials shall ensure that the following administrative requirements have been met prior to shipment of materials:

- The material must be identified by the most appropriate Proper Shipping Name in accordance with the Hazardous Materials Tables of Code of Federal Regulations, 49 CFR Part 172. Radioactive Waste being shipped for disposal or shipped to a collector or processor for eventual disposal by shallow land burial shall be classified in accordance with Code of Federal Regulations, 10 CFR Part 61, or a valid disposal site license.
- If the material is a hazardous or mixed waste, the material must be identified by the most appropriate USEPA Waste Code in accordance with Code of Federal Regulations, 40 CFR Part 261.
- The generator, transporter, and disposer of hazardous or mixed wastes shall have valid EPA Identification Numbers and all EPA Permits (Generator Permits, Transporter Permits, TSD Permits, etc.), as appropriate. The generator shall also provide evidence that the waste stream(s) being shipped is acceptable at the receiving facility in accordance with all permit requirements.
- The generator of hazardous and mixed waste shall have completed all notifications and certifications for the waste material subject to the land disposal restrictions in accordance with Code of Federal Regulations, 40 CFR Part 268.
- The generator of radioactive waste or mixed wastes shall have all applicable permits or other requirements of the disposal facility, such as the following:
  - Evidence of the acceptability of the waste stream by the facility (including all waste profile information and analytical data)
  - Any other required federal, state, or local permits, or other requirements mandated by law including compact import/export requirements
  - Evidence, by provision of a receiving/disposal site license, of the acceptability of the waste being shipped
- Radioactive Materials not shipped as waste shall be shipped in such a manner as to conform to all federal, state, and local ordinances. Non-waste radioactive materials shall only be shipped to a facility upon provision of evidence, such as a valid USNRC license, by the customer, that the material is acceptable at the receiving facility.
- All radioactive materials shipped internationally shall be shipped in accordance with all applicable international regulations and requirements, i.e. IMO and IATA.

## 6.2 Tools, Materials, and Equipment

Unless provided by the customer, the broker will be required to provide all tools, administrative forms, survey instruments, labels, markings, and placards for each shipment of materials. Special care must be taken by the broker to ensure that an adequate supply of such materials is maintained. A Broker's Field Kit Materials List is provided with this procedure.

## 6.3 Detailed Instructions

### 6.3.1 Procedure for Material Preparation

All materials shipped by Shaw E & I shall be in strict adherence to the requirements of Code of Federal Regulations, 49 CFR, and all other applicable federal, state, and local regulations:

- Materials shall be packaged and the packaging inspected in accordance with the requirements of Code of Federal Regulations, 49 CFR Part 173 for the Proper Shipping Name and USDOT Subtype of the material being offered for transport. Type B and USNRC-approved Type A Packages shall be prepared in accordance with the applicable Certificate of Compliance.

- All packages offered for transport shall be properly marked and labeled in accordance with the requirements of Code of Federal Regulations, 49 CFR Part 172, prior to shipment.

- Shipping papers will be prepared for shipments as follows:

  - All radioactive materials (unless otherwise excepted) shall have USDOT hazardous materials shipping papers prepared in accordance with Code of Federal Regulations, 49 CFR Parts 172.200 - 172.205.

  - In addition to USDOT hazardous materials shipping papers, all mixed waste shall have a Uniform Hazardous Waste Manifest selected and prepared in accordance with Code of Federal Regulations, 40 CFR Part 262.20.

  - All low-level radioactive waste and "NORM" waste shall have a manifest prepared in accordance with the requirements of Code of Federal Regulations, 10 CFR Part 20.311.

  - Additional forms shall be prepared as may be required by Federal, State, and Local ordinances, and by receiving site license or acceptance criteria.

## 6.4 Procedure for Material Loading

With the exception of common carrier shipments of radioactive materials, the following procedure shall be followed when loading material for transportation:

1. Conduct and document a visual inspection of the conveyance and ensure that any discrepancies are repaired prior to loading. This inspection shall include all vehicle safety devices, tires, brakes, and trailer, as applicable.

2. If the vehicle floor shows evidence of moisture, wipe the floor as dry as possible and note the condition of the floor and action taken on the shipping papers. The consignee shall also be notified prior to shipment.

3. Perform and document a radiation and contamination survey of the conveyance prior to loading. Compare the survey results to the requirements of Code of Federal Regulations, 49 CFR Part 173.

4. The Broker shall inspect all packages as they are loaded to ensure that the packages are in full compliance with all the requirements set forth in this procedure. Incompatible materials shall be segregated as required by Code of Federal Regulations, 49 CFR.

   NOTE: SPECIAL CARE SHALL BE TAKEN TO ENSURE THAT ALL STRONG TIGHT CONTAINERS USED FOR RADIOACTIVE MATERIAL TRANSPORT ARE COMPLETELY SEALED TO THE MAXIMUM EXTENT PRACTICAL. THIS INCLUDES THE USE OF SEALANT ON SEAMS OF METAL BOXES. <u>SPECIAL CARE SHALL ALSO BE TAKEN TO ENSURE THAT ALL SPECIFICATION PACKAGES ARE PROPERLY PREPARED FOR TRANSPORT AND IN PRISTINE CONDITION PRIOR TO TRANSPORT.</u>

5. Upon completion of loading, visually verify that all packages are loaded.

6. Verify the proper use of blocking, bracing, dunnage, and tie-down, as appropriate.

7. Verify the conveyance is properly placarded, as applicable.

8. Perform and document a final contamination and radiation survey of the conveyance and ensure that the results are in compliance with the requirements of Code of Federal Regulations, 49 CFR Part 173.

9. Seal the vehicle/conveyance if required.

## 6.5 Post Loading Requirements

1. Have the driver (or transporter's representative) and shipper (or shipper's agent) sign all required forms.

2. Review all paperwork to ensure legibility.

3. Copy and distribute paperwork as needed. Uniform Hazardous Waste Manifests shall be distributed in accordance with Code of Federal Regulations, 40 CFR Part 262 and as required by the laws of the generating state.

4. Verify that the driver (transporter's representative) understands all special instructions such as the maintenance of exclusive use and prior notification requirements. The shipment may now be released for transport.

5. Make any required prior notification of correction telephone calls. Mail copies of the Radioactive Shipment Manifest (RSM) cover sheets to the disposal site for radioactive waste shipments.

6. Notify the emergency response services in accordance with Shaw E & I Health and Safety Procedure HS811, *DOT 24-Hour Emergency Number*.

## 6.6 Shipping Errors

If the responsibilities of the broker are improperly executed and/or negligence is shown on the part of the broker, the broker shall be suspended from all shipping activities until the error is investigated and appropriate corrective action determined. Reinstatement shall be made only after any required retraining or re-certification is completed.

## 6.7 Records

### 6.7.1 Broker

The broker shall retain copies of records, forms, and shipping papers generated as a result of this procedure until written acknowledgment is received from the consignee for all waste shipments or telephone acknowledgment is received for all non-waste shipments.

### 6.7.2 Project Records

All shipping papers shall be retained as part of a permanent project file for each project.

### 6.7.3 Generator

The generator of waste shall be provided with a copy of all shipping papers.

## 7. ATTACHMENTS

Broker Field Kit Recommended Material List

# BROKER FIELD KIT RECOMMENDED MATERIAL LIST

I. PROCEDURES AND REFERENCES

1.) 49 CFR, PARTS 100-177;

2.) 10 CFR, PARTS 0-50 AND 51-199;

3.) 40 CFR, PARTS 260-299;

4.) SHAW E & I PROCEDURE, T-RA-003, *SHIPMENT OF RADIOACTIVE MATERIAL*S;

5.) ALL APPLICABLE PROJECT SPECIFIC RULES, REGULATIONS, AND LICENSES (RADIOACTIVE MATERIAL LICENSES, STATE HAZARDOUS MATERIAL REGULATIONS, ETC.);

II. PAPERWORK

1.) BLANK LOW LEVEL RADIOACTIVE WASTE MANIFESTS;

2.) BLANK BILLS OF LADING;

3.) BLANK US EPA UNIFORM HAZARDOUS WASTE MANIFESTS;

4.) ALL PROJECT SPECIFIC PAPERWORK (STATE HAZARDOUS WASTE MANIFESTS, WASTE CERTIFICATION FORMS, PRIOR NOTIFICATION FORMS, ETC.).

III. LABELS AND MARKINGS

1.) "RADIOACTIVE" STICKERS;

2.) "RADIOACTIVE-LSA" STICKERS;

3.) WASTE CLASS AND STABILITY STICKERS;

4.) ITEM NO. AND WEIGHT STICKERS;

5.) HAZARDOUS MATERIALS LABELS;

6.) "7A TYPE A" STICKERS;

7.) HAZARDOUS WASTE CONTAINER LABELS;

8.) PERMANENT MARKERS (2) AND PENS (2);

9.) HAZARDOUS MATERIALS PLACARDS;

10.) PROJECT SPECIFIC MARKINGS AND LABELS AS REQUIRED.

# BROKER FIELD KIT RECOMMENDED MATERIAL LIST

IV. TOOLS AND MATERIALS

1.) 12" CRESCENT WRENCH (1);

2.) 15/16" COMBINATION WRENCH (2);

3.) HALF ROUND NEOPRENE GASKETS AND SILICONE GREASE (IF SHIPPING DRUMS);

4.) E-520 WITH HP-260 AND HP-270 PROBES, OR EQUIVALENT;

5.) OTHER TOOLS, MATERIALS, AND INSTRUMENTATION AS REQUIRED BY PROJECT.

**RADIATION PROTECTION PROCEDURE**

**Subject: Field Project Radiological Controls**

## 1. PURPOSE

The purpose of this procedure is to describe in general the radiological controls that will be instituted on Shaw E & I projects involving radiological hazards. These projects typically include the survey or monitoring, analysis, and/or decontamination activities associated with fixed or temporary building structures, equipment, or environmental media. Each project will have a Site Specific Radiation Protection Plan approved by the License RSO which complies with Shaw's Health and Safety procedure HS700 *Policy and Guidance for Developing Radiation Protection Plans*. Scope

This procedure specifies standard practices for performing operations conducted in radiologically controlled areas. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 2. TABLE OF CONTENETS

## 3. REFERENCES

- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000
- US Nuclear Regulatory Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors.*
- US Nuclear Regulatory Commission, Regulatory Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure.*
- Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.
- Shaw E & I Health and Safety Procedure HS600, *Personnel Protective Equipment.*
- Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program.*
- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification.*
- Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.
- Shaw E & I Procedure T-RA-008, *Dosimetry Administration*.
- Shaw E & I Procedure T-RA-009, *Radiation Exposure Rate Monitoring*.
- Shaw E & I Procedure T-RA-010, *Radiological Site Controls.*
- Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*.
- Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*.

## 4. DEFINITIONS

- **Access Control Point**—A location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas.
- **Action Level**—A predetermined radionuclide concentration that, when reached, requires that a specific, predefined set of follow up protocols go into effect, which may include re-analysis of the original sample, collection of additional bioassay samples, and dose assessments.
- **Acute Exposure**—The uptake of a relatively large amount of radioactive material (or exposure to large amounts of ionizing radiation) over a short period of time.
- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Alpha Contamination**—The presence of radionuclides that emit alpha particles (He-$4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.
- **Alpha Radiation (α)**—Alpha particles (He-4++) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.
- **Annual Limit on Intake (ALI)**— The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.
- **Anti Contamination Clothing (Anti-Cs)**—Personal Protective Equipment (PPE) worn by radiation workers to prevent the contamination of the worker's skin or clothing when working in contaminated areas.
- **Authorized License Users**—Individuals who, by virtue of training and/or experience, have been authorized by the RSO to use or directly supervise the use of radioactive materials under the requirements of USNRC Service License.
- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from

the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ‘‘Background radiation’’ does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Beta Radiation (β)**—Beta particles (e-) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Bioassay**—The measurement, or assay, of kinds, quantities or concentrations and in some cases, the locations of radioactive materials within an individual worker. Bioassay is generally determined by in vitro methods, such as urine analysis, sampling of other body fluids (such as blood), tissue analysis, or by fecal sample. Bioassay may also be performed by direct (in vivo) measurement using specialized radiation detection equipment.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Contamination Areas (CA)**—Areas where surface contamination exceeds the established limits, areas where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in excess of the limits.

- **Controlled Materials**—Any licensable radioactive material controlled by Shaw at a project location under NRC license.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Decay Chain**—A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.

- **Declared Pregnant Woman**—A woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Derived Air Concentration (DAC)—**The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

- **Derived Air Concentration hours (DAC-hours)—**The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

- **Direct Measurement—**A reading taken using a portable instrument directly on a surface or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed location measurements and scans.

- **Dosimetry—**The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Exposure—**Being exposed to ionizing radiation or to radioactive material.

- **External Dose—** That portion of the dose equivalent received from radiation sources outside the body.

- **Fixed Location Measurements—**Direct measurements performed by placing a detector at a fixed location on, or near, the surface being evaluated.

- **Frisking—**The process of searching a person's clothing or body with a radiation detection instrument prior to releasing the person from a radiologically controlled area.

- **Gamma Radiation (γ)—**High energy, short wavelength photons emitted from radionuclides while undergoing decay, or by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.

- **Guideline Values—**A predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **High Radiation Area—**An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.

- **Intake (or Uptake)—**Radionuclides entering the body by any exposure pathway, primarily inhalation, absorption, or ingestion means.

- **Inventory—**Licensable radioactive materials that are in the position of Shaw (company-wide) prior to the beginning of a project and materials controlled by Shaw (company-wide) during the course of a project.

- **Investigation Level—**The level of exposure above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.

- **In Vitro—**"In the glass." For the purposes of an internal dosimetry program, in vitro bioassay measurements are performed by analysis of bodily fluids or tissues removed from the body and analyzed in a laboratory environment.

- **In Vivo—**"In the living body." For the purposes of an internal dosimetry program, in vivo bioassay measurements are performed by measuring radionuclide body burden within the body using specialized detection instrumentation and monitoring techniques.

- **Ionizing Radiation—**Alpha ($\alpha$) particles, beta ($\beta$) particles, gamma ($\gamma$) rays, neutrons (n), energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Licensed Material—**Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under NRC license number 10-25362-01.

- **Minimum Detectable Concentration (MDC)—**The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity.

- **Monitoring** -The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

- **Neutron Radiation (n)—**An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.

- **License Radiation Safety Officer (License RSO)—**An individual who, by virtue of education, certifications, or experience, is qualified to provide planning for, and oversee the proper implementation of, radiological controls measures for work activities involving the potential for exposure to ionizing radiation and has been approved by the NRC and is named in the license.

- **Quality Factor—**A unitless number assigned to a particular type (and energy) or radiation in producing biological effect. Quality factors are used to derive equivalent dose from absorbed dose. Gamma, X-ray, and Beta radiation are assigned a quality factor of 1. Alpha and Neutron radiation have quality factors between 2 and 20.

- **Radiation Area—**An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- **Radiation Worker—**An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **RadCon—**An abbreviation for Radiological Controls.
- **Project Radiation Safety Officer (Project RSO)—**An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians. The Project RSO is qualified as an "authorized user" by the License RSO.
- **Radiological Controls Technician (RCT)—**An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Radiologically Controlled Area (RCA)—**Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.
- **Rem—**A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor.
- **Restricted Area—** An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.
- **Roentgen—**A unit of exposure equal to the amount of gamma or X-rays required to produce 1 electrostatic unit (esu) of charge in 1 cc of dry air at standard temperature and pressure.
- **Scanning—**A type of direct measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.
- **Self-Reading Dosimeter (SRD)—**A radiation-monitoring device used to provide a direct readout of gamma and/or x-ray exposure.
- **Smear Sampling—**A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally 100 $cm^2$.

- **Stay Time—**Allowable dose (measured in mRem) divided by radiation level (measured in mRem/hr).

- **Survey—** An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Thermoluminescent Dosimeter (TLD)—**Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

- **Total Contamination—**Radioactive material, including both the fixed and removable contamination fractions, found on, or as a part of, an item or surface.

- **Transferable, Removable, or Loose Contamination—**Radioactive material that can be easily removed from a surface or item.

- **Transient Shielding—**Any form of shielding that is used temporarily.

- **Very High Radiation Area—**An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

- **Whole Body –** For purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

- **Whole Body Counting—**An estimate of the amounts of internal contamination by a gamma-emitting nuclide obtained by counting the gamma rays emitted from the body and analyzing the pulse-height spectrum. This technique can also be used to measure the bremsstrahlung from energetic beta emitters.

- **Working Level (WL)—**Any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of $1.3 \times 10^5$ MeV of potential alpha particle energy.

- **X-ray Radiation—**High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and pose a substantial external radiation hazard.

# 5. RESPONSIBILITIES

## 5.1 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License Users/Project RSO
- Maintain all required license records at the location specified on the license

## 5.2 Shaw E & I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

## 5.3 Project Managers

Project Managers are responsible to identify any radiological safety issues associated with projects under their cognizance. Further, Project Managers are responsible for ensuring that appropriate radiological controls are established on projects under their cognizance in order to ensure the protection of workers, the general public, and the environment and to maintain exposures to ionizing radiation As Low As Reasonably Achievable (ALARA).

## 5.4 Project Radiation Safety Officer

The Project RSO is designated by the License RSO as an Authorized User and is responsible to understand, implement, and properly document the performance of the Site Specific Radiation Protection Plan at a project location, as established by the License Radiation Safety Officer. The Project RSO shall report to the License RSO, on radiological matters. Further responsibilities include the following:

- The Project RSO shall be familiar with the procedures and Federal/State Regulations listed in Section 3.0 and all applicable Radioactive Material Licenses prior to beginning a project. Copies of these documents should be available at the job site.
- The Project RSO is responsible for issuing and reporting personnel dosimetry for projects as specified in Shaw E & I Procedure T-RA-008, *External Dosimetry Administration* and Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans. The Project RSO is also responsible for ensuring that personnel dosimetry is properly worn for the duration of each project.

- The Project RSO is responsible for developing site-specific radiological controls procedures or work instructions, as required, in accordance with all applicable Shaw radiological controls procedures.
- The Project RSO is responsible for maintaining project radiological records in the project file throughout the duration of the project and in the permanent project file.

### 5.5 Radiological Controls Technicians

Radiological Controls Technicians (RCTs) are responsible to understand and use procedures, instructions, and/or plans established by the License RSO or Project RSO. They shall conduct and document all radiological operations in accordance with this procedure and with the procedures referenced within. They shall also provide immediate oversight, guidance, and enforcement of the radiological control program to ensure that all operations are radiologically safe and exposures are maintained ALARA.

### 5.6 Site Radiation Workers

Site Radiation Workers are responsible to comply with all radiological controls procedures, including postings and verbal instructions from radiological controls personnel, that are applicable to their assigned work activities. Site Radiation Workers will receive training on all radiological control requirements and procedures prior to working in radiologically controlled areas.

## 6. PROCEDURE

### 6.1 Requirements

The following sections present the general requirements for conducting work with potential for exposure to ionizing radiation. Each project will have a Site Specific RPP which addresses the specific controls appropriate for the conditions existing at that site. All Projects with Site Specific RPP shall be reviewed annually to ensure compliance with the terms of the License and NRC and DOT regulations as applicable. The review shall ensure that occupational doses and doses to members of the public are ALARA. Records of audits and other reviews of program content are maintained for at least three years from the date of the record.

#### 6.1.1 Prerequisites

The following prerequisite requirements will be performed prior to conducting radiological work:

- An appropriate project-specific radiation protection plan (RPP), consistent with the identified radiological hazards, and in compliance with this document and Shaw Health and Safety Procedure HS700 Policy *and Guidance for Developing Radiation Protection Plans*, will be developed and approved by the License RSO prior to conducting radiological work.

- Permanent and temporary Shaw personnel and contractors shall be trained in radiation safety in accordance with Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification*, prior to beginning radiation work.

### 6.1.2 Tools, Materials, and Equipment

Radiological instruments in sufficient quantities to adequately perform the monitoring required by this procedure shall be available on the job site prior to the start of work.

### 6.1.3 Calibration and Maintenance of Radiation Detection Instruments

This section provides the minimum calibration and maintenance requirements for radiation detection instruments. Only instruments with a current calibration label shall be used for conducting surveys. Instruments suspected of providing incorrect measurements shall be removed from service and tagged pending a satisfactory response check. The Project RSO shall be notified of suspect instruments.

The requirements for instrument set up and checks are found in Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*. When this procedure is used, a current copy of Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*, shall be available. Only personnel trained in the use of portable radiation monitoring equipment shall be allowed to use this equipment.

### 6.1.4 Radioactive Check Source Handling

The following safety precautions should be observed by personnel working in radiological areas using radiation detection equipment:

- Damage to or loss of a radioactive source may result in the spreading, inhaling, or ingesting of contamination. If a source is lost, notify the Project RSO. Immediate steps should be taken to recover the source and minimize radiation exposure to or contamination of personnel as a result of the lost source.
- To prevent sources from being lost, all sources should be held under signature custody. These procedures are in addition to and do not supersede the accountability requirements for sources controlled under the Nuclear Regulatory Commission or Agreement State Licenses.
- Except for sources that are permanently attached to detection instruments (e.g., check sources), sources shall be kept in a locked cabinet when not in use. The number of keys to the cabinet and the number of personnel having access to the keys should be kept at a minimum.

## 6.2 Radiological Controls Requirements

This procedure provides methods for ensuring that satisfactory controls are in place to minimize personnel radiation exposure and to properly manage radioactive contamination at all times.

### 6.2.1 Related Instructions

This procedure has been developed to provide guidance for compliance with Shaw radiological controls policies, including Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans.

### 6.2.2 Implementation of Radiological Control Procedures

Radiological controls are required by Shaw in areas where radioactive materials are handled or stored, in areas traversed by potentially contaminated personnel and materials, and in other areas where radiological work is performed.

The radiological controls requirements of this procedure, and referenced Shaw procedures, include the following:

- Control of external radiation exposure to personnel by means of personnel monitoring, area monitoring, installed shielding, and planning and execution of radiological work
- Control of internal radiation exposure to personnel by monitoring for contamination in air and on surfaces, by using anti-contamination clothing and respiratory protective equipment, and by controlling contaminated areas
- Control of radioactive wastes by means of specified procedures
- Decontamination
- Instructions for receiving, transferring, storing, shipping, and accounting for radioactive materials

The instructions in subsequent sections are those required to ensure radiological safety under most situations. In unusual situations, personnel are expected to perform additional measurements and take other additional precautions as deemed necessary to provide adequate protection.

### 6.2.3 Radiological Control Training Requirements

Periodic radiological control training is necessary to ensure that all personnel understand the general and specific radiological aspects that they might encounter, understand their responsibilities to their employer and to the public for safe handling of radioactive materials, and understand their responsibilities for minimizing their own exposures to radiation.

The appropriate degree of training for each individual (Shaw employees and Shaw subcontractors) necessary for an individual project shall be determined by the requirements of the radioactive material license and Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification*. Personnel need to be trained in the appropriate categories discussed in the following sections.

The Project RSO shall ensure that the training requirements of this Section are implemented. Personnel designated to verify practical abilities, conduct classroom and practical training, and conduct oral examinations shall be designated in writing by the License RSO.

#### 6.2.3.1 Radiation Workers

Radiation workers include personnel authorized to receive radiation exposure in the course of their work.

Personnel who routinely require access to or work in RCAs shall have met the Radiation Worker Training Standard in Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification,* prior to being issued dosimetry equipment. Other personnel issued dosimetry, but who have not completed this training, shall be escorted by a qualified individual when in radiological areas.

Radiation Worker Training shall be verified by written examination(s), which includes questions concerning areas of required knowledge and questions concerning actions required by the individual in event of an unusual radiological control situation (e.g., puncture of a contamination containment area). Knowledge, understanding, and practical abilities shall be verified by the signature of a designated individual in accordance with Shaw E & I Procedure, T-RA-002, *Radiological Controls Training & Qualification*.

#### 6.2.3.2 Radiological Controls Technicians

Qualified radiological controls technicians shall have met the Radiological Control Technician Training Standard in accordance with Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification,* and shall be able to apply this knowledge to situations they might encounter during work.

#### 6.2.3.3 Visitors/Contract Workers

Management, technical, and other personnel who require occasional access to RCAs and areas where radioactive materials are stored and who enter these areas for observation or similar purposes, or to perform work not involving radioactive materials, shall have the radiological control training necessary for the radiological conditions expected to be encountered or shall be escorted by appropriately qualified personnel at all times. A continuous escort is not required if the visitor/contract worker is in continuous view of qualified personnel. The presence of personnel normally assigned to these areas fulfills this function. The Project RSO shall determine the training requirements and shall record the decision. Dosimetry shall be provided in accordance with Shaw E & I Procedure T-RA-008, *External Dosimetry Administration,* and Section 6.3 of this document.

### 6.2.4 Records and Certification of Training

Personnel training records shall be maintained in the on-site project file throughout the duration of the project.

Certification of radiological control training for all personnel shall be accomplished annually for continuous qualification as a Radiation Worker in accordance with Shaw E & I Procedure T-RA-002, *Radiological Controls Training & Qualification*.

Certification of training as a Radiation Worker shall include a comprehensive written examination. Personnel shall also demonstrate that they have retained the practical abilities needed to perform their specific jobs.

### 6.2.5 Instruction on Radiation Exposure to the Unborn Child

Prior to being issued dosimetry equipment, all personnel authorized to receive radiation exposure, all supervisors, and all females authorized to receive radiation exposure as visitors shall be given specific instruction about prenatal exposure risks to the developing embryo and fetus. This instruction shall include both verbal and applicable written information found in the appendix to U.S. Nuclear Regulatory Commission, Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." Instruction concerning prenatal exposure to the unborn child shall be given during initial and re-verification training. All personnel receiving instruction in accordance with this section shall sign the "Instruction on Radiation Exposure to the Unborn Child Acknowledgement Form" prior to being issued dosimetry.

This form shall be maintained by the Project RSO with the dosimetry records in accordance with Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*. Statements signed by visitors shall be retained for three years following project completion.

### 6.2.6 Radiological Incident/Investigation Reports

Instructions for incident reporting and incident investigation are located in Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. These instructions describe the circumstances and reporting requirements for incidence and occurrences.

Where applicable, site-specific procedures may be developed to meet further requirements specific to a field project.

Shaw recognizes that many situations arise that may not be considered an incident and do not require further reporting, but that these situations can be precursors to future incidents and accidents. All employees are encouraged to report unsafe acts or conditions on the appropriate form in Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. This reporting provides the documentation and informs management of situations that may be fixed prior to becoming more serious.

## 6.3 Radiation Exposure Limits and Exposure Monitoring

Exposure limits are established to control personnel exposure to ionizing radiation. Federal and state Regulations outline the maximum exposures that a person may receive. These radiation protection regulations stress maintaining personnel exposures As Low As Reasonably Achievable (ALARA).

### 6.3.1 Administrative Exposure Limits

Shaw has established administrative exposure limits that maintain exposure below the federal and state limits. General control procedures and exposure limits for personnel working on Shaw projects are found in Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*. During a field project, a current copy of Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*, shall be available.

Visitors/Contract workers shall not be allowed to receive exposures in excess of 100 mrem per calendar year unless they are fully trained as radiation workers per Section 6.2.4.

### 6.3.2 Radiation Exposure Limits for the Unborn Child

During the entire gestation period, the maximum permissible dose equivalent to a fetus from occupational exposure for a declared pregnant worker shall not exceed 0.5 rem for the entire gestation period.

Training shall be provided to all workers in accordance with section 6.2.2 of this document. .

### 6.3.3 Radiation Exposure to the Public

The Project RSO shall ensure the following with respect to Shaw operations:

- No member of the public receives a total effective dose equivalent in one year exceeding 0.1 rem.
- Radiation levels in unrestricted areas do not cause an individual continuously present in the area to receive more than 2 mrem in one hour.
- All doses to the environment and the public are consistent with Shaw ALARA policy.
- No suspected radioactive material is released outside a controlled area in excess of limits established in any applicable regulatory guidance.

### 6.3.4 Radiation Exposure Monitoring

The monitoring of personnel radiation exposure for all Shaw activities is controlled by Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*, Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*, and Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans, which provide the procedures for the issue, processing, and recording of personnel radiation exposures of all personnel working on projects.

Personnel dosimetry requirements for each project shall be determined and approved by the License RSO prior to work activities involving the potential for radiation exposure.

Individuals shall not enter any radiologically controlled area without required personnel dosimetry. Individuals other than visitors or contract workers shall not be issued dosimeters unless a record of the individual's current annual exposure is obtained.

### 6.3.5 External Dosimetry

Dosimetry shall be worn on the area of the body expected to receive the highest radiation dose; under most circumstances, this area shall be the frontal area of the chest or waist. When the location of the body that shall receive the maximum dose is not certain, additional dosimeters may be worn; radiological control personnel shall specify the location of these additional dosimeters. When exposure to extremities (hands and forearms below the elbow, feet and legs below the knees) is expected, or the exposure has the potential to exceed 25 percent of the administrative limits of Section 6.3.1, additional dosimetry shall be worn on the exposed extremity or forearm. Whenever additional dosimeters are worn, results of processing for all dosimeters shall be included in the individual's personnel exposure records. Care shall be taken to ensure separate recording of exposures for extremities or forearms and for the whole body radiation exposure.

In situations where beta radiation is significant, the lens of the eye shall receive special consideration. Personnel shall be shielded from the beta radiation by using masks, eye protection, and/or anti-contamination clothing. If the beta radiation cannot be shielded, methods for controlling beta radiation exposure shall be evaluated and implemented to control exposures to established limits for skin exposures.

Lost dosimetric devices shall be reported as specified in Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*, and Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans.

Personnel dosimetry data for an individual will be made available to authorized requestors and to the individual upon written request through the Shaw Health and Safety Department. This information will also be readily available on the project site to enable individuals to keep track of their own exposures.

### 6.3.6 Self-Reading Dosimeters (SRDs)

SRDs shall be worn to monitor radiation exposure accumulated between readouts of other dosimetric devices, such as TLDs. SRDs shall be worn in accordance with the applicable Radiation Work Permit (RWP). The following requirements apply to SRD use:

- All personnel entering a high radiation area or in radiation areas where they could receive a dose in excess of 15 mrem in one day shall be monitored by a SRD worn at the same location on the body as the their primary dosimeter. The above requirement does not preclude the use of SRDs for other exposure monitoring.
- An individual reaching 80% of the appropriate administrative limit of Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*, shall be placed on an Alert List and shall wear an SRD. The Project RSO shall closely monitor the exposure of individuals on the alert list to prevent administrative limits from being exceeded.
- Additional SRDs are required if the location of the maximum dose on the body is not certain, as is discussed in Section 6.3.5 above.

The Project RSO shall maintain a log of all SRD results obtained between routine TLD readouts. Before the SRD is re-zeroed, the measured radiation exposure is recorded. The individual's monthly, quarterly, and/or yearly exposure totals are determined. The individual is thereby prevented from inadvertently exceeding the control levels.

SRDs, whether low or high range types, shall be read by the wearer prior to entering radiation or high radiation areas and periodically thereafter to control the wearer's own radiation exposure while in these areas.

To prevent an off-scale reading, dosimeters shall be read and recharged, and doses shall be recorded, whenever the reading exceeds three-fourths of full scale.

When a SRD reading is off-scale or a dosimeter is lost under conditions such that a high exposure is possible, the person's primary dosimeter shall be processed immediately, and the person shall be removed from the radiological area until the exposure has been determined. The Project RSO shall notify the dosimetry contractor for appropriate dosimeter processing and reporting.

SRDs in use shall be tested at least every six months to ensure accuracy. If dosimetry performance is suspected to be unacceptable due to excessive drift or fails in use, the Project RSO shall initiate action to correct the problem.

### 6.3.7 Internal Exposure Monitoring

The site-specific internal monitoring requirements shall be determined by the License RSO, or designee, prior to the commencement of any work activities that could result in internal radiation exposure. Internal Exposure Monitoring will be conducting in accordance with Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*.

Internal contamination monitoring shall be performed when personnel are or may be exposed to airborne contamination exceeding 0.3 DAC, or have the potential for intakes greater than 0.1 ALI, as defined in Code of Federal Regulations, 10 CFR Part 20 Appendix B, Table I, *Standards for Protection Against Radiation*.

Suspected intakes of radioactive materials, such as may occur when there is significant skin contamination, shall be investigated by internal monitoring.

The Project RSO shall contact the License RSO for direction if the need for internal monitoring is uncertain.

Procedures for the collection of bioassay samples shall be specified by the License RSO in accordance with Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*.

All reports of internal contamination monitoring shall be maintained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13. Copies of these reports shall be forwarded to the License RSO for evaluation, and as required by Shaw E & I Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring*, Shaw Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans, and Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

Reports of overexposure shall be performed in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review,* or Title 10, Code of Federal Regulations, Part 20, *Standards for Protection Against Radiation*,.

### 6.3.8 Exposure Records

The Project RSO shall keep records of personnel exposure and shall forward those records and data as required by Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*, and Shaw E & I Health and Safety Procedure HS700 Policy and Guidance for developing Radiation Protection Plans. Copies of all exposure records will be maintained on the project site, while original exposure reports are forwarded to the Shaw Health and Safety Department.

### 6.3.9 Visitors/Contract Workers

A record of visitor and contract worker exposures shall be maintained in the on-site project exposure files using the Visitor/Contract Worker Exposure Record Form and in accordance with Section 6.13. A report of exposure shall be provided to the individual upon written request.

## 6.4 Methods for Controlling Radiation Exposure

### 6.4.1 General Requirements

Shaw activities shall maintain personnel radiation exposure ALARA. A continuing effort is required to meet this goal by developing and implementing improvements to work procedures and work performance. Procedures for managing the ALARA Policy are found in Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*. The following general requirements are designed to assist in meeting this goal:

- In radiological work areas, work shall be performed only under the guidance of an approved procedure, work instruction, or Radiation Work Permit (RWP).
- Individual work procedures shall specify engineering controls and other applicable actions to be used to minimize radiation exposure during work. These controls/actions may include pre-work decontamination of work areas, use of ventilation to reduce airborne radioactivity, mock-up training, or removal of radioactive sources from work areas.
- Supervisory personnel and radiological control personnel shall ensure that personnel are not waiting unnecessarily in RCAs.
- Before entering an RCA, workers shall receive specific job training and/or briefings necessary to enable them to perform work with minimum radiation exposure. Examples of this training include mockup training in shops for specific jobs or periodic briefings by supervisory personnel for routine work.
- Radiation levels in high radiation areas shall be identified by the use of signs that clearly show the areas with high and low radiation levels, along with the radiation intensity, and the date of the last survey.
- Records of the cumulative radiation exposure received in performing a work task should be used, as necessary, to improve methods of work performance in order to minimize personnel radiation exposure in future similar work.

### 6.4.2 Procedures and Work Instructions

Major work in an RCA shall be performed under the guidance of a task-specific procedure or work instruction. The License RSO may determine the need for a specific approved procedure or work instruction.

Procedures or work instructions should describe the task, radiological conditions, and radiological controls.

A pre-job briefing shall be held prior to beginning work under a procedure or work instruction to ensure that all personnel understand the task, radiological conditions, and radiological controls.

### 6.4.3 Radiation Work Permits

The Radiation Work Permit (RWP) shall be used to delineate conditions and protective measures to prevent inadvertent exposure of personnel to radiation or radioactive contamination. The radiological conditions associated with the work to be performed shall be recorded on the RWP. Also specified are the protective measures required by personnel entering the designated area. The following requirements establish the proper use of the Radiological Work Permit.

The RWP shall be obtained for work operations not specifically covered by an approved procedure or work instruction that are performed in an area where any of the following conditions exist or could potentially arise:

- Airborne radioactivity resulting in greater than 2.0 DAC hours daily intake
- Surface contamination in excess of applicable project release criteria or as specified in Attachment 3 if no project limits are established.
- Radiation levels that would require posting of the area, as specified in Section 6.5.2

Whenever the need for an RWP is in question, such as when soil is to be excavated adjacent to a radiologically controlled facility, the Project RSO shall be contacted to determine if potential radiological problems may be encountered. The Project RSO shall then determine if an RWP is required.

Signs indicating the need for the RWP should be conspicuously posted at the entrances to areas were the RWP is required.

Supervisors proposing to conduct work activities within posted radiation/contamination areas are responsible for initiating the issuing of RWPs. Generally, the initiator shall be the supervisor in charge of proposed activities.

The Project RSO shall discuss the proposed work activities and work areas with the supervisor. Additionally, the Project RSO shall review previous data and determine the current radiological status of the area prior to approval and issuance of an RWP. A re-survey of the area may be necessary if radiological knowledge of the area is inadequate to complete all sections of the RWP. Any further Health Physics survey requirements shall be specified on the RWP.

A radiation dose estimate should be made based upon the work requirements submitted to the Project RSO. For work in high radiation areas, a dose budget will be prepared by work task and included with the RWP.

Prior to beginning work, the Project RSO or designee shall hold a pre-job conference with the supervisor and all personnel working under the RWP. Items discussed shall include work scope, dosimetry and protective clothing requirements, survey results, stay time limits, and emergency actions. The workers shall sign the RWP signature form to indicate that they understand the requirements. Workers added to the RWP after the initiation of work shall be briefed by the Project RSO prior to starting work and shall sign the RWP signature form.

Those personnel entering an area under the direction of an RWP shall indicate by their counter-signature, on the RWP signature form, that they are aware of the instructions and conditions of the RWP and that they have received and understood the necessary briefing.

If, during operations under valid RWPs, the radiological conditions change, the scope of work is changed, or the scope of work is expected to change, another RWP shall be required and a pre-job conference shall be held.

The Project RSO shall determine the degree of monitoring required for a specific operation. This determination should be based on the potential for radiological problems and the experience of the personnel conducting the operation.

An RWP shall terminate seven calendar days following its initiation. If the work is to be continued, a new RWP shall be initiated. Long term RWPs may be used in specific situations with the written approval of the License RSO.

The Project RSO (or designee) shall maintain an indexed project RWP log. Records in the RWP log index shall include RWP no., date of issuance, date of termination, and reason for the RWP (work scope).

The Project RSO (or designee) shall ensure that all RWPs are terminated and collected upon their expiration, and shall maintain copies of all terminated RWPs in the on-site project file throughout the duration of the project and in accordance with Shaw E & I Health and Safety Procedure HS700 Policy and Guidance for Developing Radiation Protection Plans, and Section 6.13 of this document.

The RWP may be used to detail chemical hazards and industrial hygiene hazards and requirements. The Project RSO shall review these requirements with Shaw E & I Health and Safety personnel. If the RWP is used for this purpose, the RWP supplement form will be prepared and utilized as follows:

- If industrial hygiene or occupational health hazards are identified, the RWP Supplement Form may be used to identify the hazards. This form is not intended to be a substitute for existing forms or procedures that provide better information and protection.
- When the RWP Supplement Form is used, it shall be attached to the RWP and kept with the RWP.

- The information in the RWP Supplement form shall be covered in the briefing associated with the RWP.
- On the RWP Supplement Form, place the RWP number with which it is associated.

### 6.4.4 Access Control Point

An access control point is a location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas. The dimensions and material requirements depend on the type of work to be performed, the number of personnel involved, and the location of the work. Shaw E & I Procedure T-RA-010, *Radiological Site Controls*, and the following items outline the basic considerations for establishing an access control point:

- Determine the extent of the area to be isolated and the location where entry and exit shall be controlled.
- Plan for physical boundaries to prevent inadvertent or unauthorized access to the contaminated area. Boundaries shall be conspicuously marked and posted. Existing walls and equipment may effectively be used as boundaries.
- Cover the floor of the contamination control point using paper or plastic sheet or other material provided for this purpose. The intent is to provide an easily removable walking surface within the contamination control point to prevent tracking of contamination from the area. Maintain a supply of the material to replace floor covering as necessary.
- Provide a "step-off pad" at the exit from the contamination control point. This pad is to be used when removing clothing during exit from the area.
- Provide easily accessible receptacles for radioactive waste and contaminated clothing, respirators, and equipment at the contamination control point. A supply of plastic bags shall be available as necessary for receiving contaminated equipment and tools. Radiation tags or labels shall be available to identify contaminated items being removed from the area.
- Provide radiation detection instruments for monitoring personnel and equipment. Frisking should be performed in a low radiation background and where the audible response of the frisker can be heard.
- Provide a means for recording stay times, as may be required, at the entrance of the areas for personnel. It may be necessary to provide a record of previous radiation exposure received by personnel entering an RCA so that maximum allowable time in the RCA can be determined.
- At the entrance to the access control point, information shall be posted concerning radiation and contamination conditions, precautions for entry, precautions for exit, step-off points, clothing and waste receptacles, and personnel monitoring. A copy of the applicable RWP shall be posted at the access control point.

- Radiological control personnel shall maintain the control point. The Project RSO shall assign a qualified person to the control point to ensure that personnel and equipment are adequately monitored prior to leaving the area and that all logging requirements of Shaw E & I Procedure T-RA-010, *Radiological Site Controls*, are met.
- In some instances where high-level contamination exists, it may be necessary to wear two sets of anti-contamination clothing. The outer garments should be removed at a designated location close to the contaminated work to minimize tracking of contamination to the access control point.
- Adequately trained personnel may be permitted to assist in frisking other personnel and themselves.
- Contaminated individuals shall be processed in accordance with Section 6.10.4.

### 6.4.5 Transient Shielding

Since incorrect installation, unauthorized movement, or removal of temporary shielding can result in large changes in work area radiation levels, control of transient shielding is essential. The following requirements will be adhered to when utilizing temporary or transient shielding:

- Transient shielding installation and removal should be controlled by written instructions. These instructions shall specify locations and amounts of transient shielding.
- After installation, transient shielding shall be inspected to ensure that it is properly located.
- Periodic radiation surveys conducted in accordance with Section 6.5.1 shall be reviewed by the Project RSO or radiological engineer to ensure that shielding maintains its effectiveness in reducing radiation dose rates. In reviewing these surveys, particular attention shall be paid to components that had radiation levels greater than 1 rem/h prior to shielding, since personnel could receive high radiation exposure in a short time if the shielding loses its effectiveness.
- Lead shielding shall not be used in radioactively contaminated areas or in association with radioactively contaminated materials without prior approval of the Shaw Project Manager or designee.

## 6.5 Radiation Survey and Posting Requirements

### 6.5.1 Radiation Surveys

Radiation surveys are performed as necessary to ensure that personnel do not exceed radiation exposure limits and to meet requirements for posting of radiation areas. These surveys are performed to determine whether abnormal radiation levels exist and to determine the extent and magnitude of radiation levels. The surveys in this section shall be the minimum performed. Surveys are to be performed and documented as stated in this section and Shaw E & I Procedure T-RA-009, *Radiation Exposure Rate Monitoring*.

Generally, radiation exposure surveys are required within the following periodicities:

- Radiation surveys shall be performed whenever operations are performed that might be expected to change existing radiation levels. Examples of such operations include movement or removal of shielding, processing of radioactive waste, and relocation of radioactive materials.

- Temporary boundaries (e.g., rope boundaries) of radiation areas shall be surveyed daily to ensure that radiation areas do not extend beyond posted boundaries.

- Gamma monitoring shall be performed at least weekly in occupied posted radiation areas and in radioactive material short-term storage areas. Long-term storage areas should be monitored at least monthly.

- When highly radioactive equipment (with a radiation level at 30 cm greater than 100 mrem/hr) is moved, gamma monitoring should be performed in spaces surrounding work areas (including the spaces above and below them, if applicable) where personnel are likely to be exposed to radiation.

- Potentially contaminated ducts, piping, and hoses outside radiological controlled areas shall be monitored at least monthly for gamma radiation when in use or at least annually when not in use (e.g., deactivated systems).

- Surveys of ventilation filters shall be performed whenever work is performed on these filters.

- Other surveys should be performed as necessary to control personnel exposure to gamma, beta, and alpha radiation. Such surveys should include the following: (1) a gamma monitoring during initial entry into a tank containing potentially radioactive piping; (2) gamma monitoring in spaces where significant radiation levels might exist from an adjacent operating facility; (3) beta as well as gamma measurements when personnel might come in contact with surfaces exposed to beta-emitting contamination (use of open-window G-M detectors is acceptable).

- Surveys shall be conducted when performing operations that could result in personnel being exposed to small, intense beams of radiation. These operations include working with spent fuel handling containers, removing shielding, or opening shipping/storage containers of radioactive equipment. When surveying areas or equipment where small, intense beams of radiation could be present, the instrument should be equipped with a means for producing an audible response (e.g., earphones). An audible response is necessary since the visible meter response is usually considerably slower. The probe should be moved slowly enough so that the instrument has a chance to give an audible increase for a large radiation level increase. If an audible increase is noted, the probe should be moved to the location producing maximum response, and the meter should be read. If general dose rates are sufficiently high such that a change in audible response is not detectable, slower monitoring rates should be used so that beams are detectable by observing the meter. The probe is moved at a speed that is determined by considering the size of the probe, the instrument response time, the possible intensity of the beam, and the general dose rates in the area. Particular attention shall be given to thoroughly scanning suspected areas such as portable shield sections and areas that are or are likely to be occupied. For equipment with complex shield design, surveyors and workers should be briefed on the equipment design so that areas most likely to have small beams can be given special attention.

- Gamma radiation surveys shall be performed monthly on a revolving basis in the areas of the work site where radioactive materials are not stored or handled. The survey should consist of a visual inspection and scans of accessible areas and lockers with either a G-M dose rate meter or a portable gamma scintillation meter (if available).

### 6.5.2 Posting of Radiation Areas

Specified below are requirements for the posting of areas where radiation or the potential for radiation may exist:

- *Radiation Area.* Any area within a controlled area accessible to personnel in which radiation exists at such levels that a major portion of the body could receive a dose equivalent greater than 5 mrem (50 microsieverts) in one (1) hour at 30 cm from the radiation source or from any surface through which the radiation penetrates shall be designated as a radiation area. To mark such areas, signs shall be conspicuously posted; signs shall contain the conventional magenta three-blade symbol on yellow background and the words "CAUTION RADIATION AREA"; signs are permitted to state the general area radiation level. In addition, "DOSIMETRY BADGE REQUIRED" shall be posted. No loitering is allowed in these areas.

- *High Radiation Areas.* Any area within a controlled area, accessible to personnel where a major portion of the body could receive a dose equivalent greater than 100 mrem (0.001 sievert) in one (1) hour at 30 cm from the radiation source or from any surface through which the radiation penetrates shall be designated as a high radiation area. Major portions of the body include any portion of the head and trunk. Such areas shall be posted and locked or guarded. The requirement to lock or guard a posted high radiation area does not apply to tanks or voids posted as high radiation areas if entry requires the removal of complex closures. Positive control shall be established for each individual entry into a high radiation area and shall be established in such a way that no individual is prevented from leaving the high radiation area. Prior to locking an unoccupied high radiation area, the area shall be inspected to ensure that no personnel remain inside. No loitering or entry by unauthorized personnel shall be allowed in these spaces. High radiation areas shall be conspicuously posted at all entrances into the area. Signs shall contain the conventional magenta three-blade symbol on yellow background and the words "CAUTION: HIGH RADIATION AREA." In addition, "CONTACT Project RSO PRIOR TO ENTRY" shall be posted. Instances in which high radiation areas are not controlled in accordance with the requirements of this section (e.g., locking personnel in a high radiation area or failure to lock or guard a high radiation area), shall be reported to the License RSO in accordance with Shaw E & I I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

- *Very High Radiation Areas/Exclusion Areas.* Any area within controlled areas, where access would result in personnel receiving an absorbed dose in excess of 500 rads (5 grays) in one (1) hour at 1 meter from the radiation source or from any surface through which the radiation penetrates shall be designated a very high radiation area. These areas shall be designated as Exclusion Areas, and personnel access shall be strictly controlled. Areas where general area radiation levels exceed one (1) R/hour shall be operated using an approved written work instruction. Posting of Very High Radiation Areas and/or Exclusion Areas shall at a minimum require the conventional magenta three-blade symbol on yellow background and the words "GRAVE DANGER: VERY HIGH RADIATION AREA." In addition, "CONTACT Project RSO PRIOR TO ENTRY" shall be posted. Instances in which very high radiation areas are not controlled in accordance with the requirements of this section (e.g., locking personnel in a very high radiation area or failure to lock or guard a very high radiation area) shall be reported to the License RSO in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

## 6.6 Limits and Procedures for Controlling Airborne Radioactivity

### 6.6.1 General

The basic criterion for airborne radioactivity is that internal radiation exposure resulting from inhalation of airborne radioactivity should be minimized. Levels of internal exposure to airborne radioactivity are measured in units of DAC-hours (Derived Air Concentration multiplied by hours of exposure).

Radioactivity in the form of airborne particulate, gases, or both can become airborne through sources such as the following:

- Radioactive system leaks
- Grinding or welding a contaminated component
- Decontamination operations
- Disturbing surface contamination in a work area
- Improper use of containment enclosures
- Inadequate vacuum cleaner and ventilation system control
- Inadequate application of procedures for venting and draining radioactive systems or components
- Damage or defect in radioactive instrumentation calibration and check sources
- Radon from radium sources and from trace amounts of natural radium impurities in construction materials

The Project RSO shall provide the continuous or periodic sampling required to detect and evaluate the levels of airborne radioactivity in work areas and exhaust air systems in accordance with Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

It should be noted that this monitoring is primarily concerned with the control of particulate airborne activity. For operations or materials that may result in the discharge of gaseous airborne activity, contact the License RSO for specific guidance.

### 6.6.2 Limits for Airborne Radioactivity

The Shaw E & I administrative limit for occupational exposure to airborne radioactivity is 2.0 DAC hours per day. The DACs are found in Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1, "Air Concentration Limits." Site-specific limits for occupational exposure to airborne radioactivity shall be determined during the project ALARA briefing (Shaw E & I Procedure T-RA-011, *USNRC License Implementation Procedure*).

Shaw operations should be controlled so that personnel are not exposed to airborne radioactivity levels that would require the use of respiratory protection equipment.

Any measurement that indicates the airborne radioactivity concentration to be in excess of 0.3 of the applicable DAC shall be investigated to determine the cause of the airborne radioactivity levels. Appropriate controls shall be implemented to maintain the airborne radioactivity levels ALARA.

### 6.6.3 Controlling Personnel Exposure to Airborne Radioactivity

Personnel exposure to airborne radioactivity is controlled using contamination containments and respiratory equipment as required below and in accordance with Shaw Health and Safety Procedure HS601, *Respiratory Protection Program*. In addition, many organizations have required the use of respiratory equipment for work in areas with high levels of surface contamination (e.g., 50,000 dpm/100 $cm^2$) because of the likelihood that this surface contamination could become airborne. In some circumstances, respiratory equipment might be necessary for work in areas where surface contamination exists at lower levels.

The following sections include discussion of the requirements associated with controlling personnel exposure to airborne radioactivity:

- Contamination containments shall be used to the maximum extent practicable to prevent personnel from being exposed to airborne radioactivity above the limits of Section 6.6.2. These containments are recommended during radiological work that has been known to cause or is expected to cause airborne radioactivity..
- The need for personnel to wear respiratory equipment in accordance with Section 6.6.7 and Shaw Health and Safety Procedure HS601, *Respiratory Protection Program,* in areas where airborne radioactivity exceeds the applicable limits of Section 6.6.2 shall be evaluated and documented prior to area entry. The evaluation shall include an assessment of the effects of respiratory equipment use on external dose due to decreased worker productivity.
- Personnel shall not be exposed to airborne radioactivity such that their daily intake exceeds 2 DAC-hour without prior approval of the License RSO.

- Signs shall be posted at entrances to areas where airborne radioactivity levels exceed or have the potential to exceed 30% of the DAC. These signs shall contain the conventional three blade magenta symbol on yellow background and the words "CAUTION: AIRBORNE RADIOACTIVITY AREA." The requirements to wear respiratory equipment shall also be included on a sign with the anti-contamination clothing requirements.

- When personnel not wearing respiratory equipment may be exposed to airborne radioactivity above the limits of Section 6.6.2, a ventilation system should be operated, which shall remove airborne particulate radioactivity to a controlled ventilation system or other system with a high efficiency particulate air (HEPA) filter. For example, during such operations as machining contaminated surfaces, vacuum cleaners fitted with HEPA filters or flexible ducts connected to a filtered ventilation exhaust shall provide suction from within about one foot of the work area. Experience has shown that some operations within containments, such as grinding on highly contaminated components, require exhausting the containment through a ventilation system with an installed high efficiency filter to prevent high airborne radioactivity outside the containment. Exceptions to this requirement are permitted with approval of the Project RSO or designee when use of a ventilation system shall cause the spread of radioactive contamination.

- HEPA filters shall be installed in the ventilation exhaust from radioactive work areas in which work in progress could cause the discharge of airborne radioactivity to the environment.

- HEPA filters shall be installed in the exhaust from contamination containments to prevent personnel from being exposed to high airborne radioactivity.

- HEPA filters shall be installed in vacuum cleaners used around loose surface contamination.

- Monitoring for airborne radioactivity shall be performed in accordance with Section 6.6.5 and Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

- Positive pressure breathing apparatus, air supply masks, or hoods shall be worn when airborne particulate activity exceeds 50 times the DAC limit of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1.

Personnel shall not enter areas where the airborne particulate activity level exceeds 1000 times the limit of DAC of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1, without License RSO approval. This restriction applies even to personnel wearing self-contained breathing apparatus or air supply respirators. If personnel entry is required to these areas, containment or filtered room ventilation shall be used to reduce airborne radioactivity levels to below 1000 times the DAC of Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table 1.

Respirators shall be selected such that the ratio of the Protection Factor from Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation,* to the airborne level (in DACs) does not exceed 1.

### 6.6.4 High Airborne Radioactivity

High airborne particulate radioactivity associated with Shaw operations can result from many causes. It can be indicated by a continuous air monitor (CAM), by a portable air sample exceeding the applicable limit of Section 6.6.2, or by an indication of a radioactive system leak or rupture. General procedures for controlling personnel exposure to airborne radioactivity are contained in Section 6.6.3.

The procedures in this section shall be followed for controlling high airborne radioactivity when particulate radioactivity is above the limits of Section 6.6.2 in occupied areas.

#### 6.6.4.1 Immediate Actions

These actions should be performed nearly simultaneously; however, the steps below should be immediately emphasized with the completion of additional steps as soon as possible (i.e., as soon as the number of radcon personnel, operating conditions, and time allows).

- Stop operations that might be causing high airborne radioactivity until adequate control of airborne radioactivity is established.
- Evacuate unessential personnel from affected areas.
- Don respiratory equipment in affected areas.
- Secure unfiltered ventilation from the affected spaces to other spaces. Secure unfiltered ventilation to the environment from affected spaces. Ventilation systems that contain high efficiency filters in exhaust ducts do not need to be secured.
- Determine the extent of the airborne radioactivity by sampling the affected area and adjacent areas using portable air samplers.
- If the high airborne radioactivity is indicated by the alarm of a CAM that is monitoring a ventilation exhaust or a work area, check the recorder chart on the CAM panel and the meter indication to determine that the CAM alarm is not the result of circuit failure or an electrical transient. If the recorder chart shows circuit failure or if the meter indication is below the alarm setting, confirm airborne radioactivity is below the limit of Section 6.6.2 by taking a portable air sample. Measure gamma radiation at the CAM to determine if the CAM alarm was caused by high radiation levels external to the CAM. If radiation levels are high, determine the source of the high levels by conducting additional monitoring and confirm airborne radioactivity is below the limit of Section 6.6.2 by taking portable air samples. Action in the subsequent steps need not be taken if the alarm was caused by high external gamma radiation levels.

#### 6.6.4.2 Supplementary Action

The subsequent actions of this procedure need not be carried out if the airborne radioactivity is confirmed to be below the limit of Section 6.6.2:

- Attempt to identify the radionuclide causing the airborne radioactivity. For example, promptly measure the sample for alpha radioactivity and determine the approximate half-life or perform gamma energy analysis.
- In order to minimize the need for respiratory equipment, and to reduce personnel exposures to airborne radioactivity, consideration shall be given to ventilating the facility with additional HEPA filtered ventilation systems. When ventilating, avoid spreading airborne radioactivity to other spaces. Periodically monitor radiation levels on ventilation filters. To minimize contamination of the ventilation system while ventilating, operate the ventilation system in accordance with applicable procedures using the minimum number of fans to achieve stable conditions in the affected spaces.
- Perform gamma monitoring of ventilation filters and ducts and measure surface contamination in the vicinity of the ventilation exhaust discharge point.
- Measure and control surface contamination in areas affected by high airborne radioactivity.
- When resuming operations, take portable air samples to verify that the cause of high airborne radioactivity is corrected.
- Monitor evacuated personnel for contamination and decontaminate as necessary. A check of personnel exposed to high particulate radioactivity for internal radioactivity uptake may be required. Nasal smears may be taken.
- Prepare a report for any occurrence involving high airborne radioactivity (above the limits of Section 6.6.2) in areas occupied by personnel not wearing respiratory equipment, in accordance with Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. This report shall include the results of monitoring personnel for internally deposited radioactivity as required.

### 6.6.5 Monitoring for Airborne Radioactivity

The system used for monitoring airborne radioactivity shall have a Minimum Detectable Concentration (MDC) not greater than 10% of the applicable DAC. Refer to Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*, for MDC calculations. Site-specific MDC requirements shall be determined during the project ALARA briefing (Shaw E & I Procedure T-RA-011, *USNRC License Implementation Procedure*).

Airborne particulate monitoring shall be performed as follows:

- Monitoring should be conducted continuously using a CAM, or at least every four hours by “grab” sample, in the following situations:
  - (1) In radiological areas when radiological work is performed
  - (2) During radiological work that has been known to cause or is expected to cause airborne radioactivity

(3) In occupied areas where removable contamination exceeds 10,000 dpm/100 $cm^2$ beta-gamma or 500 dpm/100 $cm^2$ alpha. These portable samples are not required if continuous monitoring is performed. If the installed continuous air particle detector for a ventilation exhaust is inoperative and radioactive work is being performed, portable sampling shall be performed every four hours.

- Monitoring should be conducted before initially opening systems or entering tanks or voids that contain potentially radioactive piping.
- Monitoring should be conducted whenever airborne radioactivity levels above the limit of Section 6.6.2 are suspected.
- Personnel air samplers should be used whenever air sampling indicates levels > 0.1 DAC.

Records of the above airborne radioactivity monitoring may be required to serve legal purposes and therefore shall be maintained neatly and retained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13. Documentation of airborne radioactive measurements will be in accordance with Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

Portable air particulate sampling equipment shall be immediately available to sample air during abnormal conditions that could result in significant airborne radioactivity release.

### 6.6.6 Air Sample Counting

When handling air samples collected from areas known to or suspected of containing airborne radioactivity, care should be taken to prevent the spread of contamination and cross contamination of samples taken. If significant radon daughter concentrations are expected, the samples shall be counted initially and again 24 hours later to determine the actual long-lived alpha activity.

Scaler-Counters used for counting air activity shall be set up in accordance with manufacturer's instruction and Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.

Calculate the air sample concentrations in accordance with Shaw E & I Procedure T-RA-007, *Airborne Radioactive Particulate Monitoring*.

### 6.6.7 Determination of DAC-Hours

A DAC-hour is a quantity of radioactive material equal to the quantity of material that would be inhaled if an individual occupied an area containing airborne activity at a concentration of one DAC (Derived Air Concentration), as found in Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, Table I (air), for a period of one hour.

Before an individual enters an airborne radioactivity area, the Project RSO shall determine the individual's expected daily intake, in DAC-hours, to ensure that the limit of 2 DAC hours is not exceeded.

The airborne concentration $[A]_{DAC}$ in DAC shall be determined by dividing the measured airborne concentration [A] by the concentration that equals 1 DAC.

$$[A]_{DAC} = [A] / DAC$$

An individual's expected daily intake ($I_e$) shall be determined by multiplying the planned number of hours worked ($t_w$) in an airborne radioactivity area by the measured airborne concentration ($[A]_{DAC}$).

$$I_e = [A]_{DAC} \text{ x } t_w$$

If ($I_e$) exceeds 2, and [A] cannot be reduced, respiratory protection equipment shall be evaluated for use, or the working time shall be reduced.

The actual intake ($I_a$), of each individual entering a posted airborne radioactivity area shall be recorded in accordance with Shaw E & I Procedure T-RA-008, *External Dosimetry Administration.*

### 6.6.8 Use of Respiratory Equipment

Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*, Appendix B, lists concentration limits for continuous exposure to airborne radioactivity for personnel occupationally exposed to radiation. Additionally, NRC regulations permit upward adjustment of these limits for exposure periods of less than 40 hours per week. When airborne radioactivity exists above the limits of Section 6.6.2, the actions of Section 6.6.4 limit allowed exposure duration to shorter periods of time.

Shaw requires the use of respiratory equipment as a supplementary control to keep personnel exposures ALARA.

Prior to the use of respiratory protection equipment, each individual shall meet the requirements described below and in Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program*.

Prior to the use of respiratory protection equipment, each individual shall be certified by a licensed physician as capable of wearing respiratory protective devices.

Prior to wearing a mask, air-fed respirator, or hood in an area where airborne radioactivity exceeds the limit of Section 6.6.2, personnel shall be trained in the use of this equipment and shall have passed a respirator fit test as described in ANSI Z88.2, *Practices for Respiratory Protection*. As part of this training, personnel should demonstrate the proper procedure for putting on and removing masks, air-fed respirators, or hoods, including conducting leak checks for masks and air-supplied respirators (See Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program*).

The Project RSO is responsible for ensuring that the above requirements are met and documented for personnel using respiratory equipment. A copy of this documentation shall be maintained by the Project RSO in the project file.

The use, cleaning, and inspection requirements for respiratory equipment shall be met in accordance with Shaw E & I Health and Safety Procedure HS601, *Respiratory Protection Program*.

### 6.6.9 High Efficiency Particulate Air (HEPA) Filter Requirements

HEPA filtered systems shall be tested prior to use, following each set up, and after each filter change. Acceptance criteria is a transmission of 0.05% or less of testing medium.

Great care shall be used in installing HEPA filters to ensure that the filter material separators are in the vertical position, tight seals are made around the edges of the filters, and the filters are not damaged during installation. Minor damage can greatly reduce the efficiency of these filters.

Used filters shall be disposed of as radioactive waste since loose surface contamination could be present on interior pleats.

Instructions in manufacturers' manuals shall be followed for system use and filter change-out.

### 6.6.10 Portable Ventilation Systems

A portable ventilation system can be constructed by adapting a portable electric blower with a HEPA filter. Such a system can be used during maintenance in a high airborne radioactivity condition to reduce airborne radioactivity without contaminating installed ventilation systems.

A vacuum cleaner with an installed HEPA filter can also be used effectively to reduce airborne radioactivity in a space by recirculating the air in the space through the high efficiency filter. Such a system must also be tested prior to use.

### 6.6.11 Release of Airborne Radioactivity to the Environment

Releases of airborne radioactivity to the environment may require a U.S. Environmental Protection Agency (EPA) permit. Such releases shall be evaluated for compliance with regulatory requirements (NRC, EPA, State, etc.), and the evaluation shall be documented. All unintentional releases of airborne radioactivity will be reported in accordance with Shaw Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

## 6.7 Surface Contamination

### 6.7.1 General

Radioactive contamination of surfaces (such as floors, equipment, clothing, and/or skin) may result from work operations, leaks of radioactive fluids, or gradual precipitation of airborne radioactive contamination onto exposed surfaces. The primary reason for limiting surface contamination is to minimize possible ingestion or inhalation of radioactivity. In addition, surface contamination is limited to minimize the buildup of radioactivity in the environment. In case of very high levels of surface contamination, control of external radiation exposure from this contamination may be necessary. Surface contamination is divided into two classes in this section: (1) loose contamination can be removed from surfaces by dry swipes and may be readily dispersible; (2) fixed contamination remains on affected surfaces and is not further reduced by normal non-destructive decontamination techniques.

Swipes are usually pieces of dry filter paper, which are wiped over a surface and then measured for radioactivity. Materials that have become radioactive through exposure to neutrons are treated similarly to those with fixed contamination when performing operations (e.g., machining) that may spread radioactivity.

Contamination control procedures should be considered in planning and performing all jobs. However, the extent of the contamination control procedures used should be consistent with the amount of radioactivity being handled. The extent of site-specific contamination control procedures shall be established during the ALARA briefing required in Shaw E & I Procedure T-RA-011, *USNRC License Implementation Procedure*.

### 6.7.2 Surface Contamination Limits in Uncontrolled Areas

Limits for loose and fixed contamination shall be established prior to commencing work in potentially contaminated areas. Established limits shall be at or below any established regulatory guidance, including license limitations. In determining these limits, the License RSO will consider the following:

- The scope of work to be performed
- The nuclide most likely to be encountered
- Engineering and customer considerations
- Applicable regulatory requirements

Surface contamination levels for uncontrolled surfaces should be kept as low as possible

### 6.7.3 Contamination Areas (CAs)

Areas where surface contamination exceeds the established limits, areas where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in excess of the limits shall be designated Contamination Areas (CAs) until such areas, equipment, or materials have been adequately covered or decontaminated to meet these limits. CAs will be established and controlled as follows:

- Access to a CA shall be limited to allow only personnel in appropriate anti-contamination clothing and dosimetry to enter. Choice of appropriate anti-contamination clothing is discussed in Section 6.9.5.
- Open wounds shall be adequately protected from contamination prior to a person working in a CA. Notify the Project RSO of all open wounds prior to entering the CA.

- Entrances to CAs and potentially contaminated areas shall be posted conspicuously with signs stating the access restrictions, requirements for anti-contamination clothing and masks, levels of loose surface contamination, and radiation dose rates. These signs shall contain the conventional magenta three-blade symbol on yellow background with the words "CAUTION" or "DANGER." If the entrance to a contamination area is not at a door, barriers shall be used to mark the affected area clearly.

- Smoking, eating, drinking, and chewing shall not be permitted in CAs or potentially contaminated areas. This provision is essential to minimize the possibility of transferring contamination from the hands or other areas to the mouth. For the same reason, hands should be kept away from the face, nose, mouth, and ears when in controlled surface contamination areas.

- Where operations such as grinding or machining are being performed without containment on contaminated components or equipment, the areas of the operations shall be considered subject to the spread of loose contamination and shall be posted as a "Contamination Area."

- Where surveys for loose contamination have not been made, but contamination is suspected, the area shall be posted as a "Contamination Area" pending the results of contamination surveys.

- Levels and extent of loose surface contamination inside controlled surface contamination areas shall be limited, to control possible airborne radioactivity, to facilitate limiting the spread of contamination, to simplify subsequent decontamination, and to minimize personnel radiation exposure.

- Personnel leaving a CA shall (a) remove their anti-contamination clothing and (b) monitor or be monitored for surface contamination by "frisk" or use of a personnel contamination monitor in accordance with Section 6.9.4 of this document.

## 6.8 Controlling Surface Contamination During Operations

This section identifies controls that may be necessary to ensure proper control of radioactive contamination during operations. These controls may be applicable to CAs, buffer areas surrounding CAs, or uncontrolled areas where a potential exists for the spread of contamination. To ensure that personnel shall have the necessary training and skills in controlling contamination, additional training should be considered for personnel conducting operations such as working in glove bags or containments. Additional training should include such topics as inspecting containment, monitoring containment integrity during operations, and identifying unexpected changes in ventilation system performance or airflow.

### 6.8.1 Use of Ventilation to Control Contamination

Ventilation should be controlled, whenever practical, during operations involving radioactivity to prevent spreading the radioactive contaminants through an area or to the environment. The basic methods of controlling contamination by ventilation are by providing clean supply air into the contaminated work area and by providing filtered exhaust ventilation close to the work or from a containment enclosure erected around work areas. In containment enclosures, the exhaust ventilation flow should always exceed the supply airflow, including discharges from pneumatic tools, such that a slight negative pressure is maintained within the enclosure.

HEPA filters (and HEPA system pre-filters) are normally installed in permanent ventilation systems servicing radiological work areas. These filters may become contaminated so that handling a used filter may spread contamination. Therefore, great care should be exercised when removing used filters. Filters may require replacement because of plugging (high differential pressure), high radiation level (in some areas contamination levels may cause significant personnel radiation exposure), or lack of effectiveness in removing particulate (usually caused by damage during or prior to installation). Filters may be significantly contaminated even if they are never used for radioactive work. Contamination has been measured in high efficiency filters from natural radioactivity in the air. Contaminated used filters are normally removed into plastic bags. Contamination in the adjacent duct shall be decontaminated prior to the subsequent new filter installation.

A buildup of detectable levels of surface contamination can occur through the deposition of activity from the air without having significant levels of airborne radioactivity. Therefore, even if the air particle detector has not alarmed, ventilation exhaust ducts or ventilation system ducts from radioactive work areas should be considered potentially contaminated. When these potentially contaminated systems are opened, they should be monitored and decontaminated as practical. One method of decontamination is to use a vacuum cleaner with a HEPA filter. For similar reasons, if a portable exhaust blower is used in a contaminated space, surface contamination should be checked on surfaces exposed to the filtered exhaust of this blower.

HEPA filtered air supplies are used to exhaust air from many work areas, particularly when welding or grinding. It may be preferable to locate the filter inside the areas to minimize the amount of ducting that becomes contaminated. The exhaust shall be directed so as to prevent stirring up contamination in the area in which it is used. When removing these air supplies, flexible ducts, and filters, precautions are required to prevent spilling contamination from them.

When HEPA filters are installed in ventilation systems for radiological areas, labels should be prominently affixed verifying proper installation of the filters. These labels should be located so that they are destroyed when the filters are removed.

Potentially contaminated air that has not passed through a high efficiency filter should not be discharged to locations occupied by personnel or where supply ventilation can return it to an occupied area.

Consideration should be given to controlling contamination that has been collected in ventilation equipment and systems not normally used for radiological work, including those systems in adjacent spaces that may become contaminated in the event of a spill. Prior to work on these items, radiation measurements should be taken, the items should be treated as contaminated, and radiological control precautions should be established to prevent spreading contamination.

### 6.8.2 Use of Enclosures for Controlling Contamination

The most effective means of controlling radioactive surface contamination is through the use of enclosures or containments around the contaminated item to keep the radioactive material inside. Containment should be used as much as practical when working on the surfaces of components that have been exposed to radioactive contamination. Plastic sheet, bags, or containment areas may be used to enclose clean material and to prevent contamination of clean items inside the enclosure. The following specific requirements shall be followed when working or handling contaminated equipment and materials:

- Instructions for using containment enclosures shall be readily available.
- Containment enclosures shall be inspected by the Project RSO or designee prior to use to determine if they are properly constructed and ready for use. Enclosures shall then be marked to certify this inspection was completed. In addition, containment enclosures shall be inspected daily when in use.
- Personnel using containment enclosures shall inform radiological control personnel of any damage to containment enclosures that occurs during work.
- When a containment enclosure is damaged or is unfit for use, the enclosure shall be conspicuously tagged to prevent its inadvertent use by personnel unaware of the problem.
- Containment enclosures shall not be removed or altered without approval of the Project RSO.

## 6.9 Monitoring for Surface Contamination

### 6.9.1 General Requirements

Surface contamination surveys of structures and equipment shall be performed and documented in accordance with Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*

Measurement instruments shall be set up and checked as required in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*. The Minimum Detectable Concentration (MDC) for contamination measurements should be less than 90% of the applicable limit, with a goal of less than 10% of the limit. If the 90% requirement is not achievable, the License RSO will be consulted to determine an appropriate course of action. If background levels are higher than stated above, equipment or personnel to be monitored for release shall be relocated to an area of lower radiation levels or the area shall be shielded to lower background levels.

When monitoring personnel, any indications above background shall be investigated as possible contamination.

### 6.9.2 Methods for Taking Smears for Loose Contamination

Smears should be taken by applying moderate pressure to a clean standard-sized dry smear, made of paper or other fiber material, over about one hundred square centimeters (an area about four inches by four inches) of the surface being monitored. In known contamination areas and where contamination is suspected, rubber gloves shall be worn when taking swipes to limit contamination of the hands. Rubber gloves need not be worn in uncontrolled areas for taking swipes if contamination is not expected.

When the item has less than 100 square centimeters of surface area, the pertinent levels should be reduced proportionally, and the entire surface area should be swiped. Contamination levels should be reported as "dpm/area" (where area is a best estimate).

### 6.9.3 Method for Monitoring Fixed Contamination

Fixed contamination may be measured with an appropriate rate meter and detector for alpha and beta/gamma contamination. Since these instruments alone do not differentiate between fixed and loose contamination, the measured fixed contamination levels are actually the total radioactivity and may include some loose contamination. For fixed beta-gamma contamination, levels are usually expressed in dpm per 100 $cm^2$. When searching for fixed contamination, or when trying to find the most highly contaminated portion of contaminated materials or areas, earphones or audible instrument response should be used. Visual meter indications respond slower than audible indication. When monitoring to demonstrate lack of residual contamination, a portable scaler is recommended to reduce the MDC for the measurement.

### 6.9.4 Method for Monitoring Personnel Contamination

Personnel monitoring shall be performed when leaving contaminated areas. Monitoring of personnel for surface contamination should be done with a personnel contamination monitor, or by personnel “frisking” using a portable alarming rate meter and an appropriate detector.

Frisking is performed by moving the detector slowly over the body with the probe within about one-half inch of the body surface, giving special attention to the face, throat, chest, back, abdomen, and hands and feet in order to obtain an indication of any internal deposited radioactivity. When monitoring personnel, earphones or audible instrument response should be used.

Frisking for alpha contamination is performed using an appropriate rate meter and detector in a manner similar to that described above except that light contact between the detector and surfaces being monitored should be maintained. Alpha friskers should have an alarm set point below the applicable contamination limit.

Monitoring of personnel by taking swipes for loose surface contamination on the skin or clothing shall not be done since swipes may tend to embed radioactive particles.

When personnel have been adequately trained in frisking procedures, requiring personnel to frisk themselves may be desirable.

If facial contamination is detected, or it is suspected that radioactive nuclides have been taken into the body even though no facial contamination is evident, the individual shall be monitored for internal radioactivity. Measurements of the radioactivity of nose and throat swabs may be used.

When personnel exceed the applicable contamination limits, notify the Project RSO and proceed with decontamination in accordance with Section 6.10.4.

Anti-contamination clothing (often referred to as anti-C clothing) will also be used, as required, to help keep personnel from spreading radioactive contamination outside controlled surface contamination areas and to keep the wearer's body free from contamination. Anti-contamination clothing is required when either surface contamination or airborne radioactive contamination may exceed prescribed limits.

### 6.9.5 Requirements for Wearing Anti-Contamination Clothing

The Project RSO shall determine the appropriate requirements for anti-contamination clothing, and these requirements shall be noted on the applicable RWP.

When first entering an area that may be contaminated, prior to determining the extent and level of contamination, full anti-contamination clothing shall be worn. Full anti-contamination clothing consists of hoods, coveralls, rubber and cloth gloves, booties, and shoe covers.

Full anti-contamination clothing shall be worn when working in highly contaminated areas (greater than 20,000 dpm/100 $cm^2$ $\beta$-$\gamma$ or 1,000 dpm/100 $cm^2$ $\alpha$). Full anti-contamination clothing may be required in areas with less contamination if personnel contamination is probable. In addition, clothing should be sealed with tape at points where contamination may enter. Full anti-contamination clothing is also necessary in other situations, such as when initially opening a radioactive system without containment.

A face shield, a waterproof apron, and rubber gloves should be worn during operations such as sampling of radioactive waste tanks and processed water tanks.

When working in very highly contaminated areas (greater than 50,000 dpm/100 $cm^2$ $\beta$-$\gamma$ or 5,000 dpm/100 $cm^2$ $\alpha$), double suits of anti-contamination clothing should be worn. Plastic or coated fabrics should be considered for use as the outer garment when double anti-Cs are required. Double suits limit the contamination that may penetrate the material during work, and they also improve the ease of controlling the spread of high levels of contamination. The outer suit is normally removed prior to leaving the region of very high contamination, and the inner suit is normally removed at the boundary of the CA.

When only the hands and arms are in contaminated areas such as a glove box, rubber gloves attached to the glove box may substitute for the anti-contamination clothing.

When working in a contaminated wet area or when contaminated liquid is likely to spray on the clothing, the outer clothing shall be waterproof.

In certain circumstances of low contamination levels, with Project RSO or designee approval, it may suffice for personnel to wear shoe covers, rubber gloves, and lab coats (without the other anti-contamination clothing). If wearing gloves without anti-contamination coveralls, care should be taken not to transfer contamination from the gloves to personal clothing.

It may be desirable to remove personal clothing before putting on anti-contamination clothing for reasons of comfort when working in high temperature spaces. Removing personal clothing is not usually required for adequate radiological control as long as the anti-contamination coveralls do not tear and the anti-contamination clothing is taken off properly after use.

Respiratory protection should be used in conjunction with anti-contamination clothing if the concentration of airborne radioactive particulate may exceed the limits of Section 6.6.2.

When reading a SRD in a CA, provisions should be made so that the dosimeter does not become contaminated. Use of a transparent plastic bag has been effective for this purpose.

### 6.9.6 Frequency of Surveys for Surface Contamination

Contamination surveys are performed as necessary to ensure that radioactive contamination is properly controlled at all times. These surveys are also performed to determine whether abnormal contamination levels exist and to determine the extent and magnitude of contamination in area under Shaw control. The surveys in this section shall be the minimum performed. Surveys are to be performed and documented as stated in this section and Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*.

Generally, contamination surveys are required within the following periodicities:

- Site-specific contamination survey requirements shall be determined prior to commencing work in potentially contaminated areas.
- Contamination surveys shall be performed at least daily in occupied areas surrounding CAs and particularly in the vicinity of exits from a CA. Surveys shall be performed at least daily in occupied CAs.
- Contamination surveys shall be performed at least weekly where appropriate in all occupied radioactive material areas where there is frequent handling or short-term storage of radioactive materials. Long-term radioactive material storage areas shall be surveyed at least monthly.
- Contamination surveys shall be performed monthly in work and storage areas outside areas where radioactive materials are stored or worked on.
- Contamination surveys shall be performed prior to release of potentially contaminated materials or equipment from radiological controls.
- Contamination surveys shall be performed during maintenance of components and piping that are associated with radioactive or potentially radioactive systems.
- Contamination surveys shall be performed in areas where radioactive liquid leaks have occurred or where airborne radioactivity has exceeded the concentrations of Section

6.6.2. Surveys are required to determine the need for anti-contamination clothing and to determine the extent of contaminated areas.

- Contamination surveys shall be performed upon initial entry into tanks or voids containing potentially radioactive piping and when opening ventilation exhaust ducting from radioactive work areas.
- Any normally uncontaminated system that is suspected of radioactive contamination shall be surveyed when opened for inspection, maintenance, or repair. Contamination control procedures should be used until the portion of the system being worked on is proven to be uncontaminated. Water drained or flushed from these systems shall be treated as radioactive and sampled as appropriate.
- Contamination surveys should be performed in plenums downstream of HEPA filters during routine filter replacement or at least annually, to determine radioactivity buildup in ducts downstream of filters.
- Prior to replacing filters on inlet ducts to a radiological work area, filters should be monitored to determine if radioactivity is present.
- Surveys for contamination fixed in paint should be performed prior to the removal of paint in potentially contaminated areas. These surveys should include counting paint scrapings for gross activity.

**6.9.7 Instructions for Controlling Radioactive Spills**

Since each spill shall require different detailed actions for effective control and recovery, personnel shall be trained to take appropriate supplementary actions depending on the location and potential consequences of the specific incident. For locations where spills are most probable or would have the worst consequences, each facility should train appropriate personnel in controlling and recovering from radioactive spills. Equipment for containing spills should be prepared in advance and located in work areas.

The steps detailed below shall be followed in the event of a radioactive spill.

**6.9.7.1 Immediate Actions - SWIMS**

- **S**top the spill—If the spill is from a system that may have more material (either airborne particulate radioactivity or fluids) to leak out, promptly stop the leak if possible. If the spill is from an overturned container, try to set it upright if all the contents have not escaped. The amount of time spent stopping a difficult leak should depend upon the radiation levels involved, the possibility of inhaling airborne radioactivity from the spill, and the consequences of not making a prompt closure. In some cases, a prompt closure may not be necessary.
- **W**arn other personnel—Other personnel who may become contaminated by the spill or who may be able to help control it shall be warned immediately. Ensure radiological control personnel and the area supervisor are notified of the spill.

- **I**solate the spill—Keep unnecessary people away from the area affected by the spill to minimize the spread of contamination. This action may require closing doors, roping off the area, and verbally warning approaching personnel.

- **M**inimize personnel exposure to contamination and radiation—Personnel in the spill area should evacuate and contact radiological control personnel.

- **S**ecure ventilation in the spill area other than filtered exhausts—It may also be desirable to shut down exhaust systems in adjacent areas to ensure that air does not flow out of the spill area. Ventilation exhausts in the spill area should also be shut down, if necessary, to minimize the spread of high levels of radioactive contamination. Ventilation supplies should be shut down when exhausts are turned off.

If the spill is minor (for example, a few milliliters of water with low radioactivity spilled on a smooth surface), immediately cover the spill with the most convenient absorbent material available, such as absorbent paper or rags to soak up the liquid. Personnel shall be monitored and decontaminated as necessary.

The senior person in each area is in charge until relieved by the Project RSO. The person in charge should organize the personnel available and initiate action to control and correct the spill. It is important that this individual makes his/her presence and the fact that he/she is in charge known to all others at the scene. Upon arrival of the Project RSO, the status of corrective action taken or in progress shall be immediately brought to the Project RSO's attention.

### 6.9.7.2 Supplementary Actions

Steps below are actions to evaluate the extent of the problem, to recover from the spill, and to document the problem, as necessary. The designated supervisor shall consult with Radiological Control personnel to ensure the performance of specific portions of the steps below.

- Measure contamination on personnel who may have been affected, make contamination surveys in the area adjacent to the spill, measure airborne radioactivity inside and outside the spill area, and measure radiation levels in affected areas, particularly on ventilation filters. Monitor ventilation systems to determine if the spill has caused them to be contaminated. If it is suspected that radionuclides have been taken into the body or if facial contamination is detected, the personnel monitoring procedures shall be followed.

- Take subsequent radiological control and cleanup actions in accordance with appropriate radiological procedures. The designated supervisor shall minimize personnel radiation exposure and generation of radioactive waste consistent with the requirements to recover from the spill.

- Make appropriate reports and investigations in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

### 6.9.8 Records of Contamination

Records of abnormal spreads of radioactive contamination outside the radiologically controlled area shall be maintained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13 and shall be reported in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*. These "abnormal" events include the following:

- Any occurrence that results in loose surface contamination greater than the applicable site-specific free release limits for uncontrolled areas
- Any spread of contamination in radiologically controlled areas or CAs that results in work being stopped for more than four hours or takes more than four hours to clean up

Records of surface contamination surveys shall be retained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13. The survey information shall be recorded on a standard form in accordance with Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring*.

### 6.9.9 Criteria and Procedures for Releasing Previously Contaminated Facilities and Areas for Unrestricted Use

The criteria and procedures of this section shall be applied when releasing previously contaminated areas or radiologically controlled facilities for unrestricted use (e.g., use of the area is not controlled by radiological control procedures). Typical areas and facilities include facilities used for decontamination and repair or assembly of contaminated equipment, radioactive waste processing facilities and systems, exhaust ventilation systems for radioactive work areas, radioactive material storage areas, and outside areas accidentally contaminated.

Site-specific criteria and release requirements for previously contaminated facilities or areas shall be established prior to mobilization in compliance with requirements established by the cognizant regulatory agency.

Records of radiological investigations and surveys used to verify that facilities and areas meet the applicable release criteria will be maintain in a permanent project file in accordance with Section 6.13.

## 6.10 Radioactive Decontamination

Decontamination may be required for components, tools and equipment, work areas, clothing, or personnel. These include, in some cases, storage for decay, disposal without decontamination, or restricted use without complete decontamination. By the very nature of decontamination operations, the disposal of the waste radioactivity must be considered. Volumes of both solid and liquid wastes shall be minimized. Unauthorized chemicals shall not be used. Most radioactive contamination can be removed by normal cleaning. Wiping with a damp rag soaked with detergent shall usually provide satisfactory decontamination.

If large variations in surface contamination levels exist on highly contaminated surfaces, cleaning shall be from less contaminated toward more contaminated areas to prevent radioactivity from being spread to less contaminated areas. Cleaning solutions and cloths used in these decontamination operations shall be disposed of as radioactive waste. During decontamination operations, precautions shall be taken to limit the spread of contamination, such as taking care not to splash solutions, properly wearing anti-contamination clothing, and wearing masks as necessary. Filtered ventilation may be required to minimize the possibility of contamination being inhaled by personnel performing the decontamination.

### 6.10.1 Decontamination of Tools and Equipment

In decontaminating tools and equipment, appropriate radiological control shall be used to prevent the spread of contamination and to control airborne radioactivity and radiation exposure. The following applies to the decontamination of tools and equipment.

Tools and equipment that may be used again in contaminated areas may be temporarily stored in the contaminated area or in a contaminated tool room without decontamination if proper radiological controls and procedures are used. If certain tools are to be used solely in CAs, these tools should be durable and distinctively marked to indicate that they are always treated as potentially contaminated.

In some cases, the need for decontaminating tools may be minimized by taping some portions, such as the handles, prior to use and stripping off the contaminated tape after use. If tape is used to cover parts of tools, the residual adhesive remaining after tape removal shall be removed to minimize contamination that may be picked up in future uses of the tool. Large tools are often wrapped in plastic instead of tape. These tools need to be swiped or frisked at completion of decontamination to verify the effectiveness of the treatment.

Heavily contaminated tools can spread surface contamination within a controlled area. Therefore, such tools should be partially decontaminated as may be necessary several times throughout a work shift. Heavily contaminated tools can be readily identified without taking swipes by measuring their radiation level. The purpose of decontaminating these tools shall usually be to reduce their radiation levels rather than to remove all loose surface contamination.

When only a few tools require decontamination, wiping with cloths soaked in detergent is a convenient, effective procedure. This method is also useful when only a portion of a tool is contaminated. A disadvantage of wiping procedures is the large amount of solid radioactive waste produced.

Mechanical decontamination methods, such as using abrasives that remove some of the surface of the tool, can be useful in special circumstances where contamination is not removed by chemical cleaning. In such cases, control of possible airborne radioactivity is essential.

In decontaminating oily or greasy tools or equipment, consideration should be given to the fact that oil or grease may inhibit waste processing or disposal.

### 6.10.2 Decontamination of Areas

Contaminated areas shall first be isolated and radioactivity then removed (with care being taken to avoid the spread of contamination). In some cases, tape may be used to lift loose contamination from surfaces. If contamination levels are not sufficiently reduced, use of solvents, strong chemicals, or mechanical removal of some of the surface may be necessary. In all cases where liquids are used in decontamination, care shall be exercised to avoid spreading radioactivity and to minimize liquid waste. The areas shall be surveyed by methods detailed in an approved plan prior to release, to ensure surface contamination is below the established limits. On painted or covered surfaces, if washing does not remove the contamination, the paint or covering shall be removed. During the process of paint removal, control of airborne and surface contamination from dust and paint chips shall be necessary.

Contaminated areas should be decontaminated as soon as practical to minimize the spread of contamination and to facilitate removal before the contamination is fixed on the surface. If high radiation levels from the contamination contribute significantly to personnel radiation exposure during cleanup, it may be desirable to decontaminate the most heavily contaminated area first.

### 6.10.3 Decontamination of Anti-Contamination Clothing

Reusable anti-contamination clothing shall be laundered and monitored before reuse to minimize the possibility of spreading radioactive contamination to the wearer.

### 6.10.4 Decontamination of Personnel

Decontamination of personnel shall be performed in accordance with this section. The objectives of skin decontamination are to remove as much of the radionuclide as practicable in order to reduce the surface dose rate and to prevent activity from entering the body. An over-aggressive skin decontamination effort must be avoided since it may injure the natural barriers in the skin and increase absorption.

#### 6.10.4.1 Skin Contamination

When a worker has skin contamination, the following actions should be taken:

- Notify the Project RSO or designee immediately if there is evidence of skin breaks, ingestion of contaminated materials, or high dose rates associated with the contamination.
- Inspect the contaminated area to see if a visible "dirt" matrix of the contaminant is visible.
- First attempt to remove the material by dry (non-water) methods including soft brushing or lifting from the surface with the tacky side of masking tape. Re-monitor and record results.
- If measurable contamination still exists, wash with soap and warm water. Re-monitor the worker and record results after each decontamination attempt.
- Under no circumstances will decontamination methods be used that violate intact skin.

- The Project RSO or designee shall contact the License RSO to determine the need for additional evaluation or survey (such as nasal smears, dose assessment, etc.).
- Do not allow contaminated personnel to leave the project site without proper controls to preclude the spread of contamination.
- Incidents of personnel contamination shall be reported per Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

#### 6.10.4.2 Internal Deposition of Contamination

When it is suspected that a worker may have received an uptake of radioactivity, the following actions should be taken:

- The Project RSO or equivalent may permit the flushing of ears and eyes with cool, clean water to decontaminate those areas. If flushing is not successful, medical personnel shall direct additional decontamination efforts.
- Only medically qualified personnel shall probe the eyes, ears, nose, and throat of potentially contaminated personnel.
- Whole body counts and/or urinalysis may be required for personnel who may have inhaled or ingested radioactive material.
- The Project RSO or designee shall contact the License RSO as soon as possible to determine the need for additional evaluation or survey
- Incidents of personnel contamination shall be reported per Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

#### 6.10.4.3 Contaminated Open Wounds

Flushing of contaminated large open wounds is discouraged. However, when wounds are not substantial, i.e., cuts and scrapes, they may be rinsed with clean water. Medically qualified personnel shall direct varying techniques.

## 6.11 Procedures for Handling Radioactive Materials

This section presents procedures applicable to radiological safety considerations for controlling radioactive material associated with Shaw operations. Strict radiological control procedures are mandatory for such material to minimize the external and internal radiation exposure received by personnel and to prevent the uncontrolled spread of radioactivity to areas where the public might be affected.

### 6.11.1 Receipt of Radioactive Material

Radioactive material shall be received in accordance with the applicable operating license.

Radioactive material received by Shaw requires special control procedures to ensure that adequate radiological safety precautions are observed, both in unpacking and in subsequent use of the material. Potential radiological problems can include external exposure, surface contamination, and airborne radioactivity. Some packaging material requires disposal as radioactive waste. In addition, special precautions are required if damage has occurred during shipment.

The following procedures shall be used for radioactive material received at Shaw work sites:

- The Project RSO shall be familiar with the applicable radioactive material receipt conditions of the operating license.
- When received, the radioactive material shall be inspected. This inspection shall be performed as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.
- This inspection shall consist of verifying radiation and contamination levels on the outside of the package and verifying that the package was properly transferred. The package shall be opened solely for the survey purposes unless directed by the Project RSO. For packages that are shipped, this inspection shall verify that the package was shipped in accordance with US DOT, state, and federal regulations, and other federal and state requirements for notification and permitting.
- If damage to the radioactive material package has occurred, or removable surface contamination exceed the regulatory limits for transportation (10 CFR 71.87), or external radiation level exceed the regulatory transport limits (10 CFR 71.47), the Project RSO shall immediately notify the final delivery carrier and the NRC Operations Center by telephone., and investigate in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.
- Received packages shall be inventoried as soon as possible. Inconsistency between the observed contents and the contents indicated on the shipping document shall be brought to the attention of the shipper of the material. If the possibility exists that radioactive material has been lost in shipment, the Project RSO shall report this occurrence in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.
- Shipping containers and packing materials shall be surveyed and must meet the applicable release criteria prior to release for unrestricted handling.
- Following a satisfactory inventory, a receipt shall be returned promptly to the organization transferring or shipping the item, if requested.
- Records of the transfer of radioactive material and all associated survey documentation shall be maintained in the on-site project file throughout the duration of the project and in accordance with Section 6.13.

### 6.11.2 Packaging and Shipping Radioactive Materials

Radioactive materials shipped for disposal or to another location shall be appropriately packaged and treated as required by US DOT regulations, applicable federal and state regulations, and applicable disposal site criteria. Shipment of radioactive material shall be in compliance with Shaw E & I Procedure T-RA-003, *Shipment of Radioactive Materials*.

### 6.11.3 Radioactive Material Storage

In order to minimize the complexities of accounting for a large amount of radioactive material and the possibility of losing radioactive material, radioactive material shall be consolidated in as few areas as practical, and the amount of radioactive material in storage shall be minimized.

At a minimum, all radioactive material storage areas shall be posted in accordance with Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*.

#### 6.11.3.1 Fire Protection

Proper selection of a fire resistant storage area for radioactive material shall minimize the release of radioactivity to the environment in the event of a fire. The project health and safety plan shall include discussion of fire protection. However, the following additional fire protection practices shall be considered for storage of radioactive material to minimize the possibility of a fire and the spread of contamination in the event of a fire.

- Storage of radioactive material in fire-resistant containers is desirable to minimize contamination spread. In addition, containers of highly flammable radioactive materials shall be stored in areas segregated from other storage to reduce the risk of spreading a fire.
- Smoking shall not be permitted in radioactive material storage areas.
- An up-to-date list of locations where radioactive materials are stored shall be available to personnel who might be called to fight a fire in such areas. This list shall also identify unusual problems that may be present.
- Periodic inspections of radioactive material storage areas shall be made to identify fire hazards. Deficiencies shall be promptly corrected. A record shall be made of these inspections.
- Fire drills should be performed periodically with both fire fighting and radiological control personnel participating.
- Combustible materials shall be minimized inside radioactive material storage areas and should not be stored next to surrounding walls.
- Welding, burning, or other operations that may cause a fire shall not be conducted inside or next to radioactive material storage areas without prior authorization of the Project RSO or the designated representative. A fire watch with appropriate fire extinguishing equipment and materials shall be available during welding or burning operations.

#### 6.11.3.2 Contamination Control

Storage locations should be considered potentially contaminated. Personnel in these areas, particularly if they handle contaminated material, shall wear necessary anti-contamination clothing. Reasonable care shall be taken in packaging and storing contaminated items to prevent the spread of contamination and to ensure that entry to areas where such storage is permitted does not result in the contamination of personnel or other areas.

#### 6.11.3.3 Radiation Exposure Control

Storage of radioactive materials can result in possible personnel radiation exposure in the storage area and surrounding areas. For example, a component or bag of contaminated waste measuring one rem per hour, if stored at the entrance to the storage area would expose everyone who entered to high radiation levels. If stored in a far corner of the area, high radiation levels might be caused in surrounding areas. Facilities should store radioactive materials so as to minimize the radiation exposure of personnel entering or working in the area and of personnel in surrounding spaces. Radiation surveys of the storage area and of spaces immediately around the storage area shall be performed to ensure proper posting of radiation areas and to prevent inadvertent exposure of personnel in the storage space or surrounding spaces. When necessary, temporary shielding should be used to reduce radiation levels.

#### 6.11.3.4 Outdoor Storage

Radioactive materials should be stored where they are protected from adverse weather. Normally, radioactive material should not be stored outdoors except during short periods. However, protection from adverse weather should be considered in selection of these temporary storage locations. Large items that are designed for outdoor use, such as radioactive liquid collection tanks, may be stored outdoors. However, mechanical joints or capped pipes that may leak radioactive liquids shall be wrapped with weather resistant materials.

### 6.11.4 Loss of Radioactive Material

If radioactive material associated with Shaw operations is suspected of being lost, the following actions shall be taken:

- Immediately notify the Project RSO and License RSO, and conduct a search for the lost material. A primary purpose of this search is to ascertain that no persons shall receive inadvertent internal or external radiation exposure from this material.
- Follow up with the proper reports and investigation in accordance with Shaw E & I Health and Safety Procedure HS020, *Accident Prevention Program: Reporting, Investigation, and Review*.

## 6.12 Environmental Monitoring

Environmental monitoring consists of measurements, sample collection and analysis, and dose assessment to determine if radionuclides are being released to the environment from a facility or site. If so, the environmental monitoring is used to determine the extent of the release and the effect the release is having on the surrounding population. An environmental monitoring program generally consists of measurements and sample collection at the site boundary and at off-site locations. The types of samples and analyses are dependant on the radionuclides at the site and the possible release mechanisms. The License RSO and the customer shall specify the environmental monitoring requirements for the project.

### 6.12.1 Methods of Monitoring

An environmental monitoring program may provide for monitoring of direct radiation, air, water, soil, and vegetation.

- Direct radiation may be monitored by TLDs placed at the site boundary and at off-site locations.
- Air monitoring may consist of taking samples for airborne particulate at the site boundary and at off-site locations. The techniques may be similar to those used to monitor occupational airborne activity.
- Water monitoring may be performed by taking water samples from surface water bodies (i.e., lakes, ponds, and streams), surface runoff, and wells located both on and off site, and then analyzing those samples for radionuclide content.
- Surface soil samples may be collected and analyzed for radioactivity.
- A comprehensive program may also include sampling of flora and fauna.

### 6.12.2 Requirements

For those Shaw projects where the potential exists for releases to the environment, an environmental monitoring program shall be designed and implemented. If an environmental monitoring program is required, it shall be designed and implemented with the approval of the License RSO and shall include the following:

- Sampling Locations
- Types of Samples
- Sampling Frequency
- Types of Analyses
- Action Levels
- Required Actions

### 6.12.3 Records

All records of samples collected, analyses performed, results obtained, and actions taken shall be maintained in the on-site project file throughout the duration of the project and in the permanent project file in accordance with Section 6.13.

## 6.13 Reports and Records

Reports and records shall be maintained as follows:

- The Project RSO shall submit a weekly written report to the License RSO detailing current radiological conditions, personnel exposure, and job progress.
- All radiological records generated shall be maintained in the on-site project file throughout the duration of the project.
- All radiological records designated for retention in the permanent project file by the Project Manager (or higher level of management) shall be prepared for release to Records Management in accordance with Shaw E & I Health and Safety Procedure HS700 *Policy and Guidance for Developing Radiation Protection Plans*.
- Following completion of the project, the Project RSO shall prepare a "Lessons Learned" report describing any problems/unique situations encountered and solutions/actions taken. This report shall be submitted to the License RSO, all Project Managers, all Project RSOs, and all Radiological Engineers.
- The Project RSO shall prepare the appropriate sections of the project final report including the final survey results and personnel exposure summary.

## 7. ATTACHMENTS

- Instruction on Radiation Exposure To The Unborn Child Acknowledgement Form
- Visitor/Contract Worker Exposure Record Form

## INSTRUCTION ON RADIATION EXPOSURE TO THE UNBORN CHILD

## ACKNOWLEDGEMENT FORM

All personnel receiving instruction in accordance with Section 8.2 shall sign the following statement prior to being issued dosimetry equipment:

**"The recommendation of the National Council on Radiation Protection and Measurements to limit radiation exposure to the unborn child to the very lowest practicable level, not to exceed 0.5 rem during the entire period of pregnancy, has been explained to me."**

**Signature**________________________________________________

**Typed or Printed Name**________________________________________

**Date**______________________________________________________

# Visitor/Contract Worker Exposure Record Form

| Date | Name (Print) | Organization | TLD or SS# | Dose |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# RADIATION PROTECTION PROCEDURE

**Subject: Radiological Controls Portable Instrument Procedure**

## 1. PURPOSE

This procedure describes the methods and techniques to be used when using radiological instrumentation on field projects. Proper control, calibration, and quality control checks of portable instruments ensures that operating parameters demonstrate compliance with applicable data quality requirements and/or regulations. Also provided in this procedure are instructions for the documentation of instrument performance.

## 2. SCOPE

This procedure specifies standard practices for the performance of portable instrument operations. This document specifies the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these instrument operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls*
- National Council on Radiation Protection, Report No. 58, "A Handbook of Radioactivity Measurements"
- Manufacturer's Technical Manual(s)
- U.S. Nuclear Regulatory Commission, NUREG-1757, Vol. 2, "Consolidated NMSS Decommissioning Guidance" (DRAFT)
- U.S. Nuclear Regulatory Commission, NUREG 1507," Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions"

## 4. DEFINITIONS

- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.

- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Decay Chain**—A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Derived Concentration Guideline Level (DCGL)**—A derived, radionuclide-specific activity concentration within a survey unit corresponding to the release criterion. The DCGL is based on the spatial distribution of the contaminant and is derived from activity/dose relationships through various exposure pathway scenarios.

- **Direct Measurement**—A reading taken using a portable instrument directly on a surface, or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed location measurements and scans.

- **Frisking**—The process of searching a person's clothing or body with a radiation detection instrument prior to releasing that person from a radiologically controlled area.

- **Guideline Values**—A predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **Hot Spot**—A location within a radiologically controlled area in which the levels of radiation or contamination are noticeably greater than in the surrounding area.

- **Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Minimum Detectable Concentration (MDC)**—The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity

- **Monitoring**- The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Project Radiation Safety Officer (Project RSO)**— The Project RSO is designated by the License RSO as an Authorized User and by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including the providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Scanning**—A type of direct measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.

- **Shine**—Radiation from a source near a measurement location that interferes with a particular environmental measurement. While background is always a part of a gross measurement, in the case where shine is present, the significance and data quality of the measurement may be questionable.

- **Smear Sampling**—A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper, and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally $100cm^2$.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Total Contamination**—Radioactive material, including both the fixed and removable contamination fractions, found on, or as a part of, an item or surface.

- **Transferable, Removable, or Loose Contamination**—Radioactive material that can be easily removed from a surface or item.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as Discipline Lead for control of this document. This individual is responsible for assuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

**5.2 License Radiation Safety Officer**

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users
- Maintain all required license records at the location specified on the license

**5.3 Project Radiation Safety Officer**

The Project RSO is designated by the License RSO as an Authorized User and is responsible to understand, implement, and properly document the performance of the Site Specific Radiation Protection Plan at a project location, as established by the License Radiation Safety Officer. The Project RSO shall report to the License RSO, on radiological matters. The Project RSO is responsible for the following:

- Ensuring that radiation surveys performed for the demonstration of compliance conform to the requirements of this procedure
- Maintaining an adequate inventory of functional, calibrated radiation survey instrumentation
- Storing and controlling the use of all radiation survey instrumentation
- Ensuring that the performance of radiation instrumentation is properly documented and conforms to the requirements of this procedure

**5.4 Radiological Controls Technicians**

Radiological Controls Technicians (RCT) are responsible to follow procedures established by the , or Project RSO, and shall ensure that the setup, use, and maintenance of radiation instrumentation is performed in accordance with this procedure. The RCTs shall also properly document radiation instrument use in accordance with this procedure.

## 6. PROCEDURE

**6.1 Operational Requirements**

The requirements in this section constitute the minimum requirements necessary to ensure the proper operation of portable radiological instruments used on field projects. A copy of the manufacturers operating instructions shall be available and instruments shall be operated in accordance these instructions.

Project specific requirements for instrument/detector operation verification shall be identified during the project planning.

### 6.2 Calibration

The calibration of Shaw E & I portable radiological instruments shall be performed by Shaw E & I personnel in accordance with approved procedures, by each instrument's manufacturer, or by other approved vendors as determined by the Shaw E & I Quality Assurance Department. When calibrated, each instrument shall have a label attached that indicates the calibration date, the next calibration due date, and the signature or initials of the person who performed the calibration.

Portable survey instruments, self-reading dosimetry (SRDs), counter-scalers, and air sampling equipment shall be properly calibrated prior to use. The Project RSO is responsible for ensuring that all portable radiological instruments, dosimeters, and air sampling equipment to be used at the project have a current calibration.

Copies of calibration records shall be maintained throughout the duration of the project in the permanent project file. The Shaw E & I Radiological Equipment Division shall retain the original calibration records.

A calibration status record should be generated for all project instruments and posted in the project office.

### 6.3 Ratemeter Pre-operational Requirements

Prior to the use of ratemeter-type instruments and detectors, the following inspections/operational verifications shall be performed:

#### 6.3.1 Calibration Verification

All portable radiological instruments shall have an approved, current calibration label (See Section 6.2). Calibration verification shall be performed prior to the use of the instrument.

#### 6.3.2 Physical Check

A physical check of radiological instruments is an inspection of the general physical condition of each instrument and detector. A physical check shall be performed prior to using a radiological instrument.

The physical check should include inspecting the instrument for loose or damaged knobs, buttons, cables, and connectors; broken/damaged meter movements/displays; dented or corroded instrument cases; punctured/deformed probe/probe window(s), cables, etc.; and any other physical impairments that may affect the proper operation of the instrument or detector. Any instrument or detector having a questionable physical condition shall not be used until the condition is properly corrected.

#### 6.3.3 Battery Check

A battery check is performed to help ensure that there is sufficient voltage being supplied to the detector and instrument circuitry for proper operation. This check shall be performed in accordance with the instrument's technical manual.

### 6.3.4 High Voltage Check (HV)

The HV is adjusted during instrument calibration, additional adjustment for normal operation is not required. However, an HV check is required prior to each use in accordance with the instrument technical manual. An instrument with suspected HV problems shall be immediately reported to the Project RSO.

### 6.3.5 Response Source Check

A response source check is performed to ensure that the instrument will accurately respond to a known source of radiation. Obtain a check source of the proper size, type, and activity for the instrument/detector being used and perform the response source check as follows:

1. Determine the background radiation level. It must be low enough to allow a measurable response to the check source being used. Careful monitoring of changing background levels is necessary to obtain accurate instrument readings.

2. Begin with the instrument on the highest range/scale and energize the audible device, if applicable.

3. Slowly move the detector towards the check source and check the instrument for an increase in audible and/or visual response.

4. Change the range/scale of the instrument as appropriate to obtain a readable indication and to check each of the meter ranges/scales. If an appreciable response cannot be obtained (even in the lowest range), evaluate instrument performance by comparison to previous source check data for the instrument. If no previous source-check data is available, comparison should be made to the data associated with similar instruments in use. Notify the Project RSO of any instrument/detector response problems. Document the response on the Ratemeter Daily Instrument Check Sheet. Plot the response on the Control Graph at the bottom of the Ratemeter Daily Instrument Check Sheet.

5. The Project RSO or designee shall set up the control graph on the Ratemeter Daily Instrument Check Sheet such that lines indicate when an instrument is outside of the +/-20% variability.

6. Instruments with day-to-day responses that vary by more than 20% under identical conditions shall be removed from service. Notifying the Project RSO of such a condition is required.

A ratemeter-type instrument and detector used to perform measurements for the documentation of a release survey must meet the requirements of Section 6.4 for scaler-type instruments.

Ratemeter instrument inspections, performance verifications, and corrective actions shall be recorded on the Ratemeter Daily Instrument Check Sheet prior to use.

## 6.4 Scaler Pre-operational Requirements

Prior to the use of scaler-type instruments and detectors, the following inspections/operational verifications shall be performed in addition to those required in Section 6.3 for ratemeter-type instruments (i.e., calibration verification, physical check, battery check, HV check). Where a calculator Standard Deviation Function is used or when a spreadsheet program is used in the pre-operational checks, it should be noted on the affected paperwork.

### 6.4.1 Background Measurement (Initial Project Set-up)

1. Ensure that the sample holder tray is empty and clean. The detector/sample holder geometry should be set up in the same configuration as that to be used when counting samples to produce the most accurate results.

2. Select the desired counting time. The selected time must be consistently used to perform all source and sample/swipe counting operations. The counting time directly influences the Minimum Detectable Concentration (MDC) obtained for the instrument. Although the counting time must be long enough to obtain the desired MDC, it must be short enough to be practical. The background measurements should be performed in conjunction with the MDC calculations in Section 6.4.3.

3. Perform the background measurement for the selected time period ($t_b$) and record the total counts measured on the Scaler Instrumentation Check Sheet.

4. Repeat the background measurement ten times. Record the total counts observed for each measurement on the Scaler Instrumentation Check Sheet.

5. Calculate the average background counts ($\overline{C_b}$) and the standard deviation ($SD_b$):

$$\overline{C_b} = \frac{\sum_{i=1}^{N} C_{b_i}}{N} \qquad SD_b = \sqrt{\frac{\sum_{i=1}^{N} (C_{b_i} - \overline{C}_b)^2}{N - 1}}$$

Where:

| | | |
|---|---|---|
| $\sum_{i=1}^{N}$ | = | Summation of item 1,2,3…N |
| $\overline{C_b}$ | = | Average number of background counts |
| $SD_b$ | = | Standard deviation of the background counts |
| $N$ | = | Number of measurements |
| $C_{b_i}$ | = | Background counts 1, 2, 3 … N |

6. Record the average background ($\overline{C_b}$), background count time ($t_b$), and the standard deviation ($SD_b$) on the Scaler Instrumentation Check Sheet.

   Daily: (unless otherwise directed by the RCS or designee): perform a single background count ($C_b$). Analyze this value to the using the following formula:

$$C_b = \overline{C_b} \pm 2SD_b$$

Where:

$\overline{C_b}$ = Average background counts.

$SD_b$ = Standard deviation of the average background counts.

If the background measurement is satisfactory, continue. If the background measurement does not meet this criterion, immediately notify the RCS. Record the background measurement on the Scaler Daily Instrument Check Sheet.

7. Divide $\overline{C_b}$ by $t_b$ to determine the average background count rate in cpm ($\dot{C_b}$), and record the result on the Scaler Instrumentation Check Sheet.

### 6.4.2 Instrument Efficiency (E$_i$)

Determine the detector efficiency with a source of known activity of the nuclide to be monitored (or with a source of known activity of a nuclide with energy decay products similar to those of the nuclide to be monitored), as follows:

1. Correct the source activity for radioactive decay (when necessary) as follows:

$$A = A_o e^{-\lambda T} \quad Where: \lambda = \frac{0.693}{t_{\frac{1}{2}}}$$

Where:

A = Present source activity.

$A_o$ = Source activity at initial assay.

$\lambda$ = Decay constant for the source isotope.

T = Time elapsed since initial source assay.

$t_{1/2}$ = Source isotope half-life.

NOTE: Time units must be consistent (days, hrs., mins., etc.)

2. Count the source for the same time period ($t_s$) selected during the background measurements (See Section 6.4.1, step 2).

<u>Initially</u>: At project set-up or as otherwise directed by the project specific work plans or instructions, or the RCS, count the source ten times and calculate the average net counts ($\overline{C_n}$), the standard deviation of the average gross counts (SD$_g$), and the standard deviation of the average net source counts (SD$_n$):

$$\overline{C_g} = \frac{\sum_{i=1}^{N} C_{g_i}}{N} \qquad \overline{C_n} = \overline{C_g} - \overline{C_b}$$

$$SD_g = \sqrt{\frac{\sum_{i=1}^{N} (C_{g_i} - \overline{C_g})^2}{N-1}} \qquad SD_n = \sqrt{(SD_g)^2 + (SD_b)^2}$$

Where:

| | | |
|---|---|---|
| $C_{g_i}$ | = | Gross Source Counts (total counts observed including background) 1 through N |
| $\overline{C_b}$ | = | Average background counts. |
| $\overline{C_g}$ | = | Average gross counts. |
| $\overline{C_n}$ | = | Average net counts. |
| $SD_n$ | = | Standard deviation of the average net counts. |
| $SD_g$ | = | Standard deviation of the average gross counts. |
| $N$ | = | Number of measurements. |
| $SD_b$ | = | Standard deviation of the average background counts. |
| $\sum_{i=1}^{N}$ | = | Summation of item 1,2,3…N. |

Record the gross counts ($C_{g_i}$, where i =1 to N), $\overline{C_n}$ and the standard deviations ($SD_n$ and $SD_g$) on the Scaler Instrumentation Check Sheet.

3. Divide $\overline{C_n}$ by $t_s$ to determine the average net count rate ($\dot{C}_n$) and record the rate on the Scaler Instrumentation Check Sheet.

4. Initially (at project set-up): Calculate the detector efficiency ($\varepsilon_i$) as follows:

$$\varepsilon_i = \frac{\dot{C}_n}{A_c} = \frac{cpm}{dpm}$$

Where:

| | | |
|---|---|---|
| $\dot{C}_n$ | = | Average net cpm. |
| $A_c$ | = | Actual, decay corrected activity (dpm). |

Daily (unless otherwise directed by the RCS or designee): perform a single source count ($C_g$). Analyze this value to the using the following formula:

$$C_g - C_b = C_n = \overline{C_n} \pm 2SD_n$$

Where:

$\overline{C_n}$ = Average net counts.

$C_n$ = Net Source Counts

$C_b$ = Daily Background counts.

$SD_n$ = Standard deviation of the average net counts.

If the source count is satisfactory, continue. If the source count does not meet this criteria, immediately notify the RCS. If the source count falls between $\pm 2SD_n$ and $\pm 3SD_n$, the RCS shall investigate and consult with the PHP before using the instrument. Record the source count on the Scaler Daily Instrument Check Sheet.

The efficiency will only be recalculated as directed by the RCS.

5. Record the calculated efficiency on the Scaler Instrumentation Check Sheet.

### 6.4.3 Calculation of Minimum Detectable Concentrations (MDC)

The calculated MDC is determined to ensure that the detector being used will detect the presence of activity at or above the allowable limit under a given set of counting conditions. The MDC is the concentration that a specific instrument and technique can be expected to detect 95 percent of the time under actual conditions of use. MDC is based on the estimated detector efficiency, sample quantity, and the counting time.

MDC of each instrument shall be determined upon initial set-up of the counting system and as needed following modification, calibration, repair, or replacement (i.e., new detector, cables, calibration, etc.). An MDC may be required to be determined on specific materials that exhibit a different background than at initial set-up. The RCS shall be contacted to determine if an MDC determination is necessary for specific materials.

For scanning building surfaces, the $MDC_{scan}$ should be determined using the following equations (using a value recommended in Appendix A of U.S. Nuclear Regulatory Commission, NUREG-1757, Vol. 2, “Consolidated NMSS Decommissioning Guidance,” for the index sensitivity d’ of 1.38, which is for 95 percent detection of a concentration equal to $MDC_{scan}$ with a 60 percent false-positive). The background collection times shall be at least 1 minute, to ensure consistent data collection.

For static measurements of surface concentrations by either direct measurement or by a smear sample, the $MDC_{static}$ should be determined using the equation from NUREG-1507. The sample collection times should be the same as the selected background times in Section 6.4.1, step 2, if practical. The RCS shall consult with the PHP for all other conditions.

6. Calculate the $MDC_{scan}$ in dpm/100cm$^2$:

$$MDC_{scan}\left(building\ \ surfaces\right)=\frac{5994+1.38\sqrt{C_{bscan}}}{\sqrt{p\varepsilon_i\varepsilon_s At_{scan}}}$$

Where:

| | | |
|---|---|---|
| 5994 | = | Conversion factor to convert to dpm/100cm$^2$ |
| 1.38 | = | Index of sensitivity d' |
| $\overline{C_{bscan}}$ | = | Average background counts in time interval $t_{scan}$ |
| *p* | = | Surveyor efficiency (0.5) |
| $\varepsilon_i$ | = | Instrument Efficiency for the emitted radiation |
| $\varepsilon_s$ | = | Source Efficiency in emissions/disintegration (0.25) |
| *A* | = | Probe's sensitive area, in cm$^2$ |
| $t_{scan}$ | = | Sample count time, time interval of the observation while the probe passes over the source in minutes. |

7. Record the calculated $MDC_{scan}$ on the Scaler Instrumentation Check Sheet.

8. Calculate the $MDC_{static}$ in dpm/100cm$^2$:

$$MDC_{static} = \frac{3 + 4.65\sqrt{\overline{C_{bstatic}}}}{K\,(t_{static})} = \frac{3 + 4.65\sqrt{\overline{C_{bstatic}}}}{\varepsilon_i * \varepsilon_s * (A/100) * (100\,cm^2) * t_{static}}$$

Where:

| | | |
|---|---|---|
| $\overline{C_{bstatic}}$ | = | Average background counts during time interval $t_{static}$ |
| $t_{static}$ | = | Sample counting time, time interval in min. the probe is in direct contact with the surface or smear |
| *K* | = | $\varepsilon_i*\varepsilon_s*(A/100)*(100cm^2)$ A calibration constant (best estimate) to convert counts/min to dpm/100 cm$^2$. |
| *A* | = | Probe's sensitive area, in cm$^2$ |
| $\varepsilon_I$ | = | Instrument Efficiency for the emitted radiation |
| $\varepsilon_s$ | = | Source Efficiency in emissions/disintegration (0.25) |

9. Record the calculated $MDC_{static}$ on the Scaler Instrumentation Check Sheet.

The calculated $MDC_{static}$ should be less than 50 percent of the appropriate DCGL, and while there is no specific recommendation of $MDC_{scan}$, it should be no more than 50 percent of the appropriate DCGL if possible. If the desired MDC cannot be attained, then inspect the instrument for equipment problems (contaminated detector or sample holder, loose cables/connectors, etc.) and notify the RCS. If no equipment problems are found, parameters such as sample quantity, count time, or background radiation levels may have to be adjusted appropriately to obtain an acceptable MDC. If reasonable adjustment of these parameters (as directed by the RCS) does not result in an acceptable MDC, a more suitable instrument/detector shall be required.

### 6.4.4 High Voltage Plateau (HVP)

The high voltage plateau is performed during instrument calibration and should not be required under normal operating conditions. However, following any equipment modification or replacement (i.e., new detector, cables, etc.) or whenever there is a noticeable degradation of instrument/detector performance (e.g., decreasing efficiency, erratic results, etc.), the high voltage plateau shall be investigated. If necessary, a new HVP shall be performed in accordance with the specific instrument's Manufacturer's Technical Manual.

### 6.5 Potential Detection Problems

In reviewing the instrument/detector performance records, the RCS should be notified when the following observations indicate detection problems:

- Background drift in a continuous direction either up or down.
- Alpha background greater than 0.5 counts per minute.
- A ratemeter-type instrument that does not zero.
- A battery check that does not respond.
- Failure to indicate response on a ratemeter-type instrument during a response check.

### 6.6 Solutions to Potential Detection Problems

If the above problems are encountered, the RCS has the following options:

- Remove the instrument/detector from service, tag it as out of service, and replace it with a comparable instrument/detector
- If no replacement is immediately available, contact the Task Manager to determine an appropriate mode of corrective action.

### 6.7 Records

The RCS shall be responsible for maintaining instrument/detector physical checks and performance verification records identified in Section 6.1 through 6.6. Equivalent forms that meet the intent of the forms in this procedure may be used with the approval of the RCS or designee. In addition, all instrumentation problems and corrective actions shall be recorded on the appropriate data sheets and in the RCS daily log.

Specific document forms to record actual field sampling data shall be required. These forms may vary from project to project, and the use of such forms shall be determined by the RCS and the Project Manager/Supervisor with approval by the Task Manager.

All records, daily logs, forms, and memos shall be maintained in the on-site project file throughout the duration of the project.

All radiological records designated for retention in the permanent project file by the Project Manager (or higher level of management) shall be prepared for release to Document Control.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject: Airborne Radioactive Particulate Monitoring**

## 1. PURPOSE

This procedure describes two techniques for determining the concentration of airborne radioactive particulates. The techniques differ only in sample collection; the analytical technique for determining the concentration from the filter media is the same for either sample collection method. The procedure should be used to do the following:

- Demonstrate compliance with the intake limits for workers specified in applicable federal or state regulations
- Meet the posting requirements for airborne radioactivity areas specified in applicable federal or state regulations
- Determine whether precautionary measures such as process or engineering controls, increased surveillance, limitation on working times, provision of respiratory protective equipment, or other precautions should be considered
- Determine whether exposures to radioactive materials are being maintained as low as reasonably achievable

This procedure also describes the method for calculating working level (WL) determinations and conversions to Derived Airborne Concentrations (DAC) for radon daughter. Also provided are instructions for the documentation of airborne radioactivity concentrations and radon working levels.

## 2. SCOPE

This procedure specifies standard practices for the performance of airborne radioactivity particulate monitoring and radon working levels. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing airborne monitoring operations. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection against Radiation*
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls*
- Shaw E & I Standard Operating Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000

- Burak, T.B., E.D. Franco and R.F. Holub, 1982, "An Evaluation of Working Level Measurements Using a Generalized Kusnetz Method," *Health Physics* 42:459-467, Pergamon Press


## 4. DEFINITIONS

- **ALARA**—An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.

- **Annual Limit on Intake(ALI)**—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Decay Chain**—A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Direct Measurement**—A reading taken using a portable instrument directly on a surface, or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed location measurements and scans.

- **Derived Air Concentration (DAC)**—The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI.

- **Derived Air Concentration hours (DAC hours)**—The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

- **Filter Ratio**—The ratio of the size of the counted filter section to the size of the original collected filter.

- **Guideline Values**—A predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Minimum Detectable Activity (MDC)**—The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, $L_D$, multiplied by an appropriate conversion factor to give units of activity.

- **Monitoring**-The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Project Radiation Safety Officer (Project RSO))**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Survey Unit**—A predefined geographical area, or location within a facility, that forms the boundary for a specific radiological evaluation or survey.

- **Working Level (WL)**—Any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission of $1.3 \times 10^5$ MeV of potential alpha particle energy.

## 5. RESPONSIBILITIES

### 5.1 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users
- Maintain all required license records at the location specified on the license

### 5.2 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.3 Project Managers

Project Managers are responsible to identify any radiological safety issues associated with projects under their cognizance. Further, Project Managers are responsible for ensuring that appropriate radiological controls are established on projects under their cognizance in order to ensure the protection of workers, the general public, and the environment and to maintain exposures to ionizing radiation As Low As Reasonably Achievable (ALARA).

### 5.4 5.4 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to understand, implement, and properly document the performance of the requirements of this procedure for a specific project, as established by the License RSO. The Project RSO is responsible for the following:

- Ensuring that airborne monitoring performed for the demonstration of compliance conforms to the requirements of this procedure
- Maintaining an adequate inventory of functional, calibrated airborne monitoring instrumentation
- Storing and controlling the use of all airborne monitoring instrumentation
- Ensuring that the performance of airborne monitoring equipment is properly documented and conforms to the requirements of this procedure

### 5.5 Radiological Controls Technicians

Radiological Controls Technicians (RCT) are responsible to follow procedures established by the Project RSO, and shall ensure that the setup, use, and maintenance of radiation instrumentation is performed in accordance with this procedure. The RCTs shall also properly document radiation instrument use in accordance with this procedure.

## 6. PROCEDURE

### 6.1 Prerequisites

Project-specific airborne monitoring equipment shall be identified during the project planning.

Prior to conducting airborne radioactive particulate monitoring, the RCT conducting the monitoring shall ensure that the following prerequisites are met:

- Project-specific radiological survey and data collection requirements and data quality objectives are established in written project documents and are understood by the RCTs performing surveys.
- All required survey supplies and material are available for use on site. These materials include the following:
  - Completed and approved Activity Hazard Analysis for the monitoring to be performed
  - Radiation Work Permit (RWP) prepared and approved in accordance with Shaw E & I Standard Operating Procedure T-RA-010, *Radiological Site Controls* (if entering radiologically controlled areas to perform monitoring)
  - Airborne Radioactivity Sample / Monitor Report Forms
  - Appropriate radiation dosimetry
  - Properly calibrated instrumentation or analytical equipment capable of measuring the contaminant(s) of interest
- Previous radiological surveys and airborne monitoring results for the area of interest have been checked, if available, to determine radiation and contamination types and levels in the areas to be surveyed and to determine whether conditions of safety have changed since the last survey.
- Appropriate action levels or guideline values are established and required actions or reporting requirements are understood by RCTs performing monitoring.

### 6.2 Sampling Instructions

Air samples may be of two general types: grab samples and environmental samples. Grab samples are typically a quick sample of a fixed volume of air around a worker or work area. Environmental samples are typically samples collected over an extended period of time. The type of samples needed for the project should be determined during project planning.

#### 6.2.1 Area Samples

The procedure for collecting area samples is as follows:

1. Select an air-sampling unit and install the appropriate diameter filter in the filter head. The sampler shall be calibrated in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.
2. Select a suitable location for sampling. Choose the location based upon an evaluation of the operation being performed. The ideal location shall approximate the breathing zone of a worker and shall be between the source of the potential airborne material and the location of the worker(s).
3. Determine the time and flowrate necessary to sample a volume sufficient to ensure that an adequate Minimum Detectable Concentration (MDC) is obtained in accordance with Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual* and Shaw E & I Procedure T-RA-005, *Field Project Radiological Controls*.

4. Turn on the air-sampling unit; adjust the flowrate to a calibrated value; and record the time, initial flowrate, and initials of the technician on the Airborne Radioactivity Sample/Monitor Report or Radon DAC radioactivity Sample/Monitor Report, as appropriate.

5. Record the exact location of the air sampling unit and the nature of the work being performed. Record any other pertinent comments.

6. Periodically check the air-sampling unit for proper operation.

7. Record the final flowrate and time, and turn off the air-sampling unit. Remove the air filter and place it in the sample envelope.

### 6.2.2 Lapel Samples

The procedure for collecting lapel samples is as follows:

1. Select a lapel air sampler and install a 25mm or 37mm diameter filter (as appropriate) in the filter cassette head. Calibrate the flowrate and record on the appropriate report form.

2. Determine the time and flowrate necessary to sample a volume sufficient to ensure that an adequate MDA is obtained. Due to the low flowrate of lapel air sampling pumps, it is usually necessary to operate the pump a minimum of four (4) hours. A six (6) to eight (8) hour sample, if possible, is preferable.

3. Select a worker with a high potential for exposure to airborne radioactive materials. Instruct the worker regarding the wearing of the lapel sampler. Ensure that the filter head is positioned in the breathing zone.

4. Record the name of the worker and the nature of the work being performed. Record any other pertinent information.

5. Turn on the air-sampling pump; adjust the flowrate to the calibrated value; and record the time, initial flowrate, and initials of the issuing technician.

6. Periodically, check the work area and air-sampling unit for proper monitoring and operation.

7. Record the final flowrate and time, and turn off the air-sampling unit. Remove the air filter and place it in the sample envelope.

## 6.3 Counting Instruction

### 6.3.1 Airborne Radioactive Particulate Determination

1. As appropriate, it may be necessary to have a minimum of 72 hours from the end of sample collection before counting the sample (to allow for the decay of short-lived radon daughters). An initial count or 24-hour decayed count may be performed for informational purposes. If radon is not a problem, an immediate count of the air sample is appropriate.

2. Using an appropriately calibrated Scaler-Counter, set up in accordance with Shaw E&I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*, count the sample for the pre-determined count time. This count time is established during instrument setup based on the required MDC for the nuclide(s) of interest.

3. Preserve the sample for potential recount by placing the sample in an appropriate individual sample storage container. Mark the container with the sample number and the date and time that the initial count was made.

4. Calculate the airborne radioactive particulates (activity) and the Minimum Detectable Concentration (MDC), using the following equations:

$$Activity(\mu Ci/ml) = \frac{(Sample\ cpm - Bkg\ cpm)}{(2.22E6\ dpm/\mu Ci)(Vol)(E)(F_a)}$$

Where

Vol = Volume of sample, in ml, calculated by multiplying the average flow rate by the runtime by the appropriate conversion factor into ml.

Average flow rate ($\overline{f}$ ) = (initial flowrate + final flowrate) / 2

Volume (ml) = (Runtime in min) ($\overline{f}$ in cfm) (2.83E4 ml/ft$^3$)

Volume (ml) = (Runtime in min) ($\overline{f}$ in lpm) (1000 ml/l)

Volume (ml) = (Runtime in min) (ml)

E = Detection efficiency of counting equipment

$F_a$ = Filter absorption, 0.8 for α and 1.0 for β –γ

2.22E6 dpm/ μCi = Conversion from dpm to microcuries

NOTE: When the selected air sampling unit has a filter diameter larger than 2 inches, an appropriate sample must be removed from the larger filter to accommodate sample counting equipment. The removed sample should be taken from the middle of the original filter. In this case, the calculated activity must be adjusted by multiplying the activity by the Filter Ratio (FR), the ratio of the size of the counted filter section to size of the original collected filter.

Where

$T_b$ = Background count time in min

$T_s$ = Sample count time in min

5. Record the results on the Airborne Radioactivity Sample/Monitor Report and in the Airborne Radioactivity Sample Log. If the results are greater than 10% of the most restrictive Derived Air Concentration (DAC) of a nuclide of concern, notify the Project RSO.

6. The Project RSO shall routinely review the airborne radioactivity sample log to note any trends of increasing airborne activity at various work locations.

$$MDC = \frac{2.71 + 4.65\sqrt{(Bkg\ cpm)(T_b)}}{(2.22E6\ dpm/\mu Ci)(Vol)(E)(F_a)(T_s)}$$

### 6.3.2 Radon Working Level Determinations

1. After decay time of forty (40) to ninety (90) minutes, count the sample for alpha activity in accordance with Shaw E & I SOP T-RA-006, *Radiological Controls Portable Instrument Procedure*. Count for a minimum of 5 minutes, or as required, to achieve an MDC of 0.01 WL. Record the results using the Radon DAC Radioactivity Sample/Monitor Report.

2. Calculate the activity and MDC values as defined in Section 6.3.1, step 3.

3. Calculate the atmospheric concentration of radon daughters as a fraction or multiple of the working level using the following equation:

$$DAC(\%DAC) = \frac{(Sample\ cpm - Bkg\ cpm)}{(E)(VPM)(T_{SC})(T_s)(K)(3)}$$

Where

| | |
|---|---|
| E | = Detection efficiency |
| VPM | = Air flow rate (LPM) |
| $T_{SC}$ | = Sample collection time |
| $T_s$ | = Sample count time in min |
| K | = Kusnetz conversion factor (Kusnetz Conversion Factor Chart) |
| 3 | = Conversion factor from WL to DAC (0.33 WL = 1 DAC) |

4. Record the results on the Radon DAC Radioactivity Sample/Monitor Report and in the Airborne Radioactivity Sample Log.

### 6.4 Records

#### 6.4.1 Sample Log

All samples generated as result of this procedure shall be logged using the Airborne Radioactivity Sample Log form. The samples shall be numbered as follows: a six-digit number representing the date followed by a two digit sequential number for samples collected on that date.

#### 6.4.2 Record Retention

All forms generated as a result of this procedure shall be maintained throughout the duration of the project and then retained in accordance with Shaw E & I Health and Safety Procedure HS700, Policy and Guidance for Developing *Radiation Protection Plans*.

## 7. ATTACHMENTS

- None

# RADIATION PROTECTION PROCEDURE

**Subject: External Dosimetry Administration**

## 1. PURPOSE

This purpose of this procedure is to provide guidelines for the establishment and implementation of a dosimetry administration program on field projects involving the potential for exposure to ionizing radiation. This procedure will prescribe the manner in which dosimetry and exposure data will be managed on projects, including assigning responsibilities for establishing and implementing dosimetry programs.

## 2. SCOPE

This procedure provides standard practices for dosimetry administration programs. It provides the minimum required steps and quality checks that employees and subcontractors are to follow in establishing and implementing such programs. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans.*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation.*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers.*
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Standard Operating Procedure T-RA-013, *Bioassay and Internal Exposure Monitoring.*

## 4. DEFINITIONS

- **Action Level—**A predetermined exposure that, when reached, or measured, requires that a specific, predefined set of follow up protocols go into effect to minimize personal exposure and to control sources of radiation.
- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Alpha Radiation(α)**—Alpha particles (He-$4^{++}$) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.

- **Annual Limit on Intake (ALI)**—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Attenuation**—The process by which a beam of radiation is reduced in intensity when passing through some materials, including air. It represents a combination of absorption and scattering processes that lead to a decrease in flux density as the beam passes through matter.

- **Background Radiation—**Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Radiation(β)—**Beta particles ($e^-$) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Biological Effect**—The net biological change caused by a specific quantity of absorbed dose to body tissues, measured in Rems or Sieverts.

- **Calibration**—The check or correction of the accuracy of a measuring instrument to ensure proper operational characteristics.

- **Committed Dose Equivalent (CDE)**—The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. Committed dose equivalent is expressed in Rem.

- **Committed Effective Dose Equivalent (CEDE) -** The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues and is expressed in Rem.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)**—The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Deep Dose Equivalent (DDE)**—Applies to external whole-body exposure; the dose equivalent at a tissue depth of 1 cm.

- **Dose**— A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

- **Dose Equivalent (DE)**—The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The unit of dose equivalent is rem.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Effective Dose Equivalent (EDE)**—The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

- **Exposure**—Being exposed to ionizing radiation or to radioactive material.
- **External Dose**—That portion of the dose equivalent received from radiation sources outside the body.
- **Gamma Radiation(γ)**—High energy, short wavelength photons emitted from radionuclides while undergoing decay, or emitted by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.
- **Gray**—A unit of absorbed dose equal to 1 Joule/kilogram or 100 rads.
- **High Radiation Area**—An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.
- **Intake (or Uptake)**—Radionuclides entering the body by any exposure pathway, primarily inhalation, absorption, or ingestion means.
- **Investigation Level**—The level of exposure above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Monitoring-**The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses
- **National Voluntary Laboratory Accreditation Program (NVLAP)**—Accredits testing and calibration laboratories that are found competent to perform specific tests or calibrations, or types of tests or calibrations. NVLAP is a U.S. Government entity administered by the National Institute of Standards and Technology (NIST), an agency of the Department of Commerce.
- **Neutron Radiation(n)**—An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.
- **Rad**—A unit of absorbed dose equal to 0.01 Joule/kilogram or 0.01 Grays.
- **Radiation Area**—An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Radiological Work Permits (RWPs)**—A work document that contains the necessary controls and protective measures to prevent inadvertent exposures to radiation and radioactive contamination while performing work in radiologically controlled areas.

- **Radiologically Controlled Area (RCA)**— Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.

- **Rem**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor. One Rem is equal to 0.01 Sievert.

- **Restricted Area**—An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

- **Roentgen**—A unit of exposure equal to the amount of gamma or X-rays required to produce 1 electrostatic unit (esu) of charge in 1 cc of dry air at standard temperature and pressure.

- **Self-Reading Dosimeter (SRD)**—Radiation monitoring device used to provide a direct readout of gamma and/or x-ray exposure.

- **Shallow Dose Equivalent (SDE)**—Applies to the external exposure of the skin or an extremity, taken as the dose equivalent at a tissue depth of 0.007 centimeters.

- **Sievert**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Gray multiplied by a quality factor. One Sievert is equal to 100 Rems.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Total Effective Dose Equivalent (TEDE)**—The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

- **Thermoluminescent Dosimeter (TLD)**—Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

- **Very High Radiation Area**—An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

- **Whole Body** - For purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee

- **X-ray Radiation—**High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and to pose a substantial external radiation hazard.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the RSO shall do the following

- Assess the need for a dosimetry monitoring program
- Identify the appropriate dosimetry and to employ proper practices for its use.
- Establish specific requirements for a project exposure-monitoring program, including the establishment of investigative and action levels.

### 5.3 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to implement established exposure monitoring requirements for a specific project, as established by the License RSO. The Project RSO is responsible to ensure that the proper collection and documentation of radiation exposure history data is available and maintained in on-site records. The Project RSO is also responsible for the issuance and collection of dosimetric devices on project sites within the appropriate periodicity (generally monthly).

### 5.4 Site Radiation Workers

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of dosimetry data. This includes proper wearing of, and maintaining control of, dosimeters in compliance with established site procedures.

## 6. PROCEDURE

Once the need for a project dosimetry program is established by the License RSO, radiation workers will be issued an appropriate dosimetry badge per Sections 6.2 and 6.3 prior to entry into any controlled area where they are likely to receive a measurable occupational dose. In addition to requiring a dosimetry badge, any personnel entry into radiologically controlled areas of the site must satisfy the requirements of the project bioassay and training program, as appropriate, except for casual visitors as described in Section 6.2.1.

External dosimeters, such as TLDs and SRDs, monitor external radiation dose; internal doses are monitored in accordance with Shaw E & I Procedure T-RA-013, *Bioassay and Internal Dose Monitoring*.

NOTE: Project personnel may participate in an existing client dosimetry program, in lieu of establishing a program, if the requirements of that client program, upon evaluation by the License RSO, are equivalent, or exceed, the requirements of this procedure.

### 6.1 Radiation History Reports

All personnel with prior radiological work experience shall complete a Personnel Dosimetry Record. If current records are not provided by an individual, the individual shall provide a completed Request for Report Of Radiation Dose History form to obtain their past reports of radiation history. In addition, they shall make available a copy of their dose history on NRC Form 4, or equivalent, and NRC Form 5, or equivalent. The Project RSO or equivalent shall review these forms when completed and maintain these forms in the project records. Copies of all dose history records will be forwarded to the Health & Safety Department at the completion of the project, or once per quarter, whichever is more restrictive.

## 6.2 Issuance of TLD Badges

All permanently assigned site personnel will be issued an appropriate dosimetric device prior to entry into any Radiologically Controlled Area (RCA). Other workers will be supplied and required to use individual monitoring devices under any of the following conditions:

- The workers are adults likely to receive, in 1 year from sources external to the body, a dose in excess of 400 mrem Total Effective Dose Equivalent (TEDE).
- The workers will be entering a high or very high radiation area.
- The workers are likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI of 10 CFR Part 20, "Standards for Protection Against Radiation."

A NRC Form 4 and NRC Form 5, or equivalent, shall be obtained for each individual assigned a TLD badge. A Personnel Dosimetry Record shall be completed for each individual issued a TLD with the following information:

- Individual's name
- Date of Birth
- Sex
- Social Security Number
- Individual's Home Address

### 6.2.1 Visitors

Visitors shall be issued dosimetry badges as deemed appropriate by the Project RSO or equivalent, taking into consideration radiation and contamination levels, duration of visit, and other pertinent information. For groups of visitors, at least one dosimeter shall be issued to an individual in each group. Visitors shall not be allowed to enter areas where they may exceed one half of the applicable limits of 10 CFR Part 20, "Standards for Protection Against Radiation".

Visitors may be exempted from the requirements of the bioassay, dosimetry, and training programs at the discretion of the Project RSO or equivalent, under the following conditions:

- The visit is a "one-time" occurrence
- The location to be visited is not an RCA, and has very low potential for airborne contamination
- The visitor is escorted at all times by an individual with a dosimeter

### 6.2.2 Dosimeter Use

Dosimeters shall be worn on the front of the body between the shoulders and the waist, unless otherwise specified by the Project RSO or equivalent.

Dosimeters shall be exchanged and returned to the vendor for processing, monthly, quarterly, as required by the Project RSO with the concurrence of the License RSO, or as specified in site-specific plans or work instructions. Monthly or quarterly TLD reports should be returned to the Project RSO, or a designee. Results shall be recorded on the Personnel Dose Record Form, Personnel Internal Dose Record Form, and Personnel Internal Dose Assessment Form.

A control dosimeter, of the same type as issued dosimetric devices, and all other badges (when not being worn by personnel) shall be stored in areas known to have low backgrounds not affected by radiation emanating from the site. If necessary, a shielded container shall be provided for the storage of all badges when not in use. The Project RSO will designate the appropriate daily storage location for dosimeters not in use, as well as the location of the control dosimeter.

Dosimeters are not to be taken home at the end of the workday.

In the event of a lost dosimeter, a calculated dose shall be utilized for an individual's dose record using the Loss of Personnel Dosimetry Report form. Results from co-worker dose and calculations of individual dose through reconstruction of the individual's work history leading to the potential dose shall be reviewed during the evaluation. Report all lost dosimeters to the Project RSO or equivalent, immediately, verbally and in writing using the Loss of Personnel Dosimetry Report.

Visitor dosimeters, if not self-reading dosimeters, will be processed at the time of regular badge exchange, unless otherwise authorized by the Project RSO or equivalent.

Dosimeters shall only be issued to one individual, and shall not be reissued until processed.

The Project RSO or equivalent shall record any unusual occurrences or conditions that may relate to personnel dosimetry data on the Personnel Contamination/Dose Report Form.

## 6.3 Administrative Personnel Dose Guidelines

Personnel doses shall not exceed the guidelines established in Shaw E & I Procedure T-RA-001, *Health Physics Policy Manual*, and the limits of 10 CFR Part 20, “Standards for Protection Against Radiation,” The Project RSO or equivalent may establish more restrictive project-specific administrative limits.

An investigation shall be conducted and documented by the Project RSO or designee if any person receives, or is suspected of receiving, a dose that exceeds the established administrative limit.

If an overdose is suspected, the individual’s personnel dosimetry shall be processed immediately. Bioassay samples shall be initiated, and internal dose calculations shall be performed, if necessary. The individual shall be restricted from entering the RCA until the Project RSO, and the License RSO, can determine that no administrative or legal dose limits will be exceeded. The Project RSO shall initiate an investigation and report the incident in accordance with Shaw E & I Health and Safety Procedure HS020, “Accident Prevention Program: Reporting, Investigation, and Review.”

## 6.4 Dosimetry Vendors and Processors

Laboratories supplying and process dosimetry shall be accredited by the National Institute of Standards and Technology (NIST) by participation in the National Voluntary Laboratory Accreditation Program (NVLAP). The Project RSO shall verify accreditation prior to selecting a dosimetry vendor for the project.

## 6.5 Personnel Dosimetry Records

On-site individual dose files shall be maintained for all personnel who are monitored for external and/or internal dose.

The following records shall be included in each individual's dose file:

- Personnel Dosimetry Record
- Request for Report of Radiation Dose History, as required
- NRC Form 4 or equivalent
- NRC Form 5 or equivalent
- Personnel Contamination/Dose Report Form, as required

- Loss of Personnel Dosimetry Report, as required
- Personnel Dose Forms or equivalent (Personnel Dose Record Form, Personnel Internal Dose Record Form, Personnel Internal Dose Assessment Form)

The Personnel Dosimetry Record form shall be initiated at the site for all subcontractor personnel working at the site. These records shall then be forwarded to the Project RSO or equivalent for inclusion into the project files.

### 6.6 Records Retention

All forms generated as a result of this procedure shall be maintained throughout the duration of the project and then retained in accordance with Shaw E & I Health and Safety Procedure HS700, *Radiation Protection Program*.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

## Subject: Radiation Exposure Rate Monitoring

## 1. PURPOSE

This procedure describes general methods and techniques to be used when performing radiation exposure rate monitoring as part of a radiation survey. Radiation monitoring is performed, in conjunction with an assessment of the overall radiological conditions and other potential hazards, in order to demonstrate compliance with applicable regulations. Radiation monitoring is also used to determine external radiation levels in work areas so that personnel radiation dose can be minimized. The monitoring data helps determine the need for area control and postings, personal dosimetry requirements, and the requirements for Radiation Work Permits (RWPs) in order to maintain exposures ALARA.

## 2. SCOPE

This procedure provides standard practices for the performance of radiation exposure rate measurements as part of a radiation survey. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these measurements. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers*
- Shaw E & I Procedure T-RA-005, *Field Project Radiological Controls*
- Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*
- Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*
- Shaw E & I Procedure T-RA-010, *Radiological Site Controls*

## 4. DEFINITIONS

- **Action Level—**For radiation monitoring, a predetermined rate of exposure that, when reached, or measured, requires that a specific, predefined set of follow-up protocols go into effect to minimize personal exposure and to control sources of radiation.
- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and

socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Radiation (α)**—Alpha particles (He-$4^{++}$) emitted by some radionuclides while undergoing radioactive decay. While Alpha radiation does not pose an external exposure threat, Alpha emitters may also emit photons (gamma or X-ray) during decay or attenuation.

- **Attenuation**—The process by which a beam of radiation is reduced in intensity when passing through some materials, including air; represents a combination of absorption and scattering processes that lead to a decrease in flux density as the beam passes through matter.

- **Background Radiation—**Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Radiation(β)—**Beta particles ($e^-$) emitted by some radionuclides while undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit photons (gamma or X-ray) during decay. Beta particles cannot penetrate human skin but do pose a hazard to the skin and lenses of the eye.

- **Biological Effect**—The net biological change caused by a specific quantity of absorbed dose to body tissues, measured in Rems or Sieverts.

- **Calibration—**The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.

- **Contamination—**The deposition of unwanted radioactive material on surfaces or in media.

- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.

- **Dose**— A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Exposure**—Being exposed to ionizing radiation or to radioactive material.

- **External Dose**—That portion of the dose equivalent received from radiation sources outside the body.

- **Flux—**A term applied to the amount of some type of radiation crossing a certain point, or area, per unit time. The unit of flux is particles (or gamma energy) per $cm^2$ per second.

- **Gamma Radiation (γ)—**High energy, short wavelength photons emitted from radionuclides while undergoing decay, or by the interaction or attenuation of other types of radiation. Gamma radiation easily penetrates human tissue and poses a substantial external radiation hazard.

- **Gray—**A unit of absorbed dose equal to 1 Joule/kilogram or 100 rads.

- **Hot Spot—**A location within a radiologically controlled area in which the levels of radiation or contamination are noticeably greater than in the surrounding area.

- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Monitoring-** The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses**.**
- **Neutron Radiation (n)—**An uncharged particle ejected from an atomic nucleus in varying energy states. Neutrons interact by collision with other nuclei and are highly penetrating because of their low mass and lack of electrical charge.
- **License Radiation Safety Officer (License RSO)**—An individual who, by virtue of education, certifications, or experience, is qualified to provide planning for, and oversee the proper implementation of, radiological controls measures for work activities involving the potential for exposure to ionizing radiation.
- **Quality Factor**—A unit less number assigned to a particular type (and energy) or radiation in producing biological effect. Quality factors are used to derive equivalent dose from absorbed dose. Gamma, X-ray, and Beta radiation are assigned a quality factor of 1. Alpha and Neutron radiation have quality factors between 2 and 20.
- **Rad**—A unit of absorbed dose equal to 0.01 Joule/kilogram or 0.01 Grays.
- **Radiation Worker—**An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)** — Individuals who, by virtue of training and/or experience, have been authorized by the License RSO to use or directly supervise the use of radioactive materials under the requirements of USNRC Service License.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Rem—**A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Rad multiplied by a quality factor. One Rem is equal to 0.01 Sievert.
- **Roentgen**—A unit of exposure equal to the amount of gamma or X-rays required to produce 1 electrostatic unit (esu) of charge in 1 cc of dry air at standard temperature and pressure.
- **Shine—**Radiation from a source near a measurement location that interferes with a particular environmental measurement. While background is always a part of a gross measurement, in the case where shine is present, the significance and data quality of the measurement may be questionable.
- **Sievert**—A unit of biological effect, or dose equivalent, equal to the absorbed dose of one Gray multiplied by a quality factor. One Sievert is equal to 100 Rems.
- **Survey—** An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.
- **Survey Unit**—A predefined geographical area, or location within a facility, that forms the boundary for a specific radiological evaluation or survey.
- **X-ray Radiation—**High energy, short wavelength photons produced outside an atomic nucleus by the interaction or attenuation of other types of radiation. Identical to Gamma radiation in ability to penetrate human tissue and pose a substantial external radiation hazard.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (License RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the License RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site

- Review, and approve, the qualifications of Authorized License users

Maintain all required license records at the location specified on the license.

### 5.3 Project Radiation Safety Officer

Project RSO’s are responsible to understand, implement, and properly document the performance of the activities in accordance with the conditions of the license and all procedures, and program requirements that are incorporated by reference, on Shaw E & I projects where the license is in use. Project RSO’s must be approved by the license RSO and shall report directly to the License RSO in matters involving the implementation of the USNRC license

The Project RSO is responsible to implement the radiation monitoring requirements for a specific project, as established by the License RSO. The Project RSO is responsible to ensure the proper collection and documentation of radiation survey data on the project site.

### 5.4 Radiological Controls Technicians

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of survey data. This includes performing operational checks on monitoring instrumentation, performing measurements, and documenting results in compliance with established procedures and convention.

## 6. PROCEDURE

### 6.1 Prerequisites

Prior to conducting radiation exposure rate monitoring, the RCT conducting the survey shall ensure that following prerequisites are met:

- Project-specific radiological survey and data collection requirements, and data quality objectives, are established in written project documents and are understood by the RCTs performing surveys.

- All required survey supplies and material are available for use on site. These materials include the following:

  - Completed and approved Activity Hazard Analysis for the monitoring activity to be performed

- Radiation Work Permit (RWP) prepared and approved in accordance with Shaw E & I Procedure T-RA-010, *Radiological Site Controls* (if entering radiologically controlled areas to perform surveys)
- Radiation/Contamination Survey Report Forms
- Appropriate radiation dosimetry
- Properly calibrated instrumentation or analytical equipment capable of measuring the radiation(s) of interest

- The appropriate monitoring instrument has been selected and calibrated and is operating properly in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- The previous surveys of the area of interest have been checked, if available, to determine radiation and contamination types and levels in the areas to be surveyed and to determine whether conditions of safety have changed since the last survey.
- A survey map of the area of interest has been obtained or prepared, using a survey record form, providing a graphical representation of the area or item to be monitored.
- Appropriate action levels or guideline values have been established, and required actions or reporting requirements are understood by RCTs performing surveys.
- For systematic measurements, appropriate reference and sample grids have been established based on data quality requirements.

## 6.2 Measuring Exposure Rates

Generally, radiation exposure rate measurements include the following types of measurements:

- Initial Entry – Entry into areas with exposure rates that are unknown (if required due to lack of available radiological data).
- General Area – Measurements taken to determine radiation levels in work areas to allow ALARA planning and to determine the need for radiation shielding to limit exposures.
- Area Posting – Measurements taken to determine or verify regulatory area posting requirements.
- Beta Exposure – Measurement of dose from Beta radiation.

### 6.2.1 Initial Entry Surveys

Initial entry survey shall be conducted prior to, and during, initial entry into work areas where there is a potential for substantial external exposure to ionizing radiation. The following steps shall be taken to ensure exposures are maintained ALARA:

- Using a detection instrument with an audible response, turn on the portable detection equipment and adjust the instrument to its highest range setting. If the instrument is over-ranged at the highest setting, immediately exit the area and obtain an instrument capable of detecting higher exposure rates.
- If the instrument is not over-ranged, adjust the instrument range setting until an accurate measurement can be seen on the meter face.
- Document data on a Radiation/Contamination Report Form
- Once an exposure rate is established, by audible response and meter reading, conduct general area and area posting surveys as described below.

6.2.2 General Area Measurements

For measurement of the general area gamma radiation level, take measurements at approximately 1 meter from surfaces or above ground. This should be done with the beta shield in the "closed" position. Repeat measurements as necessary to verify data. Document data on a Radiation/ Contamination Report Form.

6.2.3 Area Posting Measurements

For measurement of the gamma radiation level in support of posting requirements, take measurements at 30 centimeters from the radiation source or from any surface that the radiation penetrates. This should be done with the beta shield in the "closed" position. Upon completion of the monitoring activities, post the work area as required by the applicable regulatory reference. Repeat measurements as necessary to verify data. Document data on a Radiation/Contamination Report Form.

6.2.4 Beta Exposure Rate Measurements

For measurements of beta dose rates, perform measurements at the location where the worker may be exposed, with the beta shield both open and closed. For instruments without a beta shield, the active area of the detector will be covered with an appropriate shielding material for the closed measurement. Record the results. Beta measurements should be taken no more than 1 centimeter from the surface. To obtain true Beta dose, subtract the closed window reading from the open window reading and multiply the result by the predetermined beta calibration factor for the instrument used. The net result is the exposure from Beta radiation. Repeat measurements as necessary to verify data. Record data on the Radiation/Contamination Report Form.

**6.3 Quality Control Measurements/Samples**

In order to ensure the level of data quality required by the purpose of the survey being performed, quality control measurements and samples will be collected as part of the monitoring process. Specific requirements for performance, collection, and analysis will be established prior to performing any monitoring activities. The RCT performing each survey will be given instruction regarding the QC sample requirements for the sampling activity being conducted.

**6.4 Waste Management**

Waste streams associated with monitoring and sampling activities include used personal protective equipment (PPE) (tyvek and gloves) and used smears. If not suspected of being contaminated, these items will be disposed of as trash. If radiological contamination is suspected, based on monitoring data, PPE and contaminated smears will be bagged and disposed of as radioactive waste.

**ATTACHMENTS**

None

# RADIATION PROTECTION PROCEDURE

**Subject: Radiological Site Controls**

## 1. PURPOSE

This procedure describes how access to radiologically impacted sites, radiologically controlled facilities, or other areas, is restricted to only those personnel authorized to enter such areas. Access to these areas is controlled for the purpose of minimizing radiation exposures to site workers, visitors, and the general public.

## 2. SCOPE

This procedure specifies standard practices for the control of radiologically impacted areas. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when accessing these controlled areas. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document. Such variances shall be implemented, with proper documentation in project records and approval by the proper project authority. These variances will be applicable only for specific project use.

## 3. REFERENCES

- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans*.
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls.*
- Shaw E & I Standard Operating Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- Shaw E & I Standard Operating Procedure T-RA-008, *External Dosimetry Administration*.
- Shaw E & I Standard Operating Procedure T-RA-012, *Surface Contamination Monitoring.*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000

## 4. DEFINITIONS

- **Access Control Point**—A location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas.
- **ALARA**—An acronym for “As Low As Reasonably Achievable.” Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and

socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha-emitting radionuclides may also emit gamma radiation photons during decay.

- **Background Radiation**—Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

- **Beta Contamination**—The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.

- **Contamination**—The deposition of unwanted radioactive material on surfaces or in media.

- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Frisking**—The process of searching a person's clothing or body with a radiation detection instrument prior to releasing the person from a radiologically controlled area.

- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.

- **Monitoring**-The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.

- **Project Radiation Safety Officer (Project RSO)**— The Project RSO is designated by the License RSO as an Authorized User and by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including the providing direction to radiological controls technicians.

- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.

- **Radiologically Controlled Area (RCA)**—Areas within a Restricted Area that are specifically posted and controlled according to types of radioactive material and radiation levels present. Access control measures are in place to prevent the spread of radioactive materials to uncontrolled areas.

- **Smear Sampling**—A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper, and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally $100cm^2$.

- **Survey**—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

- **Transferable, Removable, or Loose Contamination**—Radioactive material that can be easily removed from a surface or item.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program which includes selection of controlled areas, personnel protective equipment, and appropriate exit contamination survey instrumentation.

### 5.3 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to understand, implement, and properly document the performance of the requirements of this procedure for a specific project, as established by the License RSO. The Project RSO is responsible for the following:

- Ensuring that radiological surveys performed for the demonstration of compliance conform to the requirements of this procedure
- Maintaining an adequate inventory of functional, calibrated radiation survey instrumentation
- Storing and controlling the use of all dosimetry
- Ensuring that the performance of site controls is enforced and conform to the requirements of this procedure

### 5.4 Radiological Controls Technicians

Radiological Controls Technicians (RCTs) are responsible to follow procedures established by the License RSO, or Project RSO, and shall ensure that site controls are performed in accordance with this procedure.

### 5.5 Individuals

Individuals requiring entry into controlled areas are required to obey any written postings and verbal instructions provided to them by radiological controls personnel and to enter, or egress, areas only through properly identified and posted access control points.

## 6. PROCEDURE

All personnel entering a Radiologically Controlled Area (RCA) at a project site or a Shaw E & I controlled facility shall do so only at the designated access control points. Personnel who have regular job assignments at a project site shall be issued a personnel dosimeter, if required, per Shaw E & I Standard Operating Procedure T-RA-008, *External Dosimetry Administration*. Visitors shall be issued a dosimeter, and/or escorted at the discretion of the Project Radiation Safety Officer or equivalent.

All personnel shall log in at the Access Control Point using the Radiation Work Permit (RWP) Signature Form in accordance with Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls*.

All personnel shall don the appropriate personnel protective equipment as specified in the RWP.

Upon exiting the RCA, all personnel shall be surveyed for contamination in conformance with Shaw E & I Procedure T-RA-012, *Surface Contamination Monitoring* (i.e. by frisking). The time of exit shall be recorded on the RWP signature form. Doff personal protective equipment (PPE) in accordance with Posted Decon/PPE Removal Procedures.

All materials and/or equipment shall be surveyed for contamination in conformance with Shaw E & I Standard Operating Procedure T-RA-012, *Surface Contamination Monitoring* (i.e. by frisking and smear surveys).

Personnel and equipment decontamination shall be performed in accordance with Shaw Health and Safety Procedure HS700, *Radiation Protection Program* and 29 CFR 1910.120.

All personnel dosimeters, if issued, shall be left at the Access Control Point or in an area designated by the RCS or equivalent.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

## Subject: USNRC Service license Implementation Procedure

## 1. PURPOSE

This purpose of this procedure is to establish a formal procedure for the implementation of the Shaw E & I U.S. Nuclear Regulatory Commission (USNRC) Service License.

## 2. SCOPE

This procedure specifies regulatory and programmatic requirements for the implementation of the USNRC License on Shaw E & I field projects. The procedure is intended to provide guidance to potential license users in requesting implementation.

## 3. REFERENCES

- Shaw E & I Health and Safety Procedure HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Shaw E & I Standard Operating Procedure T-RA-001, *Health Physics Policy Manual.*
- Shaw E & I Standard Operating Procedure T-RA-005, *Field Project Radiological Controls.*
- Shaw E & I Standard Operating Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*

## 4. DEFINITIONS

- **ALARA**—An acronym for “As Low As Reasonably Achievable.” Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Authorized Users/ Project RSO**—Individuals who, by virtue of training and/or experience, have been authorized by the License RSO to use or directly supervise the use of radioactive materials under the requirements of USNRC Service License.
- **Controlled Materials**—Any licensable radioactive material controlled by Shaw E & I at a project location under NRC Service license.
- **Inventory**—Licensable radioactive materials that are in the position of Shaw E & I (company-wide) prior to the beginning of a project, and materials controlled by Shaw E & I (company-wide) during the course of a project.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Licensed Material**—Source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under the NRC Service License.

- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Radiation Safety Officer ( License RSO)**—The representative of the licensee, identified by name in the NRC license, who is responsible for implementation of the license and the associated radiation safety program. The License RSO also maintains all required records associated with license implementation.
- **Reciprocity**—Mutual agreement between two entities, in the context of this document between a USNRC agreement state and the licensee, allowing the licensee to conduct licensed activities under the jurisdiction of the agreement state.
- **US NRC License**— US NRC license possessed by Shaw Environmental, Inc. allowing the licensee to perform the following:
  - Decontamination of facilities, equipment, and containers
  - Solidification and treatment of wastes
  - Packaging for transport
  - Any activity related to site characterization
  - Transport, in packages or containers approved for use under the provisions of 10CFR Part 71, for transfer to licensees authorized to receive the materials

  These activities may only be conducted on temporary job sites anywhere in the United States where the USNRC maintains jurisdiction for regulating the use of licensed material.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The Radiation Safety Officer (License RSO) is responsible to maintain and implement USNRC License in strict compliance with the requirements of this document, the conditions of the license, and the associated radiation safety program. Specifically, the License RSO shall do the following:

- Act as the official point of contact between the USNRC and Shaw E & I for all license-related issues, including making notification to USNRC of license implementation and the termination of license use on a project site
- Review, and approve, the qualifications of Authorized License users
- Maintain all required license records at the location specified on the license

### 5.3 Project Manager

The site-specific Project Manager (PM) is responsible to maintain operations such that license requirements are met at all times. The PM will consult with the License RSO and the project authorized license user when planning licensed activities.

### 5.4 Authorized Users/Project Radiation Safety Officer

Authorized Users/Project RSO's are responsible to understand, implement, and properly document the performance of the activities in accordance with the conditions of the license and all procedures, and program requirements that are incorporated by reference, on Shaw E & I projects where the license is in use. Authorized Users/Project RSO's must be approved by the license RSO and shall report directly to the License RSO in matters involving the implementation of the USNRC license.

## 6. PROCEDURE

Prior to implementation of the USNRC Service license, a proposed authorized license user shall prepare an ALARA License Implementation Review Form (Attachment 1). This form will be reviewed and approved by the license RSO.

The License RSO will review the qualifications of proposed project authorized license users to ensure that each user is qualified, in accordance with the requirements of the license, to act as a license user. The License RSO will approve each proposed authorized license user in writing on the ALARA License Implementation Review Form.

Prior to NRC notification of intent to implement the license, the License RSO and all authorized users will conduct a pre-notification briefing, in accordance with the "Field Project ALARA Briefing Data/Check-off Form (Attachment 2)," which shall be used as an agenda and to document this briefing.

### 6.1 Notifications to USNRC Prior to Initiating Activities

At least 3 days before initiating activities at a temporary job site, the license RSO shall notify the USNRC, in writing, of the following information:

- Estimated type, quantity, and physical/chemical form(s) of licensed material
- Where the job site is located
- Description of project activities, including waste management and disposition
- Estimated project start date and duration
- Identification of, and contact information for, key project personnel

This information shall be sent by the License RSO to:

Regional Administrator
USNRC Region I
Attn: Chief Nuclear Materials Licensing/Inspection Branch
475 Allendale Road
King of Prussia, PA 19406-1415

### 6.2 Use of Multiple Licenses

If more than one USNRC or Agreement State license will be in use on the project site, a written agreement is required between Shaw and the other licensee specifying which licensee activities shall be performed under the other licensee's cognizance and which licensee activities shall be performed under Shaw supervision pursuant to the conditions of the NRC Service License. This agreement shall include a commitment by the licensee and the customer to ensure safety, and any commitments by the licensee to help the customer clean up the site if there is an accident.

NOTE: IF APPROVED BY THE RADIATION SAFETY OFFICER, REASONABLE ACTIONS MAY BE TAKEN IN AN EMERGENCY THAT DEPART FROM THE CONDITIONS OF THE LICENSE WHEN THE ACTION IS IMMEDIATELY NEEDED TO PROTECT PUBLIC HEALTH AND SAFETY, AND NO ACTION CONSISTENT WITH ALL LICENSE CONDITIONS THAT CAN PROVIDE ADEQUATE OR EQUIVALENT PROTECTION IS IMMEDIATELY APPARENT.

### 6.3 Notification to USNRC at the Completion of Activities

At the completion of activities involving the USNRC license at each job site location, the License RSO, or designee shall notify:

Regional Administrator
USNRC Region I
Attn: Chief Nuclear Materials Licensing/Inspection Branch
475 Allendale Road
King of Prussia, PA 19406-1415

Included in the notification shall be status of the temporary job site and the disposition of the licensed material.

### 6.4 Other Notifications, Approvals, and Licenses

In accordance with the requirements of 10 CFR 30.36(d), the License RSO shall promptly notify the USNRC in writing of a decision not to complete actions that require the implementation of the USNRC license at the facility.

Implementation of the USNRC license in Agreement States shall be with the written approval of the state regulating agency and the above notifications of the USNRC.

Upon entering a facility where the customer has a USNRC or Agreement State license, copies of all licenses shall be obtained by the RSO or designee.

Notification of local police, fire, and medical facilities of the activities being undertaken should be done upon project initialization to discuss applicable hazards.

### 6.5 Authorized User/Project RSO Responsibilities

Authorized users of the USNRC license, as approved, in writing, by the License RSO for specific field projects, are responsible for the following actions:

- Ensuring that proper radiological control measures are invoked, in accordance with approved procedures, which minimize personnel exposures and generation of wastes
- Ensuring appropriate accountability of radioactive materials possessed under the license
- Notifying the License RSO of unexpected and unusual situations at the project, and any incidents or accidents that occur
- Ensuring that project documentation is accurate and complete throughout the project for all activities undertaken
- Ensuring that appropriate licensing documents and applicable regulations are on hand at the project site, including all applicable Shaw operations, safety, and radiation protection procedures
- Notifying the License RSO of all regulatory agency inspections, scheduled or otherwise

- Escorting regulatory agency personnel on the project site, as applicable
- Maintaining general contact with local regulatory representatives to ensure that these agencies are fully appraised of the project progress
- Ensuring proper transportation and disposition of all radioactive materials for which possession was taken during the project

An authorized license user shall remain on the project site when activities involving radioactive material covered by the license are being performed.

## 6.6 Radioactive Material Tracking

In order to stay within the limits established by the NRC for the maximum amount of radioactive materials that may be possessed by Shaw at any one time, as described by condition number 8 in the NRC license, the following procedures must be observed.

- Prior to the beginning of each field project, the project manager will consult with the License RSO regarding the approximate amounts of radioactive materials that will be controlled under the NRC license at the site. If the amounts discussed will approach 50-percent of the allowable limit, the License RSO will evaluate the amount of materials being controlled under the license at other sites and determine if a potential exists for the license limits to be exceeded.
- At the beginning of each field project, the Authorized User/Project RSO will review the current inventory of licensed materials controlled under the NRC license. The Authorized User/Project RSO should report to the License RSO any additions to the inventory that may result in the license limits being approached as they occur. The Authorized User/Project RSO should also be made aware of changes to the inventory that may have occurred on another site as needed. Radioactive material, which may be controlled only temporarily under the NRC license, may not be added to the inventory.
- To track radioactive materials that are controlled under the NRC license at a project site, Licensed Radioactive Material Tracking Sheets will be used to ensure license limits are not exceeded. The tracking sheets will be initiated, controlled, and maintained on site by the project Authorized User/Project RSO. Upon completion of the project, the tracking form will be sent to the license RSO. The following steps are required to complete the tracking sheets:

  1. Enter the project information (location, number, Authorized User/Project RSO)
  2. Identify the type of licensed material to be tracked by the sheet (A, B, C, or D) (only one type per sheet)
  3. Identify the maximum amount of the material allowable by the license
  4. Identify, or estimate, the amount of material in current inventory
  5. Enter all additions and reductions of controlled materials and maintain a running total, including inventory changes from other sites

  If the running total reaches ¾ of the maximum amount of the material allowable by the license, the authorized user will inform the License RSO prior to each subsequent addition of controlled materials.

  At the end of the project, the tracking forms will be maintained by the license RSO.

## 6.7 Records

All records generated in accordance with this procedure shall be made available to the customer and USNRC upon request. At the completion of activities at temporary job sites, the records shall be transferred to the customer for retention until the site is released for unrestricted use. Copies shall be provided to the license RSO and retained for a minimum of five (5) years.

## 7. ATTACHMENTS

- ALARA License Implementation Review Form
- Field Project ALARA Briefing Data/Check-Off Form
- Licensed Radioactive Material Tracking Sheet

Attachment 1

# ALARA LICENSE IMPLEMENTATION REVIEW FORM

This form is required prior to implementation of USNRC Service License.

ALARA Meeting Date:_____________________Completed by:_____________________

ALARA Meeting members present:

Radiation Safety Officer ______________________________________

Proposed Authorized User/Project RSO ______________________________________

Project Name and Number:_______________________________________________________

1. Scope of work (including location, schedule requirements and risk vs. SHAW experience, capabilities and present capacity for added work).

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

2. Radionuclides of concern and their activity__________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

3. Total radioactivity level involved__________________________________________________

4. Physical form and characteristics of the radioactive material (soil, dusty, wet, surface contamination, water, gas, etc.).

_____________________________________________________________________________

_____________________________________________________________________________

5. Man REM estimate for the work. ___________________ person-REM

6. USNRC Region involved, contact person Region _______

Contact person, phone number________________________________________________________

7. State regulatory agency involved, contact person

State Agency, phone number_______________________________________________

Contact person, phone number _____________________________________________

8. Waste disposal issues and options.

_____________________________________________________________________________

_____________________________________________________________________________

9. Presence or absence of hazardous materials.

_____________________________________________________________________________

_______

10. Is an emergency plan required? ___________________

## ALARA LICENSE IMPLEMENTATION REVIEW FORM

If an emergency plan is not required has written

USNRC approval been received? ____________________

11. Licensing issues.

If the customer holds an NRC or Agreement State license do we have a written agreement between the licensee and the customer specifying which licensee activities shall be performed under the SHAW license? ____________________

12. Authorized radioactive materials license user for the project.

____________________________________________________________

Submitted by:

Proposed Authorized User________________________________Date_______________________

APPROVAL:

Radiation Safety Officer___________________________Date_______________________

# Field Project ALARA Briefing Data/Check-Off Form

Project Name:______________________________ Number:_____________ Start date:_________________

Location:________________________________ Project RSO:________________________________________

Client's Rad Con Dept.______________________ Title/Ph.#:_________________________________________

Authorizing Radioactive Materials License for Project_________________________________________

1. Project Scope:______________________________________________________________________

______________________________________________________________________

2. Known or Potential Radioactivity Source(s) — Expected Level(s) and Type(s) - Nominal/Max.

| Known or Potential Radioactivity Source(s) | Radiation ( /hr) | Contam. (dpm/ 100cm$^2$) | Airborne (µCi/ml) |
|---|---|---|---|
| ______________________ | ________/________ | __________/__________ | _______/________ |
| ______________________ | ________/________ | __________/__________ | _______/________ |
| ______________________ | ________/________ | __________/__________ | _______/________ |

3. Required Instrumentation (List MFR./Model#, inst. type; B; Qty. etc.)

Contamination Survey(s):_____________________________________________________________

Inventory/Avail.:_____________________________________________________________

Radiation Survey(s):_____________________________________________________________

Inventory/Avail.:_____________________________________________________________

Airborne Monitoring:_____________________________________________________________

Inventory/Avail.:_____________________________________________________________

Counter-Scaler(s):_____________________________________________________________

Inventory/Avail._____________________________________________________________

Check Source(s)/Misc. Equip.:_____________________________________________________________

Inventory/Avail.:_____________________________________________________________

4. Project Control/Release Limit(s):

| | Contamination | Radiation |
|---|---|---|
| - Personnel | ______________ | N/A |
| - Equipment | ______________ | ______________ |
| - Other/Routine | ______________ | ______________ |
| - Project Site (at completion) | ______________ | ______________ |

5. Discussion Points: Initials _____

a) Work area layout - boundaries, exits/control point(s), etc. (attach basic diagram of Project Site Set-up if necessary) _______

# Field Project ALARA Briefing Data/Check-Off Form

b)Radiation, Contamination, Airborne activity levels/controls _______

c) Baseline Survey requirements (yes/no if yes explain):______________________________

______________________________________________________________

d)Special work area requirements (e.g. CSCA, containments, etc.):____________________

______________________________________________________________

e)Monitoring requirements (type, frequency, duration, etc.):___________________________

______________________________________________________________

______________________________________________________________

f) Personnel Monitoring Requirements(s) Dosimetry: Initials ________

Responsible Party/Processing Vendor ______________/_____________ _______

Type/Qty.:__________________ Inventory:________________

Radiation Worker Examinations NRC Form 4 for each worker

Internal: Bioassay ___________ Whole Body Count __________ _______

Notes:_____________________________________________________________

g)Properties of expected Radionuclides - effects on personnel _______

Special Precautions:_________________________________________________

h)General Worker Training requirements: _______

______________________________________________________________

Visitors:__________________________________________________________

I) Handling/Packaging of Waste/Broker: _______

______________________________________________________________

j) Necessary postings, barriers, etc.: _______

Caution Radioactive Material, Contaminated Area,

Radiation Area, Airborne Radioactivity Area:

k)Environmental monitoring: _______

6. Notes:_____________________________________________________________

______________________________________________________________

An ALARA briefing in has been conducted this _______________ day of___________________________,

with:1. __________________________________; 2. ______________________________;

3. ______________________________________

.

## Field Project ALARA Briefing Data/Check-Off Form

RSO Approved: ______________________________________ Date ____________________

# LICENSED RADIOACTIVE MATERIALS TRACKING SHEET

| LICENSED RADIOACTIVE MATERIALS TRACKING SHEET | | Page _____ of _____ |
|---|---|---|
| Location: | | Project Number: |
| | | Project RSO: |
| Licensed Material:<br>(Select one per sheet)<br><br>A - Byproduct materials with<br>atomic numbers 1 through 92<br>B - Source material<br>C - Byproduct materials with<br>atomic numbers 93 and above<br>D - Special nuclear material<br>(U-235, U-233 or plutonium) | (Enter letter above) | Maximum allowable limits:<br><br>A - 100 curies total<br>B - 5,000 kilograms total<br>C - 10 curies total<br>D - 350 grams U-235<br>200 grams U-233<br>200 grams plutonium<br>(or any combination of these provided that the sum of the ratios of the quantities does not exceed unity) |

| | | |
|---|---|---|
| 1 | Maximum amount allowable by license: | |
| 2 | Amount currently in inventory: | |
| 3 | Balance permitted by license (line 1 - line 2) | |

Material quantity adjustments: Additions input "###" - Reductions input "<###>"
When total equals three-quarters of the maximum amount allowable by license, contact the RSO.

| DATE | TIME | MATERIAL DESCRIPTION | ADJUSTMENT | TOTAL |
|---|---|---|---|---|
| | | Amount currently in inventory (line 2 above) or the total from the previous tracking sheet. | 0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

End of material tracking for project (Yes/No) ? __________
If "No," go to page _____ of _____
If "Yes," return forms to license RSO.

# RADIATION PROTECTION PROCEDURE

**Subject:** **Surface Contamination Monitoring**

## 1. PURPOSE

This procedure describes general methods and techniques to be used when performing surface contamination monitoring as part of a contamination survey. Contamination surveys including an assessment of overall radiological conditions and other potential hazards are performed and documented to demonstrate compliance with applicable regulations and to determine the following:

- Protective clothing and respiratory protection requirements for Radiologically Controlled Areas (RCAs)
- Proper radiological postings
- Contamination levels for release of items and materials from RCAs
- Residual contamination levels in remediated areas prior to release from regulatory controls
- Effectiveness of contamination control and decontamination methods

## 2. SCOPE

This procedure provides standard practices for the performance of surface contamination surveys for radioactive contamination. This document provides the minimum required steps and quality checks that all employees and subcontractors are to follow when performing these surveys. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document.

## 3. REFERENCES

- Shaw E&I Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000
- Shaw E & I Procedure T-RA-005, *Field Project Radiological Controls*
- Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*
- Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*
- Shaw E & I Procedure T-RA-010, *Radiological Site Controls*

## 4. DEFINITIONS

- **Action Level—**For contamination surveys, a predetermined quantity of contamination that, when reached, or measured, requires that a specific, predefined set of follow up protocols go into effect to minimize the spread of contamination or reduce risk of exposure to radiation.

- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
- **Alpha Contamination**—The presence of radionuclides that emit alpha particles ($He\text{-}4^{++}$) when undergoing radioactive decay. Alpha emitting radionuclides may also emit gamma radiation photons during decay.
- **Anti-Contamination Clothing (Anti-Cs)—**Personal Protective Equipment (PPE) worn by radiation workers to prevent the contamination of the workers' skin or clothing when working in contaminated areas.
- **Background Radiation—**Radiation that occurs naturally in the environment. Background radiation consists of cosmic radiation from outer space, or radioactive elements in geological media, building materials, or other natural sources, including radon and its decay products in air and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. ''Background radiation'' does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.
- **Beta Contamination—**The presence of radionuclides that emit beta particles ($e^-$) when undergoing radioactive decay. With few exceptions, beta-emitting radionuclides also emit gamma radiation photons during decay.
- **Biased Measurements**—Radiological measurements or samples conducted at locations based on the professional judgement of the surveyor.
- **Calibration—**The check or correction of the accuracy of a measuring instrument to assure proper operational characteristics.
- **Contamination—**The deposition of unwanted radioactive material on surfaces or in media.
- **Curie (Ci)—**The basic unit of radioactivity. The quantity of any radioactive element that decays at a rate equal to 2.22E+12 disintegrations per minute.
- **Decay Chain—**A sequential radiological decay process by which a parent nuclide produces a radioactive progeny which, in turn, decays to produce another radioactive product, and so on, until eventually a stable nuclide is produced.
- **Decontamination**—The reduction or removal of contaminating material from a structure, area, object, or person, or the extraction of radionuclides from contaminated media. The ratio of initial activity to final activity after any decontamination process is the **decontamination factor**.
- **Direct Measurement—**A reading taken using a portable instrument directly on a surface, or in an area. These readings measure total contamination on a surface. The two types of direct measurements routinely performed are fixed-location measurements and scans.
- **Fixed-Location Measurements—**Direct measurements performed by placing a detector at a fixed location on, or near, the surface being evaluated.
- **Frisking—**The process of searching a person's clothing or body with a radiation detection instrument prior to release of that person from a radiologically controlled area.
- **Guideline Values—**For surface contamination surveys, a predetermined quantity or concentration of residual contamination that, when measured, exceeds an established dose-based, or risk-based, regulatory or administrative limit and requires further evaluation, additional measurements, or decontamination of the surface prior to release from radiological controls.

- **Hot Spot—**A location within a radiologically controlled area in which the levels of radiation or contamination are noticeably greater than in the surrounding area.
- **Ionizing Radiation**—Alpha particles, beta particles, gamma rays, neutrons, energetic electrons or protons, and other particles capable of producing ions when interacting with matter.
- **Minimum Detectable Concentration (MDC)**—The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity.
- **Monitoring**-The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.
- **Radiological Controls Technician (RCT)**—An individual who, by virtue of education, experience, or certification, is qualified to perform radiological surveys and implement radiological controls for work activities.
- **Random Measurements**—Radiological measurements performed at randomly selected locations within a facility or survey unit.
- **Scanning**—A type of direct measurement monitoring performed by moving a detector slowly over the surface or area being evaluated.
- **Shine—**Radiation from a source near a measurement location that interferes with a particular environmental measurement. While background is always a part of a gross measurement, in the case where shine is present, the significance and data quality of the measurement may be questionable.
- **Smear Sampling—**A method of determining the removable contamination on a surface. A specified area is wiped with a filter paper, and the radioactivity collected on the paper is measured by portable or laboratory instrumentation. The area smeared is normally $100cm^2$.
- **Survey—**An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation..
- **Survey Unit**—A predefined geographical area, or location within a facility, that forms the boundary for a specific radiological evaluation or survey.
- **Systematic Survey**—Radiological surveys performed at systematically selected fixed measurement or smear sampling locations on a pre-determined sampling grid.
- **Total Contamination—**Radioactive material, including both the fixed and removable contamination fractions, found on, or as a part of, an item or surface.
- **Transferable, Removable, or Loose Contamination—**Radioactive material that can be easily removed from a surface or item.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer (License RSO)

The License RSO is responsible to assess levels of contamination in project work areas and to determine the need for, and periodicity of, surface contamination surveys. The License RSO is also responsible to establish specific requirements for project surface contamination survey including the selection of parameters to be measured, instrumentation, and appropriate data quality objectives. The License RSO shall also establish action levels for surface contamination on project sites.

### 5.3 Project Radiation Safety Officer (Project RSO)

The (Project RSO)is responsible to implement established surface contamination monitoring requirements for a specific project, as established by the License RSO. The Project RSO is responsible to ensure the proper collection and documentation of data on the project site.

### 5.4 Radiological Controls Technicians

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of contamination survey data. This includes performing operational checks on survey instrumentation, collecting and analyzing smear samples, performing measurements, and documenting results in compliance with established procedures and conventions. Site workers are also responsible to properly wear PPE and Anti-Cs and to obey site work rules designed to maintain exposures ALARA.

## 6. PROCEDURE

### 6.1 Prerequisites

Prior to conducting surface contamination surveys, the RCT conducting the survey shall ensure that following prerequisites are met:

- Project-specific radiological survey and data collection requirements, and data quality objectives, are established in written project documents and are understood by the RCTs performing surveys.
- All required survey supplies and material are available for use on-site. These materials include the following:
  - Appropriate smear sample media and smear envelopes
  - Scintillation vials and cocktail (for liquid scintillation analysis)
  - Gloves, appropriate anti-contamination clothing, and other PPE as required based on identified hazards
  - Completed and approved Activity Hazard Analysis for the survey activity to be performed
  - Radiation Work Permit (RWP) prepared and approved in accordance with Shaw E & I Procedure T-RA-010, *Radiological Site Controls* (if entering radiologically controlled areas to perform surveys)

- Radiation/Contamination Survey Report Forms
- Appropriate radiation dosimetry
- Properly calibrated instrumentation or analytical equipment capable of measuring the radiation(s) of interest at, or below, the specified MDA (10-50% of MDA recommended)

- The appropriate survey instrument has been selected and calibrated and is operating properly in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure.*
- The previous surveys of the area of interest have been checked, if available, to determine radiation and contamination types and levels in the areas to be surveyed and to determine whether conditions of safety have changed since the last survey.
- A survey map of the area of interest has been obtained or prepared, using a survey record form, providing a graphical representation of the area or item to be surveyed.
- Appropriate action levels or guideline values have been established, and required actions or reporting requirements are understood by RCTs performing surveys.
- For systematic measurements, appropriate reference and sample grids have been established based on data quality requirements.

### 6.2 Scan Surveys

Scan surveys are generally conducted as an investigative tool to identify areas that require further evaluation by fixed measurement or sampling. These surveys may be quantitative or qualitative with regard to the quality of data collected. Scan surveys shall be conducted as follows:

1. Verify that the instrument has been calibrated and has been set up in accordance with the manufacturer's technical manual, project quality requirements, and Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure,* prior to use.
2. Determine the required scan rate necessary to meet required MDAs based on the contaminant of interest and selected instrument (10-50% of action levels or guideline values is recommended). MDA determination shall be documented in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.
3. With the instrument in operation, at the pre-determined scan rate, move the detector over the surface being evaluated. Using the audible response of the instrument, document instrument readings as required by the survey-specific data quality objectives.
4. "Flag," or mark, any locations or areas that exceed established action levels. Take any required corrective, or protective, action required by project plans and procedures. Levels exceeding these values will also be noted on the survey map(s).

### 6.3 Fixed-Measurement Surveys

Fixed-measurement surveys may include random, systematic, or biased measurement locations. These surveys are performed to provide quantitative measurement of the total contamination on a surface. Fixed-measurement surveys shall be performed as follows:

1. Verify that the instrument has been calibrated and has been set up in accordance with the manufacturer's technical manual, project quality requirements, and Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure,* prior to use.
2. Determine the required measurement count time necessary to meet required MDAs based on the contaminant of interest and selected instrument (10-50% of action levels or guideline values is

recommended). MDA determination shall be documented in accordance with Shaw E & I Procedure T-RA-006, *Radiological Controls Portable Instrument Procedure*.

3. Place the detector directly on the surface to be surveyed at the desired location. With the instrument operating in "Scaler" mode, take a measurement at the selected sample point for the required count time.

4. Document the direct surface contamination reading measured at the location on the survey data forms.

### 6.4 Smear Sampling

Smear sampling surveys may include random, systematic, or biased measurement locations. These samples are performed to provide quantitative measurement of the removable contamination on a surface. Smear sampling shall be performed as follows:

1. Select smear materials based on the type of smear survey being performed and the instrumentation to be used in analysis of radioactive content on the smear samples.

2. If wet smear sampling techniques (some Tritium contamination smears) are required for liquid scintillation analysis, obtain prepared scintillation vials with 3 to 5 milliliters of deionized water added to each vial. Place the unused smears into the prepared vials.

3. For dry smears, place each individual smear into an envelope or small clean plastic bag (smears with individual "fold-over" covers do not require separate envelopes or bags).

4. At each sample point, remove a single smear from its container (if required) and wipe the smear over an area of approximately 100 $cm^2$ by wiping a square area of approximately 4 inches by 4 inches or an "S" pattern approximately 16 inches long.

5. Once the smear sample is collected, quickly place smear into an individual prepped scintillation vial or bag/envelope. For "foldover" type smear, fold the cover in half to cover the sample.

6. Mark the vial, envelope, or "foldover" cover containing the smear with a unique number identifying the sample location and the sample number. Transport the smear sample to the counting station or on-site laboratory for analysis.

### 6.5 Quality Control Measurements/Samples

In order to ensure the level of data quality required by the purpose of the monitoring being performed, quality control measurements and samples will be collected as part of the survey process. Specific requirements for performance, collection, and analysis will be established prior to performing any monitoring activities. The RCT performing each survey will be given instruction regarding the QC sample requirements for the sampling activity being conducted.

### 6.6 Waste Management

Waste streams associated with monitoring and sampling activities include used PPE (tyvek and gloves) and used smears. If not suspected of being contaminated, these items will be disposed of as trash. If radiological contamination is suspected, based on monitoring data, PPE and contaminated smears will be bagged and disposed of as radioactive waste.

## 7. ATTACHMENTS

None

# RADIATION PROTECTION PROCEDURE

**Subject: Bioassay and Internal Exposure Monitoring**

## 1. PURPOSE

The purpose of this procedure is to establish guidelines for the establishment and implementation of bioassay and internal dosimetry programs on field projects involving the potential for exposure to ionizing radiation. This procedure will prescribe the manner in which bioassay programs will be established on projects including assigning responsibilities for establishment and implementation of such programs.

## 2. SCOPE

This procedure provides for standard practice for bioassay and internal dosimetry programs. It provides the minimum required steps and quality checks that employees and subcontractors are to follow in establishing and implementing such programs. The direction provided by this document may be amended to comply with specific client, project, program, or regulatory requirements that are equivalent, or more restrictive, when compared to the requirements of this document.

## 3. REFERENCES

- Shaw E&I Health and Safety Procedure, HS700, *Policy and Guidance for Developing Radiation Protection Plans*
- Code of Federal Regulations, 10 CFR Part 20, *Standards for Protection Against Radiation*
- Code of Federal Regulations, 10 CFR Part 19.12, *Instructions to Workers*
- NUREG-1556, Vol. 18, "Program-Specific Guidance About Service Provider Licenses,' dated November 2000
- NUREG/CR 4884, 1990, *Interpretation of Bioassay Results*
- Shaw E & I Procedure T-RA-008, *External Dosimetry Administration*
- International Commission on Radiological Protection, Publication 30, *Limits on Intakes of Radionuclides by Workers*
- International Commission on Radiological Protection, Publication 54, *Individual Monitoring for Intakes of Radionuclides by Workers*
- US Nuclear Regulatory Commission, NUREG/CR-4884, *Interpretation of Bioassay Measurements*

## 4. DEFINITIONS

- **Action Level**—A predetermined radionuclide concentration that, when reached, requires that a specific, predefined set of follow up protocols go into effect which may include re-analysis of the original sample, collection of additional bioassay samples, and dose assessments.
- **Acute Exposure—**The uptake of a relatively large amount of radioactive material (or exposure to large amounts of ionizing radiation) over a short period of time.

- **ALARA—**An acronym for "As Low As Reasonably Achievable." Making every reasonable effort to maintain exposure to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

- **Annual Limit on Intake (ALI)**—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems or a committed dose equivalent of 50 rems to any individual organ or tissue.

- **Baseline Bioassay—**A bioassay measurement obtained from a bioassay program participant prior to beginning or resuming work with radioactive material. The sample is taken in order to establish a pre-exposure baseline.

- **Bioassay—**The measurement, or assay, of kinds, quantities or concentrations and in some cases, the locations of radioactive materials within an individual worker. Bioassay is generally determined by in vitro methods, such as urine analysis, sampling of other body fluids (such as blood), tissue analysis, or by fecal sample. Bioassay may also be performed by direct (in vivo) measurement using specialized radiation detection equipment.

- **Biological Half-Life—**The time required for any biological system, such as the human body, to eliminate half of its body burden of a radionuclide, or set of nuclides, by natural processes.

- **Body Burden—**The amount of radioactive material which if deposited in the total body will produce the maximum permissible dose rate to the body organ considered the critical organ.

- **Committed Dose Equivalent (CDE)—**The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. Committed dose equivalent is expressed in Rem.

- **Committed Effective Dose Equivalent (CEDE)—**The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues and is expressed in Rem.

- **Derived Air Concentration**—The concentration of a radionuclide in air which, if breathed by an individual for a working year of 2,000 hours, would result in an intake of one ALI.

- **Dosimetry**—The theory and application of the principles and techniques involved in the measurement and recording of radiation dose.

- **Effective Half-Life—**The time required for the amount of a radionuclide deposited in a living organism to be diminished by half as a result of radioactive decay and biological elimination.

- **Intake (or Uptake)—**Radionuclides entering the body by any exposure pathway, primarily by inhalation, absorption, or ingestion means.

- **Investigation Level**—The level of CDE or intake above which the result is regarded to be of sufficient concern to warrant additional investigation. Investigation levels should be established for routine and non-routine monitoring.

- **In Vivo—**"In the living body." For the purposes of an internal dosimetry program, in vivo bioassay measurements are performed by measuring radionuclide body burden within the body using specialized detection instrumentation and monitoring techniques.

- **In Vitro—**"In the glass." For the purposes of an internal dosimetry program, in vitro bioassay measurements are performed by analysis of bodily fluids or tissues removed from the body and analyzed in a laboratory environment.
- **Non-Routine Bioassay—**Any bioassay measurement that is not required to be performed as part of the routine bioassay program requirements, but that is required for confirmation of a suspected intake of radionuclides, to estimate the absorbed dose, or as a result of a known uptake.
- **Project Health Physicist**—An individual who, by virtue of education, certifications, or experience, is qualified to provide planning for, and oversee the proper implementation of, radiological controls measures for work activities involving the potential for exposure to ionizing radiation.
- **Radiation Worker**—An individual who is properly trained, in accordance with the personnel training requirements of 10 CFR 19.12, USDOE Radiation Worker II, or equivalent training, to perform work activities involving the potential for exposure to ionizing radiation.
- **Project Radiation Safety Officer (Project RSO)**—An individual who, by virtue of education, experience, or certification, is qualified for on-site implementation of a project radiological controls program, including providing direction to radiological controls technicians.
- **Recording Level**—The level of committed dose equivalent or intake above which the result is of sufficient interest to be worth keeping and interpreting.
- **Routine Bioassay Sample—**A bioassay measurement taken on a predetermined, periodic schedule, to establish a worker's internal exposure status relative to previous exposure periods.
- **Termination Bioassay Sample**—A bioassay measurement taken at the end of an individual's participation in activities that could result in an intake of radionuclides. This measurement is taken in documenting body burden at cessation of exposure.

## 5. RESPONSIBILITIES

### 5.1 Shaw E&I Safety Director (Safety Director)

The Safety Director will serve as the lead for control of this document. This individual is responsible for ensuring that this document is properly maintained and that its requirements are consistent with applicable regulatory requirements, Shaw corporate policy, and recognized industry practice.

### 5.2 License Radiation Safety Officer

The License Radiation Safety Officer (License RSO) assigned to a project involving potential for worker exposure to radiation or radionuclides is responsible to assess the need for an internal exposure monitoring program for a specific project based on the License RSO's assessment of internal exposure potential. The License RSO is also responsible to establish specific requirements for a project internal exposure monitoring program including the establishment of investigative and action levels.

### 5.3 Project Radiation Safety Officer

The Project Radiation Safety Officer (Project RSO) is responsible to implement the established internal exposure monitoring program for a specific project, as established by the License RSO. The Project RSO is responsible to ensure the proper collection and documentation of bioassay measurements and, if appropriate, DAC-hour exposure data derived from airborne radioactivity concentrations in work areas.

### 5.4 Site Radiation Workers

Site radiation workers are responsible to follow procedures established by the License RSO, or Project RSO, for the collection of bioassay samples. Site workers are also responsible to properly wear respiratory protection equipment and to obey other site work rules designed to maintain internal exposures ALARA. Workers shall report all incidents and unplanned events that could be reasonably expected to result in internal exposure.

## 6. PROCEDURE

Prior to mobilization of field projects involving the potential for internal radiation dose to project personnel, the assigned Project Health Physicist shall determine the need for an internal dosimetry program for the project. The License RSO will also determine specific bioassay requirements consistent with the requirements of this procedure and Shaw Health and Safety Procedure HS700. Any project where workers have the potential to receive an internal dose that equals or exceeds 10% of a regulatory limit shall implement an internal dosimetry program. The following sections describe specific methodologies and requirements that may be included as part of project internal dosimetry programs.

### 6.1 In Vivo Monitoring

In vivo measurements of radionuclide body burden should be performed when practical since such measurements provide a more accurate assay of radioactivity present in the body. This is primarily because some radionuclides of interest may be retained in the body as insoluble compounds that will not appear in analysis of excreta, alone. In some cases, however, in vivo measurements may not be sufficient, or even appropriate. This is the case with some radionuclides, such as Tritium, or some other alpha or beta emitters that cannot be seen due to instrument sensitivity. In vivo measurements are also impractical for measurement of radionuclides with relatively short effective half-lives, due to the limited availability and access to appropriate measurement equipment. In vivo measurement equipment is, in general, only available at major DOE laboratories, along with a few environmental laboratories and university campuses. It is important to identify the availability and accessibility of measurement capability prior to establishing a project-specific program.

When in vivo measurement is appropriate and available, individual baseline measurements shall be performed prior to performance of any work activity that presents the potential for internal exposure. In vivo measurement shall be by whole body analysis conducted in a low background environment. After the baseline analysis, additional analysis shall be performed after termination of the work assignment with exposure potential, or as required by the License RSO.

Non-routine in vivo measurements shall be performed whenever there is a reason to suspect that an employee may have sustained an internal deposition of radioactive material in excess of an administrative or regulatory limit, or if a measurement result exceeds the action level for remeasurement.

### 6.2 In Vitro Bioassay

An in vitro sampling routine shall be established for projects requiring an internal dosimetry program whenever in vivo measurement is deemed impractical or inappropriate, or as a means to augment or verify the effectiveness of in vivo monitoring. Normally, in vitro sampling will be for urine bioassay. In some cases, however, fecal, or other types of samples may be required.

**Note: Universal bloodborne pathogen precautions shall be taken when preparing and handling unsealed bioassay samples. Samples that require invasive procedures such as phlebotomy (blood sampling) shall be performed only by qualified medical personnel.**

All personnel who will perform work that presents any internal exposure potential shall submit a bioassay sample prior to beginning such work, after termination of the work assignment, and as required by the project internal dosimetry program. Additional non-routine samples may be required by the License RSO during work on a project. Instructions regarding the collection of routine and non-routine samples shall be provided to workers prior to collection of samples.

Non-routine bioassay samples shall be requested whenever there is a reason to suspect that an employee may have sustained an internal deposition of radioactive material in excess of an administrative or regulatory limit, or if a bioassay result exceeds the action level for resampling.

### 6.3 Urine Bioassay Collection Instructions

Prior to supplying sample containers to workers for bioassay sample collection, each worker shall be given specific instruction on sample collection procedures and precautions. Most projects requiring internal dosimetry will utilize urine bioassay for data collection. These samples will be collected, prepared, and handled in accordance with the instructions of the analytical laboratory performing the analysis. In general, however, sampling will be conducted in accordance with the following requirements:

- Samples shall include each urine void for a 24-hour sampling period. Minimum acceptable volume for a 24-hour sample should be 1000 mL.
- Samples shall be collected in a clean container, either provided by the laboratory or approved by the License RSO for use.
- Workers shall wash hands carefully prior to each void.
- For baseline samples, no entry into radiologically controlled areas shall be made prior to completion of the sample. For termination samples, no entry into radiologically controlled areas shall be made during, or after completion of, sample collection.
- For non-routine sampling involving personnel contamination incidents, decontamination activities shall be completed prior to voiding.
- Termination samples should be collected at least 36 hours but not more than 96 hours after leaving a project site.
- Urine samples shall be collected and preserved in a manner that minimizes the loss of activity on the walls of the container. For example, uranium urine samples require several drops of 1N nitric acid in the sample bottle prior to sampling. Additional instruction for sample prep will be provided, if required, by the analytical laboratory.
- Unused sample containers shall be maintained in an area that is free from contamination.
- After sample collection, precautions shall be taken to assure the integrity of and prevent leakage from the containers or cross-contamination of the samples.
- Universal bloodborne pathogen precautions shall be used when handling unsealed samples.

If a non-Urine routine bioassay sample is required, based on radionuclides of concern or other constraints, a written collection procedure will be established prior to collection of any samples.

### 6.4 Sample Documentation

The on-site Project RSO, or a designee, shall assign control numbers to the bioassay samples as they are received. The control numbers shall be in sequential order and documented.

Bioassay samples shall be documented and controlled in accordance with the chain-of-custody requirements of the analyzing laboratory. Additionally, bioassay samples shall be documented using a project-specific data form. This form shall include the following information:

- The project name and number.
- Quantity Shipped: Total number of bioassay samples shipped, use additional forms, as necessary.
- The date samples were shipped to the lab and the method used (e.g. UPS, Fed Ex, etc.).
- Special Instructions: Indicate any comments or instructions deemed necessary for completeness. Identify any samples that are suspected of being highly contaminated.
- Employee Name: Include the full name of each individual.
- Employee Social Security Number: Include the social security number of each individual.
- Control Number: Include the bioassay sample control number as recorded from the log.
- Date Collected: The date the bioassay sample was collected.

  **NOTE: Samples should not be held for shipment greater than five (5) working days without chemical preservation**
- Collection Time: Provide the time that sample collection started and stopped. Urine samples should include the first void of the day.
- Analyses Requested: Refer to the purchase requisition, which should state the contractual requirements. Add any additional information, as necessary.
- Sample Type: List the type of bioassay sample collected.
  - UR = urine
  - FC = feces
  - NS = nasal swipe
  - OT = other (specify, e.g. wound, eye, ear, sputum)
- Purpose: List the reason for collecting the sample.
  - IN = initial sample
  - FN = final sample
  - RT = routine
  - RS = resample
  - SP = special sample (incident report may be required)

### 6.5 Quality Control

Each batch of urine samples should be analyzed concurrently with at least two control urine specimens (one blank and one spike). Blank control samples should be prepared on site and shipped with the batch of samples. Spike samples should be prepared in the laboratory.

The analytical laboratory shall perform the Quality Control (QC) checks and shall report the results of these QC analyses along with the other sample results.

If the average deviation (actual-reported/actual) for the spiked samples that accompany a particular batch is less than 0.7, this batch of samples shall be rerun.

If the repeat analysis does not meet the above criteria, an investigation of the procedures for spiking and the procedures for laboratory analyses shall be made.

### 6.6 Laboratory Results

The analytical laboratory should complete and report results of routine analysis within the turn-around-time (TAT) specified by the License RSO and identified on the laboratory chain of custody form. Results exceeding preset action levels should be reported by telephone to the on-site Project RSO or License RSO as soon as they are identified.

Results shall be evaluated against predefined recording and investigation levels in order to determine the need for additional analysis or assessment of internal dose. Results above investigation level shall be reported to, and evaluated by, the License RSO.

### 6.7 Recording Levels and Investigation Levels

Results of the bioassay program are used to evaluate dose due to internal deposition of radionuclides. Results must be evaluated against pre-established levels to ensure the proper management of internal dose based on administrative and regulatory limits. As part of development of an internal dosimetry program, the License RSO shall derive radionuclide-specific Recording Levels and Investigation Levels that are appropriate for contaminants of interest.

Data indicating intake at or above established Investigation Levels shall be investigated to determine the cause and to prevent the recurrence in keeping with the ALARA principle.

### 6.8 Non-Routine Bioassay

Whenever an intake is suspected that may result in internal dose above administrative control levels or regulatory limits, prompt bioassay follow-up is required. Such an intake shall be suspected if any of the following criteria are exceeded:

- Exposure to airborne radioactivity is greater than or equal to 1 DAC-hour in an 8-hour shift.

  **NOTE: If a person is wearing respiratory protection, the appropriate Protection Factor (PF) will be applied to the exposure to determine if it equalled or exceeded 1 DAC-hour.**

- Personnel contamination on skin or clothing is greater than or equal to 1000 dpm/100 $cm^2$ alpha contamination or greater than or equal to 5000 dpm/100 $cm^2$ beta-gamma contamination.
- Measurable nasal or saliva contamination.
- Any wound that occurs within a contaminated area.
- A routine bioassay measurement in excess of the investigation limit.
- At the discretion of the License RSO.

When any of the above conditions are met, the on-site Project RSO or License RSO shall perform and document, or ensure the performance and documentation of, additional in-vitro and/or in-vivo bioassay measurements necessary to document internal dose, and to ensure that the intake is not ongoing. The Project RSO shall identify potential uptakes that occur in the workplace under his or her area of responsibility.

## 7. ATTACHMENTS

None

# APPENDIX D

## *ENVIRONMENTAL PROTECTION PLAN*

*DRAFT*

# ENVIRONMENTAL PROTECTION PLAN

## **TIME** CRITICAL **REMOVAL ACTION**

FORMER NAVAL STATION PUGET SOUND SEATTLE, WASHINGTON

CONTRACT NUMBER N62470-08-D-1007

**Prepared for:**
**U.S. Department of the Navy**
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315

**Prepared by:**
**Shaw Environmental and Infrastructure, Inc.**
12100 NE 195th Street
Bothell, Washington 98296

TASK ORDER FNZ4
SHAW PROJECT NO. 137165

JANUARY 2010

# Table of Contents



# List of Tables

# List of Acronyms and Abbreviations

| | |
|---|---|
| CHP | Certified Health Physicist |
| TO | Task Order |
| EPP | Environmental Protection Plan |
| HAZMAT | hazardous material |
| Navy | United States Department of the Navy |
| NTR | Navy Technical Representative |
| $^{226}$Ra | Radium-226 |
| RASO | Radiological Affairs Support Office |
| Shaw | Shaw Environmental and Infrastructure, Inc. |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| TCP | Traffic Control Plan |
| TCRA | Time Critical Removal Action |

# Environmental Protection Plan

## Time Critical Removal Action
## Former Naval Station Puget Sound
## Seattle, Washington

# Signature Sheet

______________________________ ____________________
Patrick T. Moore, CIH CSP Date
Shaw Project Health and Safety Manager

______________________________ ____________________
Chris Generous, L.G. Date
Shaw Project Manager

______________________________ ____________________
Jim Langsted, CHP Date
Radiation Safety Officer

# *1.0 BACKGROUND INFORMATION*

This Environmental Protection Plan (EPP) has been prepared by Shaw Environmental and Infrastructure, Inc. (Shaw) under Contract Number N62470-08-D-1007, Task Order (TO) FNZ4 to address abatement, control, and mitigation measures necessary to protect the environment while conducting work associated with performing radiological surveys and time critical removal action (TCRA) of identified radiologically impacted areas at the former Naval Station Puget Sound, Seattle, Washington.

The procedures and guidelines contained herein were based upon the best available information at the time of the EPP preparation. Specific requirements may be revised if new information is received or conditions change. Written amendments will document any changes made to the EPP and will be included as an addendum to the EPP.

## 1.1 SITE LOCATION, DESCRIPTION AND HISTORY

This information is provided in Section 1 of the project Work Plan.

## 1.2 PROJECT OBJECTIVES

The primary objective of this project is to conduct radiological characterization surveys, TCRA and final status surveys to address radiological contamination identified in building materials, and associated sewer and storm drain lines for Building 27 and Building 2 to support timely renovation of the buildings for the recreational purposes.

## 1.3 ENVIRONMENTAL PROTECTION SCOPE

For the purposes of this scope of work, environmental protection is defined as maintenance of the environment in its natural state and the enhancement and/or restoration of the appearance of disturbed sites after completion of work. To accomplish environmental protection, consideration will be given to air, land, and water resources, including management of visual aesthetics; natural, historical, and archeological resources; noise; and liquid and solid wastes as well as other pollutants. Work will be performed in a manner that minimizes the pollution of air, land, and water resources and that complies with federal, state, and local regulations.

The following sections discuss protection of air resources, protection of surface water and groundwater resources, protection of land and archeological resources, and traffic control.

# 2.0 *PROTECTION OF AIR RESOURCES*

On-site work activities will be conducted in a manner that minimizes the release of airborne particulates. The principal air resource concerns for the work to be performed involve controlling dust, lead particles, asbestos and radiological contaminants from remediation activities.

## 2.1 DUST CONTROL

On-site work activities associated with this TO may result in the release of respirable dust particulates. The work procedures will be designed to control, prevent, and minimize these releases. Dust suppression will be implemented at the direction of the site supervisor to control observed dust emissions or as a preventative measure based on observation of radiological survey and remediation conditions and ambient weather conditions. Fugitive dust emissions generated during radiological activities will be controlled by spraying water from a water truck, water trailer, or nearby fire hydrant if needed. At the end of each workday, the work areas will be swept or washed as appropriate to minimize the potential for fugitive dust emission during evening hours. Care will be taken to control over spraying and to minimize discharge of dust control spray water to the storm drain system.

## 2.2 BURNING

Hot Work permits are not anticipated for the planned surveys and removal activities. Any other work requiring an open flame or posing a potential fire hazard will be coordinated with the Navy Technical Representative (NTR), Seattle Parks and Recreation Representative, and the Seattle Fire Department as appropriate and necessary permits will be obtained.

## 2.3 NOISE

Project personnel will comply with the Occupational Safety and Health Administration and applicable local noise standards. Equipment operators, contractors, and other personnel will be required to wear appropriate hearing protection when necessary as described in the Site Safety and Health Plan (SSHP).

# *3.0 PROTECTION OF SURFACE WATER RESOURCES*

Activities associated with this TO will be conducted to prevent the discharge of pollutants and minimize the impact to water resources within and outside the radiological area boundaries.

On-site work activities will be conducted in compliance with all appropriate federal, state, and local laws regarding potential and actual contamination of surface water. In addition, activities shall be performed in a manner that prevents the discharge of pollutants into any existing waterways.

Spill prevention measures, stormwater management, and spill response are discussed below. Additional spill prevention and response procedures are provided in Section 9.10 of the SSHP.

Specific plans for handling stormwater and sewer diversions will be prepared by the appropriate contractor(s) prior to beginning work, and will be approved by the United States Department of the Navy (Navy) Radiological Affairs Support Office (RASO).

## 3.1 SPILL PREVENTION MEASURES

During this TO, the types of liquids that could potentially result in spills and discharges include equipment decontamination water, pipe cleaning rinsate, sewage, and fuel during equipment refueling. The spill prevention measures noted below will apply during the handling and transfer of these liquids.

- Equipment decontamination will occur in a lined and bermed area designated specifically for decontamination. The location of this area will be coordinated with the Navy's radiological support contractor.
- Water from equipment decontamination, stormwater sampling, flushing of sanitary sewer and stormwater pipes, and pressure washing of the pump houses will be stored in Department of Transportation-approved drums or tanks within lined, bermed areas.
- Equipment refueling will be conducted off site if feasible. On-site refueling, if conducted, will only occur on a paved surface with no open stormwater drains nearby. The task-related site supervisor will designate an on-site staff person to observe the refueling operation and initiate the spill response procedures discussed in Section 4.4 as necessary.

## 3.2 SANITARY SEWER AND STORMWATER BYPASS

During radiological surveys of the potentially impacted sanitary sewer and stormwater systems, Shaw plans to bypass the sections involved with the survey to other active drain locations, or in the case of stormwater, to Manhole No. 160. This bypass will be accomplished using flexible hoses placed on bermed tarps to capture any potential leakage. The bypass equipment will be checked on a regular basis for any leakage and berm materials will be checked to ensure they are in good condition. The radiological surveys will be conducted in three phases for each system surveyed, as described below. Figure 5 of the Work Plan presents the locations of pump houses and sewer/storm drain lines.

### *3.2.1 Stormwater System Radiological Survey*

The stormwater system to be surveyed runs southeast to northwest from Building 27 and discharges into Lake Washington. The radiological survey will be conducted in three phases with appropriate environmental protections as follows:

- **Phase 1 – Stormwater pipe bypass and characterization survey of stormwater piping.** In order to provide access to the survey area, stormwater flow will be diverted beginning at Manhole No. 136 in Building 27 and bypassing the remaining stormwater pipe, reconnecting at Manhole No. 160 prior to discharge into Lake Washington. A baseline sample of the stormwater discharge will be taken at the Building 27 manhole. The sample will be analyzed for sheen, copper, zinc, turbidity, and pH. The stormwater will be diverted via flexible piping placed on bermed plastic sheeting. The piping included in the survey area will then be surveyed for the presence of Radium-226 ($^{226}Ra$).
- **Phase 2 – Camera survey.** If the presence of radiological contamination is confirmed by the radiological survey, a camera survey of the storm line may be conducted, and sediment samples may be collected for analysis.
- **Phase 3 – Power washing of stormwater pipe.** If the presence of contaminated sediments is verified, the stormwater system may be power washed and the resultant wash water collected in such a manner as to prevent leakage or spilling. This water will be containerized, characterized, and disposed of according to applicable state and federal regulations. Any necessary permits will be obtained prior to disposal. A final radiological survey will be conducted following power washing.

### *3.2.2 Inactive Pressurized Sewer Line Survey*

The inactive pressurized sewer line runs from Pump House 117, which is east of Building 27, west to the western side of Building 27, and then northwest to Pump House 98 (inactive pump house at old sewerage treatment plant). The radiological survey for this line will also be conducted in three phases, with potentially the inclusion of power washing of the pump houses, as described below.

- **Phase 1 – Sewer line bypass and characterization survey of sewer line.** Since this sewer line is inactive, bypass is unnecessary. However, it is likely that the line contains standing water and may need to be drained prior to conducting the characterization survey. The ends of sewer pipe and pump houses will be surveyed for the presence of $^{226}Ra$.

- **Phase 2 – Camera survey if indicated by radiological survey results.** If the presence of radiological areas is confirmed by the survey, a camera survey of the piping may be conducted and sediment samples may be collected for analysis.
- **Phase 3 – Power washing of Pump Houses 117 and 98, and potentially of inactive sewer line.** If the presence of contaminated sediments is confirmed by the above surveys, the pump houses and sewer line may be power washed and the resultant wash water containerized, characterized, and disposed of according to applicable state and federal regulations. Any necessary permits will be obtained prior to disposal. A final radiological survey will be conducted following power washing.

### *3.2.3 Gravity Flow Sewer Line Survey*

The active gravity flow sewer line survey area runs from east of Building 27 to the building's west side, then northwest and north to Pump House 116, which is south of the Lake Washington shoreline.

- **Phase 1 – Sewer line bypass and characterization survey of sewer line.** Since the gravity flow sewer line is an active line, sequential bypass of sections of the pipe within the survey area will be accomplished either by transferring the sewage periodically with a vacuum truck or by blocking sewer flow at one manhole and diverting it to the next with flexible piping placed on bermed plastic sheeting. Depending on sewage volumes, it may also be prudent to schedule the work during periods of low use (possibly weekends). Once the bypass is in place, a radiological survey will then be conducted for the section of pipe between manholes. This process will be repeated to accomplish survey of the pipe within the survey area, concluding with Pump House 116 – which is a sewer lift station.
- **Phase 2 – Camera survey if indicated by radiological survey results.** If the presence of radiological areas is confirmed by the survey, a camera survey of the piping may be conducted and sediment samples may be collected for analysis.
- **Phase 3 – Power washing of Pump House 116.** If the presence of $^{226}$Ra is confirmed, the pump house may be power washed and the resultant wash water containerized, characterized, and disposed of or discharged to the sewer according to applicable state and federal regulations. Any necessary permits will be obtained prior to disposal. A final radiological survey will be conducted following power washing.

## 3.3 STORMWATER MANAGEMENT

Surveys, TCRA and meteorological conditions may require measures to control, contain, collect, and discharge liquids (for example, stormwater, and cleaning rinsates) to prevent the discharge of impacted waters to storm drains, drainage channels, uncontrolled sheet flow, or other discharge directly or indirectly to Lake Washington. Specific measures are summarized below.

- During precipitation events, rainwater may accumulate within bermed and lined material staging areas. The accumulated water will be visually assessed for evidence of contamination such as the presence of a surface sheen. If there is no indication of contamination, the water will be drained to the nearby surface. However, if contamination is identified, the water will be pumped into drums or a polyethylene tank and stored with other waste liquids for characterization and disposal.

- Established decontamination areas already constructed with berms and liners will be inspected during the precipitation event to remove excess water as necessary. Because the decontamination area might contain site contaminants, this water will be pumped to drums or a polyethylene tank and stored with other waste liquids for characterization and disposal.

## 3.4 SPILL RESPONSE

Spill response will be conducted in accordance with Section 9.10 of the SSHP, Attachment 3 of the Accident Prevention Plan. The following equipment and materials will be used during spill response activities as appropriate to the size and type of spill:

- Absorbent pads,
- Granular absorbent material (noncombustible),
- Polyethylene sheeting,
- 55-gallon drums,
- Shovels and assorted hand tools.

If a hazardous waste spill or material release to the air, soil, or water during the work activities is observed, project personnel will immediately notify the Site Safety and Health Officer (SSHO). The appropriate regulatory agency will be contacted, depending on the release, including Washington State Department of Ecology, Puget Sound Clean Air Agency, United States Environmental Protection Agency, and/or the City of Seattle Fire Department or Hazardous Materials (HAZMAT) unit (Table 3-4). An assessment will be made of the magnitude and potential impact of the release. Project personnel will not engage in any spill control operations involving unknown chemical, biological, or radioactive agents. As such and if it is safe to do so, qualified personnel will attempt to locate the source of the release, prevent further release, and contain the spilled materials as summarized below:

- The spill area will be approached cautiously from upwind. Air monitoring instruments will be used to assess breathing zone hazards during spill response activities. Hazards will be identified based on available information from witnesses or from material identification documents(such as placards, MSDSs, logbooks). to determine the proper personal protection levels, methods, and equipment necessary for the response.
- If necessary, the release area will be evacuated, isolated, and secured.

- The spill will be immediately controlled at the source by shutting off pumps, plugging or closing valves, righting containers or drums, or transferring contents of leaking tanks or drums.
- If fuel is spilled, project personnel will impose a 50-foot-radius rule, and all sources of ignition will be eliminated.
- If possible, spill containment initially will be made without entering the immediate release area.
- Spill containment and collection will be performed by using absorbent materials and constructing temporary dikes.
- Spills within a radiologically impacted area will be contained as noted above, and then disposal options will be assessed in coordination with the NTR, RASO, and with the Navy's radiological support contractor.

***Table 3-4***

***Spill Phone Numbers***

| Contact | Phone Number |
|---|---|
| Spill Phone Numbers (all 3 must be called) | 24-hour numbers |
| 1. National Response Center | (800) 424-8802 |
| 2. Washington Emergency Management Division | (800) 258-5990 |
| 3. Washington State Department of Ecology – NW Regional Office | (425) 649-7000 |
| Additional Emergency Numbers | |
| Seattle Fire/ Police Department Emergency | 911 (from land line) |
| Seattle HAZMAT Response Emergency | 911 (from land line) |
| Key Project and Shaw Personnel | |
| Project Manager:<br>Chris Generous | (425) 402-3208 office<br>(425) 971-4801 cellular |
| Radiation Safety Officer Certified Health Physicist (CHP):<br>Jim Langsted | (720) 554-8182 office<br>(303) 870-2802 cellular |
| Project Site Supervisor or Subcontractor | TBD |
| SSHO:<br>Patrick Moore | (425) 402-3222 office<br>(206) 478-6464 cellular |
| Navy Remedial Project Manager:<br>Justin Peach | (360) 396-0082 office<br>(360) 535-4594 cellular |
| NTR: Brian Cullen | (360) 396-0083 office |

*HAZMAT denotes hazardous material*

.

# *4.0 PROTECTION OF LAND AND ARCHEOLOGICAL RESOURCES*

On-site work activities will be coordinated with the NTR, in order to minimize impact to land resources. No structure(s) or artifact(s) of historical importance have been identified within the initially planned work areas and none are expected to be found given the area consists of fill materials.

If an area is identified that requires special protection, the area will be marked and surrounded by fencing, barriers, or other physical protection. Steps will be taken to protect vegetation, landscape, and other facility elements near any planned construction. Materials temporarily moved during surveys or the TCRA (for example, active utilities, property-line or security fencing, and Caretaker Site Office-identified facility elements) will be restored “in kind” unless otherwise directed by the Navy. Facilities such as sidewalks, curbing, and fences will be restored to original alignments unless otherwise directed by the Navy. Photographs of pre- and post-construction conditions will be taken to show the groundwater plume treatment areas.

Any potential structure(s) or artifact(s) of historical interest discovered during field activities will be carefully preserved in an undisturbed state. The site supervisor will immediately report any findings to the NTR and the Seattle Parks and Recreation representative so that proper authorities may be notified.

# 5.0 *TRAFFIC CONTROL*

A Traffic Control Plan (TCP) shall be submitted to the NTR, before field work begins. Traffic control measures are expected to be minimal, since the survey will not take place in a public right-of-way. Traffic-oriented issues associated with parking areas will be discussed and resolved with the appropriate parties before work begins. Modifications to the TCP will be coordinated with the Navy. The following parties will be notified at least 3 working days before any planned closure or when a construction detour is implemented:

- Seattle Fire Department,
- City of Seattle.

The traffic controls (for example, detours, markers, and signs) will be positioned as needed before field work begins. Striping, pavement markings, and signage altered during construction will be replaced and conform to and be "in kind" with existing controls.

# *6.0 REFERENCES*

Department of the Navy, Scope of Work, Contract N62470-08-D-1007, PTO XX24, Cleanup Action at Former Naval Station Puget Sound, Washington; Naval Facilities Engineering Command Southwest.

Shaw Environmental & Infrastructure, Inc., 2009, *Health and Safety Policies and Procedures Manual*.

U.S. Army Corps of Engineers, 2008, *Safety and Health Requirements Manual EM 385-1-1*.

Washington Department of Ecology, 2009, Industrial Stormwater General Permit, an NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated with Industrial Activities, October.

# APPENDIX E

## *PROGRAM QUALITY CONTROL PLAN ADDENDUM*

*DRAFT*
# PROGRAM QUALITY CONTROL PLAN ADDENDUM

## TIME CRITICAL REMOVAL ACTION
## FORMAL NAVAL STATION PUGET SOUND
## SEATTLE, WASHINGTON

CONTRACT NO. N62470-08-D-1007

**Prepared for:**
**U.S. Department of the Navy**
Naval Facilities Engineering Command Northwest
1101 Tautog Circle, Suite 203
Silverdale, Washington 98315

**Prepared by:**
**Shaw Environmental and Infrastructure, Inc.**
12100 NE 195th Street
Bothell, Washington 98296

TASK ORDER FNZ4
SHAW PROJECT NO. 137165

JANUARY 2010

# Program Quality Control Plan Addendum

## Time Critical Removal Action
## Former Naval Station Puget Sound
## Seattle, Washington

# Signature Sheet

| | |
|---|---|
| ____________________________________ | __________________ |
| Ernie Duke<br>Program QC Manager | Date |
| ____________________________________ | __________________ |
| Chris Generous<br>Project Manager | Date |
| ____________________________________ | __________________ |
| Jim Dunn<br>Program Manager | Date |

# TABLE OF CONTENTS



## FIGURES



## EXHIBITS

# *STATEMENT OF QC PROGRAM*

This Site Specific Addendum to the Program Quality Control Plan (PQCP) is prepared and submitted for the removal of radiological contamination identified in building materials, sewer and storm drain lines, and pump houses associated with Building 27 and Building 2 at Former Naval Station Puget Sound (NAVSTA PS) Seattle, Washington, CTO F ZN4. This plan incorporates methods and procedures from the PQCP approved by the Naval Facilities Engineering Command (NAVFAC). The PQCP was developed specifically to be responsive to the Contract Specification, Contract No. N62470-08-D-1007, NAVFAC. Shaw Environmental & Infrastructure, Inc (Shaw) will perform the inspections and tests required to ensure that materials, workmanship, and construction conform to drawings, specifications, and contract requirements.

<u>Note to Employees – Concept of Quality Control</u>

Quality control should not be considered a person or an organization of personnel, but a concept to perform in such a manner that the end product of our efforts provides a quality product and customer satisfaction. The quality control individual or group cannot inspect quality into the final product, but only inspect and document the results of our efforts. The only people that can build quality into the product are the individuals performing the task of producing the end product.

It should be noted by all employees that the documentation requirements of Shaw procedures, plans, and the Task Order Specifications are considered equally as important as the end product itself. When it is stated that the documentation will be approved prior to the start of work, this is exactly what is intended. To eliminate problems in this area requires careful planning and execution by everyone.

We would do well to remember that our livelihood depends on how well we satisfy our customer. To accomplish this requires teamwork and attention to detail by all employees and contractors.

## *I. QUALITY CONTROL ORGANIZATION*

The Site Quality Control (QC) Manager will have the authority to implement and manage this Site Specific QC Plan (QCP), the three phases of quality control and the authority to stop work, which is not in compliance with the contract.

The Site QC Manager for this task order will be Patrick Moore of Shaw.

Mr. Moore will be responsible for the QCP implementation and quality reporting for this task order. He will work closely with the site personnel and the Project Manager, Mr. Chris Generous, but will report directly to Mr. Ernest Duke, Program QC Manager regarding QC related issues on the site.

Mr. Duke, Program QC Manager will serve to resolve any QC related issues, which need his involvement. The Site QC Manager will have a direct line of communication to the Program QC Manager on QC issues.

An Alternate QC Specialist may be assigned to assist Mr. Moore during site construction. The resume of this person and appointment letter will be submitted for approval.

The relationship between the QC Organization, and Production Personnel of the Task Order, is presented in the Organizational Chart, Figure I-1.

## *II. IDENTIFICATION OF PERSONNEL ASSIGNED TO THE QC ORGANIZATION*

The resumes of the Site QC Manager are incorporated into this PQCP Addendum as Figure II-1

## *III. APPOINTMENT LETTERS*

The Site QC Manager Appointment letter is provided as Figure III-1.

## *IV. OUTSIDE ORGANIZATIONS*

A list of outside organizations such as subcontractors employed by Shaw for work under this task order is provided in Exhibit IV-1. This list provides each firm's name and address and a description of the services each firm will provide. This list will be maintained current and will be available for review.

## *V. INITIAL SUBMITTAL REGISTER & REVIEWER*

### V.1 Submittal Register

The Initial Submittal Register is provided as Exhibit V-1. The status of each submittal will be recorded as changes occur.

### V.2 Personnel Authorized to Review and Certify Submittals

The Project QC Manager is responsible for the management of the submittal process. The final review and certification for submittals requiring Government approval and the final review and approval for submittals requiring contractor approval is to be performed by the QC Manager. Other personnel authorized to review and certify submittals are identified on Exhibit V-2. Any additional personnel assigned to perform submittal review and certification must be approved by the Contracting Officer prior to performance.

## *VI. TESTING LABORATORY ACCREDITATION*

Testing laboratory accreditation is fully described in Appendix F of the Work Plan and will be provided as a submittal prior to sampling.

## *VII. TESTING PLAN PREPARATION*

A Testing Plan has been prepared for this task order and is provided as Exhibit VII-1.

## *VIII. REWORK ITEMS*

Rework Items will be documented on the Daily Contractor QC Report and on the Rework Items List. This will be used to report and track Rework Items and is provided as Exhibit VIII-1.

## *IX. DOCUMENTATION PROCEDURES*

The Daily Contractor Production Report form and the Daily Contractor QC Report form will be used to document daily activities at the site. These reports will be completed on a daily basis and submitted to the Contracting Officer Representative.

## *X. QUALITY CONTROL INSPECTION PLAN*

The Quality Control Inspection Plan, Exhibit X-1, lists the task order Work Plan section and definable feature of work with provisions for recording the corresponding checklist/report for each phase of the three-phase control process. As each control phase is satisfactorily preformed, the Site QC Manager will record the corresponding report number and date.

Exhibit X-2 provides the Technical Lead Matrix for the Definable features of Work. The person identified will take the lead for the definable feature of work and be responsible for presenting the technical information and initial review of the work for completion of the task as required. The QC Manager will assist the Technical Lead with the Preparatory and Initial Inspections for each definable feature and document the results on the Daily QC Report. The QC Manager will conduct the follow-up phase inspections to verify and document on a daily basis that on-going work is in compliance with the contract requirements and that the quality of workmanship is maintained as discussed in the Preparatory Meeting and reviewed during the Initial Inspection.

## *XI. PERSONNEL MATRIX*

The personnel matrix, Exhibit XI-1, shows each section of the Task Order Work Plan sections with identification of who will review and certify submittals, who will perform and document the three phases of control, and who will perform and document testing.

1 # FIGURES

**FIGURE I-1**
**QC ORGANIZATIONAL RELATIONSHIP WITH PRODUCTION PERSONNEL**

**SHAW ENVIRONMENTAL & INFRASTRUCTURE, INC.**
**TASK ORDER NO. FNZ4**

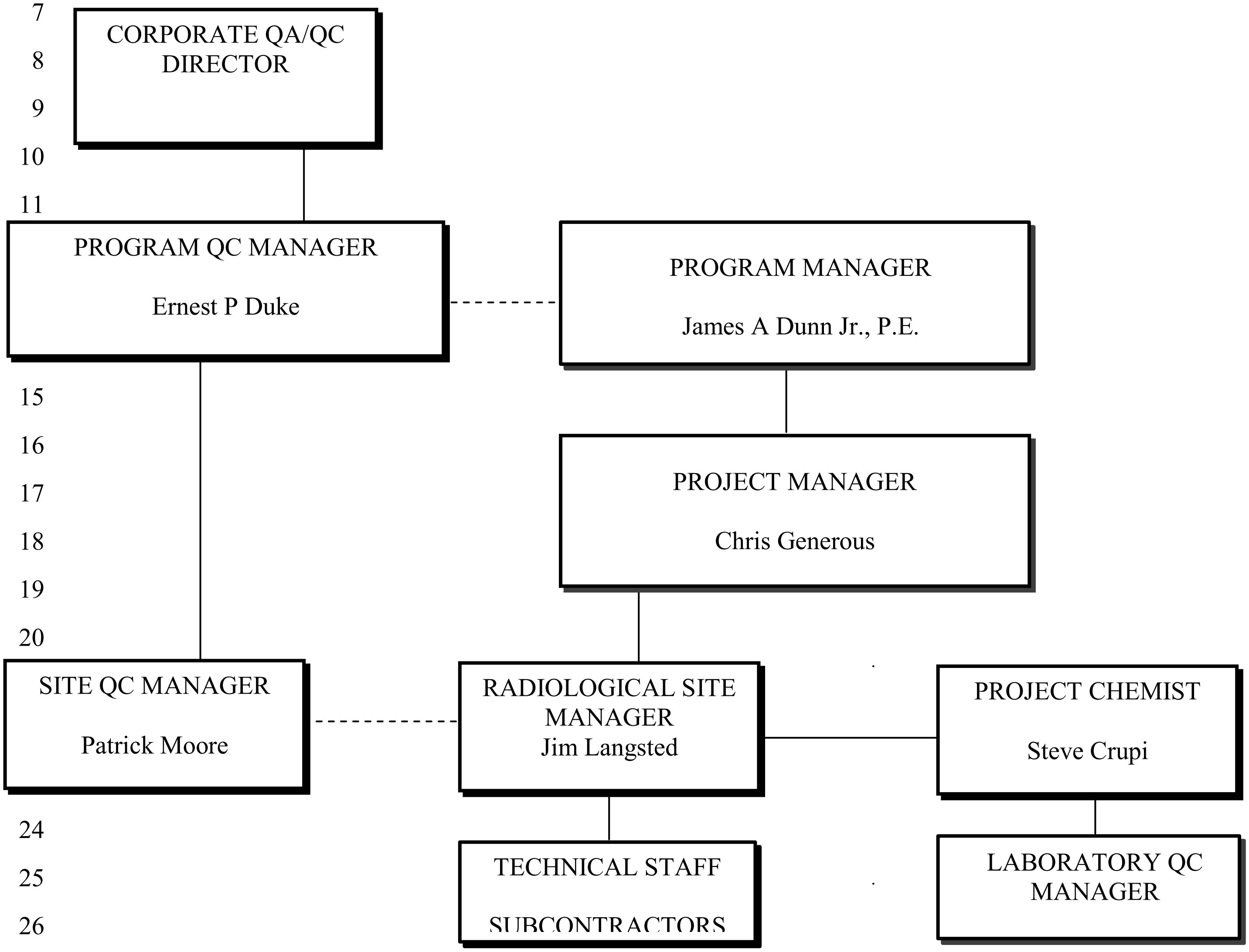


**FIGURE II-1**
**SITE QC MANAGER RESUME**

# Patrick T. Moore, C.I.H., C.S.P.

## Professional Qualifications

Mr. Moore is a Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP) with 15 years of extensive health and safety experience involving general industry, construction, demolition, hazardous waste site remediation operations, and radiation protection.

Often while performing his duties as a health and safety officer Mr. Moore has also provided quality assurance and control services in regards to hazardous waste site remediation operations. These duties included overseeing project training requirements, field equipment calibration and maintenance, and adherence to sampling and analytical standard operating procedures.

## Education

M.S., Industrial Hygiene and Safety, University of Washington; 1998
B.S., Environmental Health, University of Washington; 1995

## Registrations/Certifications

Certified Industrial Hygienist (CIH): No. 8193, 2001
Certified Safety Professional (CSP): No. 19618, 2007
Asbestos Building Inspector, AHERA Certification No. 1025143
Radon Residential Measurement Provider certification: No. 104181 RT
Radiation Protection Technologist: 1990 (lapsed)
OSHA General Industry Outreach Trainer: 1997 (lapsed)

***Additional training:***
BSI 18001 – Occupational Health and Safety Assessment Series
OSHA 40-Hour Health and Safety Training
Annual OSHA 8-Hour Health and Safety Refresher
Radioactive Materials Training Course
Spirometry Training for Worker Screening

## Experience and Background

***7/98 - Present***

*Industrial Hygiene and Safety Specialist, Shaw Environmental, Inc. (formerly IT Corporation, formerly EMCON), Bothell, Washington*
Mr. Moore currently serves as the regional Health and Safety Representative for the Shaw E&I Commercial Services Business Line. Mr. Moore is responsible for developing project-specific health and safety plans, allocating of health and safety resources to commercial projects, continuous development and improvement of the zero accident program, facilitating

commercial services business line safety councils, assisting in writing and reviewing company policies, providing leadership in motivational factors in safety, guiding business line managers and other line managers in safety leadership qualities, and developing tactical training programs for the business line.

He has also provided on-site contract health and safety support services to various companies and industries both within the United States and abroad. Mr. Moore has participated in multiple health and safety compliance and management system audits of various companies and industries, including aircraft manufacturing and repair, oil and gas production, chemical laboratories, semiconductor manufacturing, railway transportation, and the forest industry.

***4/97 – 7/97***
***Study Coordinator, Washington State Department of Labor & Industry, Spokane, Washington***

***6/95 – 4/97***
***Industrial Hygienist, Health Risk Associates, Seattle, Washington***

***6/94 – 9/94***
***Environmental Health Specialist Intern, Skagit County Health Department, Mount Vernon, Washington***

***2/89 – 9/92***
***Occupational Health & Safety Technologist, Chem Nuclear Geotech, Inc., Grand Junction, Colorado***

***9/82 – 9/88***
***Engineering Laboratory Technician, US Navy, Honolulu, Hawaii***

## Professional Affiliations

American Industrial Hygiene Association
National Environmental Health Association
National Registry of Radiation Protection Technologists

## Presentations/Publications

*Aluminum Potroom Exposures Assessed Through the Use of Continuous Reading Monitors*, Northwest Occupational Health Conference.

## FIGURE III-1
## SITE QC MANAGER/REPRESENTATIVE – LETTER OF APPOINTMENT

Shaw Environmental and Infrastructure, Inc.
12100 NE 195th Street, Suite 150
Bothell, Washington 98011

RE: Site QC Manager
Contract N62470-08-D-1007
Task Order FNZ4, NAVSTA PS

Dear Mr. Moore:

This letter will serve as your appointment as the Site Quality Control Manager on the referenced project and will also clarify your duties and authority in this position. In this position, you will be authorized to use available resources to satisfy all applicable requirements of the Program and Task Order Quality Control Plans.

This authorization specifically gives you the authority to direct removal and replacement or correction of nonconforming materials or work and stop work authority when continuation would be unsafe to personnel, harmful to the environment, or result in a significant degradation of quality.

You will be expected to work closely with the Project Manager and other project personnel, but you will not be directly responsible to anyone but me for resolution of quality issues when working in the capacity of Quality Control Manager.

If you have any question in this matter, please contact me at 412 601-1086 or at Ernie.Duke@Shawgrp.com.

Respectfully,

Ernest P. Duke
Program QC Manager
NAVFAC RAC Program

# EXHIBITS

# EXHIBIT IV-1

## APPROVED CONSULTANT AND SUBCONTRACTOR LIST
## Shaw Environmental & Infrastructure, Inc.
## Naval Station Puget Sound Time Critical Removal Action

| COMPANY NAME AND ADDRESS | DESCRIPTION OF SERVICES PROVIDED |
|---|---|
| TBD | Analytical Services |
| TBD | Radiological Services |
| TBD | Utility Surveying |
| TBD | Site Contractor Services |
| TBD | Asbestos Abatement Contractor |
| TBD | Roofing Contractor |
| TBD | Lead-Based Paint Abatement Contractor |
| TBD | Transportation & Disposal Services |
| Test America | RAD Laboratory Work |

# EXHIBIT V-1

## SUBMITTAL REGISTER

| Contract No. N62470-08-D-1007 | | | | | | Project No. 137165<br>Project Title: NAVSTA PS TCRA | | | | | | | Revision No. 01<br>Shaw Environmental & Infrastructure, Inc. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Contractor Action | | | Approving Authority | | | | | |
| Spec. Sect. | SD Number and Submittal Description | Spec Paragraph Number | Approving Authority | Other Reviewers | Transmittal Control No. | Planned Submittal Date | Action Code | Date of Action | Date Forwarded to Appr Auth/ from Contr | Date Forward to Other Reviewer | Date Rcvd from Other Reviewer | Action Code | Date of Action | Date Rcvd from Appr Auth | Remarks |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) | (n) | (o) | (p) |
| | | | | | | | | | | | | | | | |
| N/A | Project Work Plan | | G | | | 1/15/2010 | | | | | | | | | |
| Apx A | Site Safety & Health Plan (HHSP) and Accident Prevention Plan (APP) | | G | | | 1/15/2010 | | | | | | | | | |
| Apx B | Radiological Protection Plan | | G | | | 1/15/2010 | | | | | | | | | |
| Apx C | Environmental Protection Plan | | G | | | 1/15/2010 | | | | | | | | | |
| Apx D | Quality Assurance Plan/Sampling and | | G | | | 1/15/2010 | | | | | | | | | |
| Apx E | Program Quality Control Plan Addendum (PQCPA) w/ Submittal Registers | | G | | | 1/15/2010 | | | | | | | | | |
| Apx F | Waste Management Plan | | G | | | 1/15/2010 | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | ***SD-11 Closeout Submittals*** | | | | | | | | | | | | | | |
| | Contractor's Closeout Report | | | | | Closeout Report | | | | | | | | | |
| | As-Built Records | | | | | Closeout Report | | | | | | | | | |
| | Pre-existing Condition Photos | | | | | Closeout Report | | | | | | | | | |
| | Testing Summary Report | | | | | Monthly | | | | | | | | | |
| | Daily Contractor Production Reports | | | | | Daily | | | | | | | | | |
| | Daily QC Reports | | | | | Daily | | | | | | | | | |
| | Rework Items List | | | | | Monthly | | | | | | | | | |
| | | | | | | | | | | | | | | | |

| Contract No. N62470-08-D-1007 | | | | | Project No. 137165<br>Project Title: NAVSTA PS TCRA | | | | | | | Revision No. 01<br>Shaw Environmental & Infrastructure, Inc. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Contractor Action | | | Approving Authority | | | | | |
| Spec. Sect. | SD Number and Submittal Description | Spec Paragraph Number | Approving Authority | Other Reviewers | Transmittal Control No. | Planned Submittal Date | Action Code | Date of Action | Date Forwarded to Appr Auth/ from Contr | Date Forward to Other Reviewer | Date Rcvd from Other Reviewer | Action Code | Date of Action | Date Rcvd from Appr Auth | Remarks |
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) | (k) | (l) | (m) | (n) | (o) | (p) |
| | ***SD-10 Test Reports*** | | | | | | | | | | | | | | |
| | Lab Test Results | | | | | Upon Receipt | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | ***SD-08 Statements*** | | | | | | | | | | | | | | |
| | Disposal Facility Permits | | | | | Prior to Disposal | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | ***SD-18 Records*** | | | | | | | | | | | | | | |
| | Personnel Contact List | | G | | | 1/15/2010 | | | | | | | | | |
| | Disposal Manifests | | | | | Closeout Report | | | | | | | | | |
| | | | | | | | | | | | | | | | |

Notes:
Approved By:
G: Government
Blank: QC Manager
Reference; QMP-16.2 Submittal Management Process

ACTION CODES
A: Approved
AN: Approved as Noted
NR: Not Reviewed
RR: Disapproved; Revise and Resubmit

# EXHIBIT V-2

| LIST OF PERSONNEL AUTHORIZED TO REVIEW AND CERTIFY SUBMITTALS<br>Shaw Environmental & Infrastructure, Inc.<br>Naval Station Puget Sound Time Critical Removal Action | | |
|---|---|---|
| | SUBMITTAL TYPE: | AUTHORIZED PERSONNEL: |
| Work Plan Submittals | Preconstruction | Project Manager |
| Technical and Documentation Submittals | All Types | Site QC Manager, Program QC Manager, and Project Manager |
| Analytical Data | Test Reports | Site QC Manager, Project Manager |
| Radiological Data | Radiological Test Reports | Radiological Safety Officer (RSO) |

(1) Note: Site QC Manager shall perform the final review and certification for submittals requiring Government approval.
Site QC Manager shall perform the final review and approval for submittals requiring Contractor approval.

# EXHIBIT VII-1

| TESTING PLAN<br>Shaw Environmental & Infrastructure, Inc.<br>Naval Station Puget Sound Time Critical Removal Action | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONTRACT NUMBER | | | PROJECT TITLE: NAVSTA PS Time Critical Removal Action | | | | AND |
| N62470-08-D-1007 | | | LOCATION: NAVSTA PS Seattle, Washington | | | | |
| SAMPLING LOCATION | ID NUMBER | MATRIX | ANALYTICAL GROUP | CONCENTRATION LEVEL | NUMBER OF SAMPLES | SAMPLING SOP REFERENCE (1) | RATIONALE FOR SAMPLING LOCATION |
| Sewer | GS-MHxxx-SL-xxxx | Sludge | Radiochem analysis | Background | 11[2] | SOP-12 | Upstream manhole |
| Sewer pipe | GS-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer pipe | GS-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer manhole | GS-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer manhole | GS-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer | GS-MHxxx-WT-xxxx | Water | Radiochem analysis | Background | 11 | SOP-12 | Upstream manhole |
| Storm drain | SD-MHxxx-SL-xxxx | Sludge | Radiochem analysis | Background | 11 | SOP-12 | Upstream manhole |
| Storm drain pipe | SD-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Storm drain pipe | SD-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Storm drain manhole | SD-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Storm drain manhole | SD-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Storm drain | SD-MHxxx-WT-xxxx | Water | Radiochem analysis | Background | 11 | SOP-12 | Upstream manhole |
| B27 Tiles | B27-xxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Neighboring room[3] |
| B27 Tiles | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 80 $ft^2$ | SOP-20 | Neighboring room<br>2% of survey area |
| B27 Tiles | B27-xxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Neighboring room |
| B27 Roofing | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Roofing material remote from exhaust stack |
| B27 Roofing | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Roofing material remote from exhaust stack |
| B27 concrete under sewer | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Neighboring room |
| B27 concrete under sewer | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 110 $ft^2$ | SOP-20 | Neighboring room<br>2% of survey area |
| B27 concrete under sewer | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Neighboring room |
| B27 concrete hangar | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Remote area in hangar[4] |
| B27 concrete hangar | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 22 $ft^2$ | SOP-20 | Remote area in hangar, 4% of survey area |
| B27 concrete hangar | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Remote area in hangar |

# TESTING PLAN
## Shaw Environmental & Infrastructure, Inc.
## Naval Station Puget Sound Time Critical Removal Action

| CONTRACT NUMBER | | | PROJECT TITLE: NAVSTA PS Time Critical Removal Action AND | | | | |
|---|---|---|---|---|---|---|---|
| N62470-08-D-1007 | | | LOCATION: NAVSTA PS Seattle, Washington | | | | |
| **SAMPLING LOCATION** | **ID NUMBER** | **MATRIX** | **ANALYTICAL GROUP** | **CONCENTRATION LEVEL** | **NUMBER OF SAMPLES** | **SAMPLING SOP REFERENCE (1)** | **RATIONALE FOR SAMPLING LOCATION** |
| Sewer | GS-MHxxx-SL-xxxx | Sludge | Radiochem analysis | Background | 11[2] | SOP-12 | Upstream manhole |
| Sewer pipe | GS-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer pipe | GS-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| B2 Tiles | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Neighboring room[5] |
| B2 Tiles | B27-xxxx-FL-xxxx | Surface | Floor monitor | Background | 110 $ft^2$ | SOP-20 | Neighboring room 2% of survey area |
| B2 Tiles | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Neighboring room |
| Pump House 116 | PH116-xxxx-TO-xxxx | Surface | Total α/β/γ | Background | 11 | SOP-18 | Concrete on exterior of pump house |
| Pump House 116 | PH116-xxxx-SW-xxxx | Surface | Removable α/β/γ | Background | 11 | SOP-18 | Concrete on exterior of pump house |
| *B27 Survey* | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping Survey* | 11 | SOP-18 | |
| *B27 Survey* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 11 | SOP-18 | |
| *B27 Survey* | B27-xxxx-TO-xxxx (3 survey units) | Surface | Total α/β/γ | *Character. Survey* | 66 | SOP-18 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |
| *B27 Survey* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 66 | SOP-18 | |
| *B27 Survey* | B27-xxxx-FL-xxxx | Surface | Floor Monitor | | 4725 $ft^2$ | S0P-20 | |
| *B27 Vent* | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping* | 11 | SOP-18 | |
| *B27 Vent* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 11 | SOP-18 | |
| *B27 Roofing* | B27-xxxx-TO-xxxx (1 survey unit) | Surface | Total α/β/γ | *Character. Survey* | 28 | SOP-18 | Class 3 roofing and subroofing |
| *B27 Roofing* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 28 | SOP-18 | |
| *B27 Roofing* | B27-xxxx-FL-xxxx | Surface | Floor Monitor | | 4095 $ft^2$ | S0P-20 | |
| *B2 Survey* | B2-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 21 | SOP-18 | |
| *B2 Survey* | B2-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 21 | SOP-18 | |
| *B2 Survey* | B2-xxxx-TO-xxxx (3 survey units) | Surface | Total α/β/γ | *Character. survey* | 84 | SOP-18 | Class 2 floor of instrument shops, Class 3 walls |
| *B2 Survey* | B2-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 84 | SOP-18 | |
| *B2 Survey* | B2-xxxx-FL-xxxx | Surface | Floor Monitor | | ~4725 $ft^2$ | S0P-20 | |
| *B2 vent* | B2-xxxx-TO-xxxx | Surface | Total α/β/γ | *Scoping survey* | 11 | SOP-18 | |
| *B2 vent* | B2-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 11 | SOP-18 | |

**TESTING PLAN**
**Shaw Environmental & Infrastructure, Inc.**
**Naval Station Puget Sound Time Critical Removal Action**

| CONTRACT NUMBER | | | PROJECT TITLE: NAVSTA PS Time Critical Removal Action | | | | AND |
|---|---|---|---|---|---|---|---|
| N62470-08-D-1007 | | | LOCATION: NAVSTA PS Seattle, Washington | | | | |
| **SAMPLING LOCATION** | **ID NUMBER** | **MATRIX** | **ANALYTICAL GROUP** | **CONCENTRATION LEVEL** | **NUMBER OF SAMPLES** | **SAMPLING SOP REFERENCE (1)** | **RATIONALE FOR SAMPLING LOCATION** |
| Sewer | GS-MHxxx-SL-xxxx | Sludge | Radiochem analysis | Background | 11[2] | SOP-12 | Upstream manhole |
| Sewer pipe | GS-MHxxx-TO-xxxx | Surface | Total α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Sewer pipe | GS-MHxxx-SW-xxxx | Surface | Removable α/βγ | Background | 11 | SOP-18 | Upstream manhole |
| Pump House 116 | PH116-xxxx-TO-xxxx (2 survey units) | Surface | Total α/β/γ | *Characterization* | 17 | SOP-18 | Class 2 floor and walls |
| Pump House 116 | PH116-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 17 | SOP-18 | |
| *Gravity flow sewer* | GS-xxxx-SL-xxxx | sludge | Radiochemical analysis | *Scoping survey* | 18 | SOP-12 | 8 manholes |
| *Gravity flow sewer* | GS-xxxx-TO-xxxx | Surface | Total α/β/γ | | 18 | SOP-18 | |
| *Gravity flow sewer* | GS-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 18 | SOP-18 | |
| *Pressurized sewer line* | PS-xxxx-SL-xxxx | Sludge | Radiochemical analysis | *Scoping survey* | 5 | SOP-12 | |
| *Pressurized sewer line* | PS-xxxx-TO-xxxx | Surface | Total α/β/γ | | 3 | SOP-18 | |
| *Pressurized sewer line* | PS-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 3 | SOP-18 | |
| *Storm drain* | SD-xxxx-SL-xxxx | Sludge | Radiochemical analysis | *Scoping survey* | 16 | SOP-12 | 7 manholes and catch basins |
| *Storm drain* | SD-xxxx-TO-xxxx | Surface | Total α/β/γ | | 16 | SOP-18 | |
| *Storm drain* | SD-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 16 | SOP-18 | |
| *B27 FSS* | B27-xxxx-TO-xxxx | Surface | Total α/β/γ | *FSS* | 140 | SOP-18 | Class 1 floor Ra Room, Class 2 floor instrument shop, Class 3 walls |
| *B27 FSS* | B27-xxxx-SW-xxxx | Surface | Removable α/β/γ | | 140 | SOP-18 | |
| *B27 FSS* | B27-xxxx-FL-xxxx | Surface | Floor Monitor | | 5250 $ft^2$ | S0P-20 | |
| *Waste Water* | WW-xxxx-WW-xxxx | Waste Water | Radiochemical Analysis | | 11 | SOP-10<br>SOP-11 | *Waste Characterization* |

[1] From Project Sampling SOP References table (Worksheet #21)
[2] Nine samples + 20% field duplicates
[3] With similar floor tiles
[4] With similar concrete
[5] With similar floor tiles

# EXHIBIT VIII-1

**REWORK ITEMS LIST**
**Shaw Environmental & Infrastructure, Inc.**
**Naval Station Puget Sound Time Critical Removal Action**

Contract No. N62470-08-D-1007

Location: NAVSTA PS Seattle, Washington

| NUMBER | DATE IDENTIFIED | DESCRIPTION | CONTRACT REQUIREMENT (Spec. Section and Par. No., Drawing No. and Detail No., etc.) | ACTION TAKEN BY QC MANAGER | RESOLUTION | DATE COMPLETED |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# EXHIBIT X-1

## Quality Control Inspection Plan
## Shaw Environmental & Infrastructure, Inc.
### Naval Station Puget Sound Time Critical Removal Action

| | | Three-Phase Control | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Preparatory Phase | | Initial Phase | | Follow-up Phase |
| **Work Plan Section** | **Definable Feature of Work** | **Date** | **Checklist/Report No.** | **Date** | **Checklist/Report No.** | **Date** | **Checklist/Report No.** |
| **5.0** | Mobilization and Staging of Materials | | | | | | |
| **5.1** | Removal of Piping in Building 27 | | | | | | |
| **3.3** | Asbestos Survey and Abatement in Building 27 | | | | | | |
| **5.0** | Tile & Sub-Floor Removal and Sub-Floor Replacement in Building 27 | | | | | | |
| **5.1** | Radiological Survey of Building 27 | | | | | | |
| **3.3** | Removal of Carpet and Floor Tile in Building 2 | | | | | | |
| **4.1, 5.0** | Radiological Survey of Building 2 | | | | | | |
| **5.2.3** | Camera Surveys/Inspections of Drain Lines | | | | | | |
| **5.2.2** | Sludge Sampling in Manholes and Pump Houses | | | | | | |
| | Site Storm Water Containment | | | | | | |
| **5.2.4** | Drain Line and Pump House powerwashing/jetting | | | | | | |
| **4.8.7** | Decontamination | | | | | | |
| **Apx B** | Waste Management | | | | | | |
| | Site Restoration | | | | | | |
| **4.8.5** | Final Status Surveys | | | | | | |
| | | | | | | | |

# EXHIBIT X-2

## Definable Features of Work Technical Lead Matrix
## Shaw Environmental & Infrastructure, Inc.
## Naval Station Puget Sound Critical Time Removal Action

| Spec. Section | Para. No. | Feature of Work | Task Lead | Preparatory Meeting | Initial Inspection | Follow-up Inspections | Completion Inspection |
|---|---|---|---|---|---|---|---|
| Work Plan | | Mobilization and Staging of Materials | Pat Moore | Pat Moore | Pat Moore | Pat Moore | Pat Moore |
| Work Plan | | Removal of Piping in Building 27 | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Asbestos Survey and Abatement in Building 27 | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Tile & Sub-Floor Removal and Sub-Floor Replacement in Building 27 | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Radiological Survey of Building 27 | Steve Crupi | Steve Crupi | Steve Crupi | Pat Moore | Steve Crupi |
| Work Plan | | Removal of Carpet and Floor Tile in Building 2 | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Radiological Survey of Building 2 | Steve Crupi | Steve Crupi | Steve Crupi | Pat Moore | Steve Crupi |
| Work Plan | | Camera Surveys/Inspections of Drain Lines | Steve Crupi | Steve Crupi | Steve Crupi | Pat Moore | Steve Crupi |
| Work Plan | | Sludge Sampling in Manholes and Pump Houses | Steve Crupi | Steve Crupi | Steve Crupi | Pat Moore | Steve Crupi |
| Work Plan | | Site storm water containment | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Drain Line and Pump House powerwashing/jetting | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Decontamination | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Waste Management | Pat Moore | Pat Moore | Pat Moore | Pat Moore | Pat Moore |
| Work Plan | | Site Restoration | Jim Langsted | Jim Langsted | Jim Langsted | Pat Moore | Jim Langsted |
| Work Plan | | Final Status Surveys | Chris Generous | Chris Generous | Chris Generous | Pat Moore | Chris Generous |

# EXHIBIT XI-1

| PERSONNEL MATRIX<br>Shaw Environmental & Infrastructure, Inc.<br>Naval Station Puget Sound Time Critical Removal Action | | | |
|---|---|---|---|
| WORKPLAN SECTION | SUBMITTALS TO BE REVIEWED BY: | THREE PHASE TO BE PERFORMED BY: | TESTING TO BE PERFORMED BY: |
| All Sections | Site QC Manager (1), Program QC Manager, Project Manager | Technical Lead, Site QC Manager | Test America |

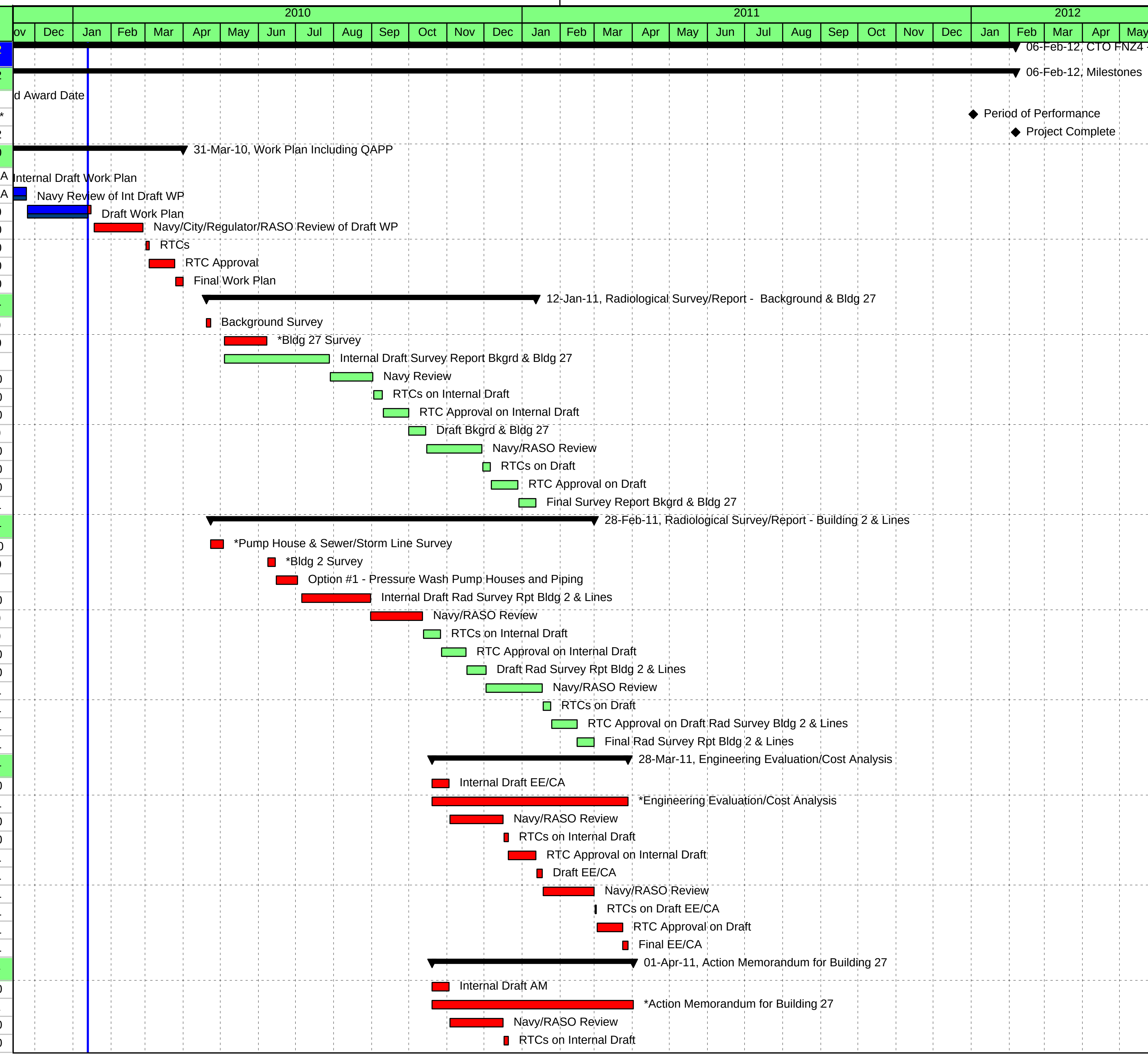
(1) Note: Site QC Manager shall perform the final review and certification for submittals requiring Government approval.
Site QC Manager shall perform the final review and approval for submittals requiring Contractor approval.

# APPENDIX F

## *PROJECT SCHEDULE*

CTO FNZ4 - Former Naval Station Cleanup Action Puget Sound, Washington 092909 - POP 01/03/12

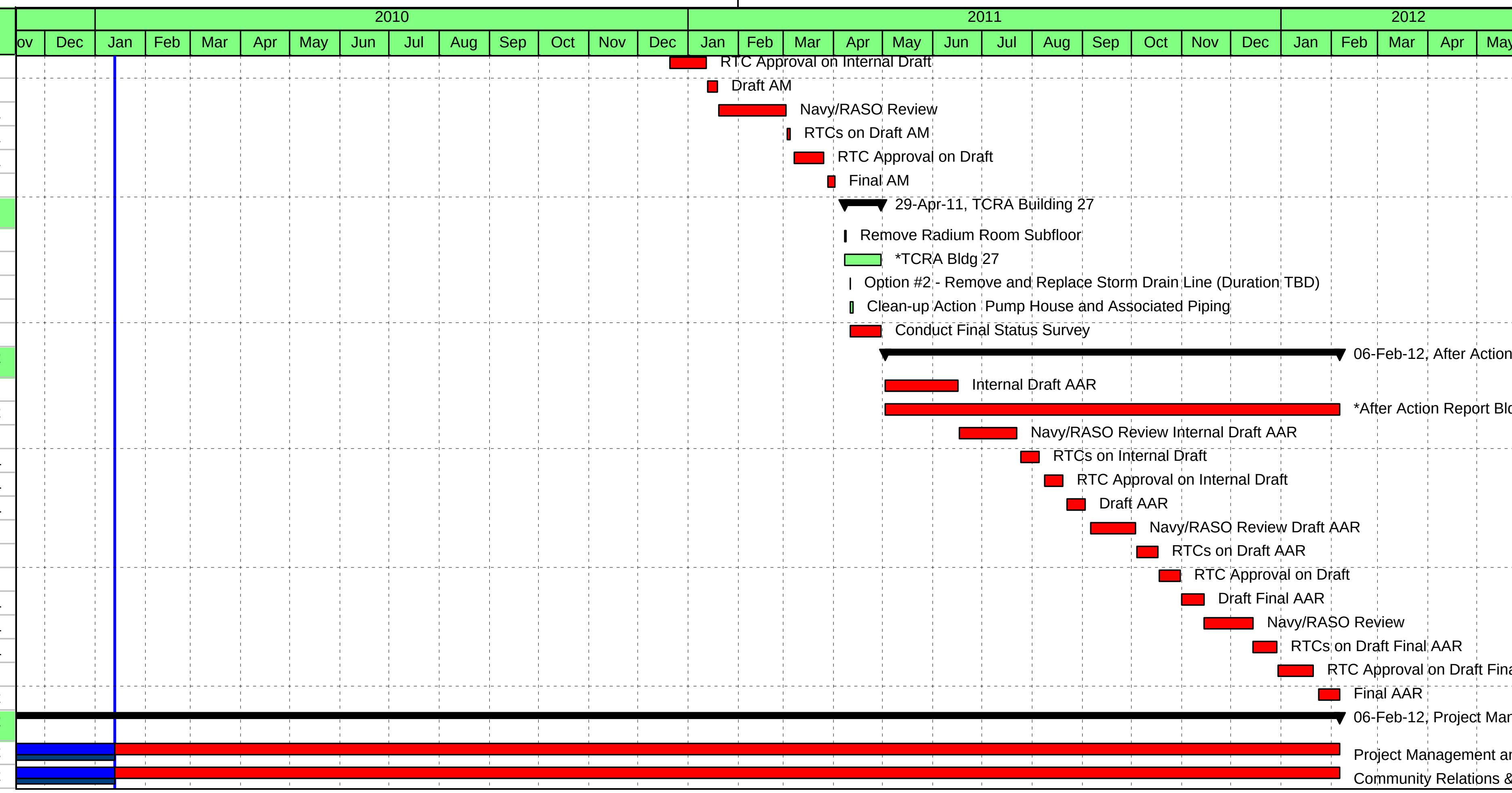
| Activity ID | Activity Name | OD | Start | Finish |
|---|---|---|---|---|
| **CTO FNZ4 - Former Naval Station Cleanup Action ...** | | 755 | 25-Sep-09 A | 06-Feb-12 |
| **Milestones** | | 35 | 25-Sep-09 A | 06-Feb-12 |
| 1000000 | Anticipated Award Date | 0 | 25-Sep-09 A | |
| 2000010 | Period of Performance | 0 | | 03-Jan-12* |
| 2000000 | Project Complete | 0 | | 06-Feb-12 |
| **Work Plan Including QAPP** | | 78 | 28-Sep-09 A | 31-Mar-10 |
| 01009105 | Internal Draft Work Plan | 0 | 28-Sep-09 A | 04-Nov-09 A |
| 01009110 | Navy Review of Int Draft WP | 0 | 09-Nov-09 A | 24-Nov-09 A |
| 01009125 | Draft Work Plan | 3 | 25-Nov-09 A | 15-Jan-10 |
| 01009130 | Navy/City/Regulator/RASO Review of Draft WP | 30 | 18-Jan-10 | 26-Feb-10 |
| 01009135 | RTCs | 3 | 01-Mar-10 | 03-Mar-10 |
| 01009140 | RTC Approval | 15 | 04-Mar-10 | 24-Mar-10 |
| 01009145 | Final Work Plan | 5 | 25-Mar-10 | 31-Mar-10 |
| **Radiological Survey/Report - Background & Bldg 27** | | 269 | 19-Apr-10 | 12-Jan-11 |
| 40009300 | Background Survey | 4 | 19-Apr-10* | 22-Apr-10 |
| 40009000 | *Bldg 27 Survey | 24 | 04-May-10 | 07-Jun-10 |
| 40009050 | Internal Draft Survey Report Bkgrd & Bldg 27 | 60 | 04-May-10 | 28-Jul-10 |
| 40009010 | Navy Review | 25 | 29-Jul-10 | 01-Sep-10 |
| 40009015 | RTCs on Internal Draft | 5 | 02-Sep-10 | 09-Sep-10 |
| 40009020 | RTC Approval on Internal Draft | 15 | 10-Sep-10 | 30-Sep-10 |
| 40009025 | Draft Bkgrd & Bldg 27 | 10 | 01-Oct-10 | 14-Oct-10 |
| 40009030 | Navy/RASO Review | 30 | 15-Oct-10 | 29-Nov-10 |
| 40009035 | RTCs on Draft | 5 | 30-Nov-10 | 06-Dec-10 |
| 40009040 | RTC Approval on Draft | 15 | 07-Dec-10 | 28-Dec-10 |
| 40009045 | Final Survey Report Bkgrd & Bldg 27 | 10 | 29-Dec-10 | 12-Jan-11 |
| **Radiological Survey/Report - Building 2 & Lines** | | 312 | 23-Apr-10 | 28-Feb-11 |
| 40009200 | *Pump House & Sewer/Storm Line Survey | 7 | 23-Apr-10 | 03-May-10 |
| 40009100 | *Bldg 2 Survey | 5 | 08-Jun-10 | 14-Jun-10 |
| 30001000 | Option #1 - Pressure Wash Pump Houses and Piping | 14 | 15-Jun-10 | 02-Jul-10 |
| 40009105 | Internal Draft Rad Survey Rpt Bldg 2 & Lines | 40 | 06-Jul-10 | 30-Aug-10 |
| 40009110 | Navy/RASO Review | 30 | 31-Aug-10 | 12-Oct-10 |
| 40009115 | RTCs on Internal Draft | 10 | 13-Oct-10 | 26-Oct-10 |
| 40009120 | RTC Approval on Internal Draft | 15 | 27-Oct-10 | 16-Nov-10 |
| 40009125 | Draft Rad Survey Rpt Bldg 2 & Lines | 10 | 17-Nov-10 | 02-Dec-10 |
| 40009130 | Navy/RASO Review | 30 | 03-Dec-10 | 17-Jan-11 |
| 40009135 | RTCs on Draft | 5 | 18-Jan-11 | 24-Jan-11 |
| 40009140 | RTC Approval on Draft Rad Survey Bldg 2 & Lines | 15 | 25-Jan-11 | 14-Feb-11 |
| 40009145 | Final Rad Survey Rpt Bldg 2 & Lines | 10 | 15-Feb-11 | 28-Feb-11 |
| **Engineering Evaluation/Cost Analysis** | | 160 | 20-Oct-10 | 28-Mar-11 |
| 40009405 | Internal Draft EE/CA | 10 | 20-Oct-10 | 02-Nov-10 |
| 40009450 | *Engineering Evaluation/Cost Analysis | 110 | 20-Oct-10 | 28-Mar-11 |
| 40009410 | Navy/RASO Review | 30 | 03-Nov-10 | 16-Dec-10 |
| 40009415 | RTCs on Internal Draft | 2 | 17-Dec-10 | 20-Dec-10 |
| 40009420 | RTC Approval on Internal Draft | 15 | 21-Dec-10 | 12-Jan-11 |
| 40009425 | Draft EE/CA | 3 | 13-Jan-11 | 17-Jan-11 |
| 40009430 | Navy/RASO Review | 30 | 18-Jan-11 | 28-Feb-11 |
| 40009435 | RTCs on Draft EE/CA | 2 | 01-Mar-11 | 02-Mar-11 |
| 40009440 | RTC Approval on Draft | 15 | 03-Mar-11 | 23-Mar-11 |
| 40009445 | Final EE/CA | 3 | 24-Mar-11 | 28-Mar-11 |
| **Action Memorandum for Building 27** | | 164 | 20-Oct-10 | 01-Apr-11 |
| 40009505 | Internal Draft AM | 10 | 20-Oct-10 | 02-Nov-10 |
| 40009550 | *Action Memorandum for Building 27 | 114 | 20-Oct-10 | 01-Apr-11 |
| 40009510 | Navy/RASO Review | 30 | 03-Nov-10 | 16-Dec-10 |
| 40009515 | RTCs on Internal Draft | 2 | 17-Dec-10 | 20-Dec-10 |




Remaining Level of Effort | Remaining Work
Actual Level of Effort | Critical Remaining Work
WBS Summary | Milestone
Actual Work | Summary

CTO FNZ4 - Former Naval Station Cleanup Action Puget Sound, Washington 092909 - POP 01/03/12

| Activity ID | Activity Name | OD | Start | Finish |
|---|---|---|---|---|
| 40009520 | RTC Approval on Internal Draft | 15 | 21-Dec-10 | 12-Jan-11 |
| 40009525 | Draft AM | 5 | 13-Jan-11 | 19-Jan-11 |
| 40009530 | Navy/RASO Review | 30 | 20-Jan-11 | 02-Mar-11 |
| 40009535 | RTCs on Draft AM | 2 | 03-Mar-11 | 04-Mar-11 |
| 40009540 | RTC Approval on Draft | 15 | 07-Mar-11 | 25-Mar-11 |
| 40009545 | Final AM | 5 | 28-Mar-11 | 01-Apr-11 |
| **TCRA Building 27** | | 23 | 07-Apr-11 | 29-Apr-11 |
| 30009005 | Remove Radium Room Subfloor | 2 | 07-Apr-11 | 08-Apr-11 |
| 30009000 | *TCRA Bldg 27 | 17 | 07-Apr-11 | 29-Apr-11 |
| 30002000 | Option #2 - Remove and Replace Storm Drain Line (Dur... | 0 | 11-Apr-11 | 11-Apr-11 |
| 30009015 | Clean-up Action  Pump House and Associated Piping | 2 | 11-Apr-11 | 12-Apr-11 |
| 30009010 | Conduct Final Status Survey | 15 | 11-Apr-11 | 29-Apr-11 |
| **After Action Report Building 27** | | 281 | 02-May-11 | 06-Feb-12 |
| 80009105 | Internal Draft AAR | 34 | 02-May-11 | 16-Jun-11 |
| 80009150 | *After Action Report Bldg 27 | 195 | 02-May-11 | 06-Feb-12 |
| 80009110 | Navy/RASO Review Internal Draft AAR | 25 | 17-Jun-11 | 22-Jul-11 |
| 80009115 | RTCs on Internal Draft | 10 | 25-Jul-11 | 05-Aug-11 |
| 80009120 | RTC Approval on Internal Draft | 10 | 08-Aug-11 | 19-Aug-11 |
| 80009125 | Draft AAR | 10 | 22-Aug-11 | 02-Sep-11 |
| 80009130 | Navy/RASO Review Draft AAR | 20 | 06-Sep-11 | 03-Oct-11 |
| 80009135 | RTCs on Draft AAR | 10 | 04-Oct-11 | 17-Oct-11 |
| 80009140 | RTC Approval on Draft | 10 | 18-Oct-11 | 31-Oct-11 |
| 80009175 | Draft Final AAR | 10 | 01-Nov-11 | 14-Nov-11 |
| 80009170 | Navy/RASO Review | 20 | 15-Nov-11 | 14-Dec-11 |
| 80009155 | RTCs on Draft Final AAR | 10 | 15-Dec-11 | 29-Dec-11 |
| 80009160 | RTC Approval on Draft Final AAR | 15 | 30-Dec-11 | 20-Jan-12 |
| 80009145 | Final AAR | 10 | 24-Jan-12 | 06-Feb-12 |
| **Project Management and Support** | | 755 | 25-Sep-09 A | 06-Feb-12 |
| 90003000 | Project Management and Support | 526 | 25-Sep-09 A | 06-Feb-12 |
| 90003100 | Community Relations & Regulatory Interaction | 526 | 25-Sep-09 A | 06-Feb-12 |




Remaining Level of Effort | Remaining Work
Actual Level of Effort | Critical Remaining Work
WBS Summary | Milestone
Actual Work | Summary